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INFORMATION

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PREFACE

Dear colleagues and friends,

It is our great pleasure to invite you to attend the EURASIAN GIS Congress 2018 held in Baku on 04-07, September 2018. EURASIAN GIS Congress 2018 is a candidate of one of the most important event in the scientific schedule and tenders a possibility for researchers and academicians who researches on GIS and related disciplines. You can find a first class programme of plenary speakers, technical sessions, exhibitions and social events in this book. You will be able to catch up with the developments in Geographical Information Sciences, Information Technology, Environmental Management and Resources, Sustainable Agriculture, Surveying, Photogrammetry and Remote Sensing, meet friends and experience the traditional and fascinating culture of AZERBAIJAN. As a international congress in the field of geo-spatial information and remote sensing, EURASIAN GIS Congress 2018 is devoted to promote the advancement of knowledge, research, development, education and training in Geographical Information Sciences, Information Technology, Environmental Management and Resources, Sustainable Agriculture, Surveying, Photogrammetry and Remote Sensing, their integration and applications, as to contribute to the well-being of humanity and the sustainability of the environment. The EURASIAN GIS Congress 2018 will provide us an opportunity to examine the challenges facing us, discuss how to support Future Earth with global geo-information, and formulate the future research agenda.

150 scientists from 13 countries attended to the congress. 7 plenary speakers, 120 oral presentations and 8 poster presentations, all together with 135 in total, are presented during the congress. 135 presentations take place in 21 sessions in three days.

The Congress is carried out with the support of the organizations as the Konya Technical University, Selcuk University, Azerbaijan National Academy of Sciences Institute of Geography, Baku State University, Ministry of Agriculture of Azerbaijan Republic, General Directorate of Land Registry and Cadastre, General Directorate of Agricultural Reform of Turkey, International Federation of Surveyors (FIG), International Society for Photogrammetry and Remote Sensing (ISPRS) and Igdir University. In addition, the congress is also supported by the commercial organizations of INTEGRIS LLC, KUTLUBEY Engineering Co, RUBIKON Geosystems LLC, NETCAD, HARMIAD Surveying Engineers Businessmen Association, GEOGIS Engineering Co, MESCIOGLU Engineering Co, EMI Group Information Technology Co, PaksoyTeknik, and 4B Ölçüm.

Finally, we cheer on all of you to participate in this congress of EURASIAN GIS , and special thanks to all sponsorships and government partners for the congress. Enjoy your time and share your experiences with your friends.

Baku/Azerbaijan, September, 2018

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POSTER SESSION

THE TRANSFORMATIONS OF SLOPE SLIDE LANDSCAPES OF GREAT CAUCASUS: POSSIBILITIES OF DISCOVERING OF MAIN FACTORS

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ABSTRACT:

The Southeast extremity of the Great Caucasus which are entering into limits of Azerbaijan is characterized by high dynamism of exogenic relief forming processes, making essential impact on development of a landscape situation. Thereupon there is a necessity of working out of various methods for construction of scenarios of possible changes of a geo ecological situation in the various hills having fatal consequences, by revealing of relationships of cause and effect. With that end in view, in this work possibilities of forecasting of landslips in natural area of the Great Caucasus with use available various data and also visual supervision have been analysed.

KEYWORDS: Processes, Slope, Exodynamic, Landscapes, Erosion, Factor, Sub District, Caucasus

INTRODUCTION. Questions of revealing of the reasons of geodynamic processes – taluses, scatterings and landslips are many years in the center of attention of the geographical public of the country because of fatal consequences of these phenomena for social sphere and economic activities of all mountain regions (Makarov et al., Alizadeh et al., 2005, Pashayev 2007, John F. Shroder JR and Brandon J. Weihs., 2010, Alewell Christine et al., 2008, Rainer Bell et al., 2012, Park Ji-Hyung et al., 2013).

Southern and Northern slopes of the Great Caucasus differ the difficult geomorphologic structure, shown in difficult structure of alternation of water-permeable layers of breeds, an interlacing of tectonic infringements, and also the high seismicity which often enough is hardly noticeable, but a determinative of slipping and a collapse of weights of breeds (Figure 1.).

Figure 1. The rocks of Shahdag massive which may be the material of mood flow streams.

Essential influence on development slope slide processes renders the inclination of a terrestrial surface saving in considerable energy of all weight of breeds of a slope. But, as it is known, the big biases of slopes not always lead to landslips, even on close located to slope slide files sites. So, slopes with firm parent breeds are steady, slopes with alternation of layers of friable breeds and clays are the most subject to influence of geodynamic factors. The big biases of slopes, especially characteristic for the Southern slope of the Main Caucasian ridge lead to landslips of landslide character, in a root changing shape of a landscape of the given site (Mardanov and Hajizadeh 2003, Budagov et al. 2005, Mardanov et al. 2005).

On degree of stability to influence slope slides processes of territory of hills are differentiated on rather steady, middle active and active sites. Within a mountain-meadow zone steady in slope slide relation sites are characterized by presence of clearly expressed subalpine and Alpine landscapes. Such sites can be subject to influence of others exodynamic processes – to soil erosion, accumulation and moving of taluses and the scatterings representing not smaller danger to a landscape and all ecological situation.

As it is known, an important element of development of landscapes is carrying over of chemical particles as a part of circulation of substances. In this respect high-mountainous landscapes of the Great Caucasus are not much studied and demand the influence analysis exogenic processes on changes of quantity and a parity of various chemical elements and their connections in soils and vegetation depending on intensity of the various natural phenomena. For these purposes experts of a various profile – geographers, soil scientists, botanists, the chemists which general efforts can help to reveal an overall picture of occurring geochemical changes can be involved.

The geodynamic situation in Apsheron substantially becomes complicated the intensive town-planning accompanied by development of a social and industrial infrastructure that leads to change of an initial relief and strengthening of factors of slope slide forming.

MATERIAL AND METHODS. The Southeast extremity of the Great Caucasus which are active from the point of view of a descent of landslips, always drew attention of researchers of various disciplines – geologists, geomorphology scientists, landscape scientists, soil scientists etc. trying to establish the reasons of this destructive process, to state an estimation of degree of influence of this or that factor on the given phenomenon. The basic landscape elements of separate large landslips have been in this time defined main slope slide files, lithologic structure of breeds of slope slide slopes (Alizade et al. 2015).

These works were made during field visual researches, and also the cameralistic researches meaning measurements on topographic maps, revealing the biases of a surface stimulating slipping of mountain weights.

Gaugings of the cracks formed as a result of landslips on different files and definitions of their time dynamics allow to spend in certain degree territory division into districts on activity of breeds for the purpose of revealing most of slope slide dangerous territories (Guliyeva et al. 2014, Alizade et al. 2015). The description of a landscape situation, its separate components promotes revealing of the distinctions shown through certain time occurring also under the influence of geodynamic processes.

High-mountainous areas of the Greater Caucasus, including the mountain meadow zone, are characterized by a complex combination of natural and anthropogenic factors, leading to the development of a complex landscape structure. These factors complicate the morphological structure of the entire mountain meadow strip, forming various tracts and facies, the main causes, the formation of which are geodynamic processes. It is these processes that cause a different degree of fragmentation of the surface, and as a natural consequence, to landscape diversity.

The fragmentation of the surface, caused by soil erosion, is manifested in the presence of sites of different degrees of erosion of different types of mountain meadow soils. Such areas can be considered as the most common landscape tracts in the mountain-meadow zone.

Typologically, subalpine and alpine meadows are distinguished as independent subzones, the boundaries of which are certain hypsometric heights. As a subzone, it is possible to identify post-forest meadows that occupy significant areas from 1500 to 1600 m in the basins of the Girdimanchai, Ahsu and Pirsaat rivers. Hayfields, being, as a matter of fact, widespread tracts, can be considered as the most widespread in this zone of anthropogenic complexes.

Within this zone facies can be identified by individual geobotanical groupings forming facies groups, since these facies can be formed at different altitudes, on slopes of different exposures and different surface slopes.

As facies can be considered areas with different groups of meadow and shrubby plants that form on certain types of mountain meadow soils. Separate facies are temporary lakes, the cause of which is the accumulation of the blocks of rocks wedged out as a result of displacement to the surface of groundwater and precipitation water. Changes in the configurations of their shores and locations, their drainage, indicates a landslide activity and can be taken as an indication feature when assessing the dynamics of geodynamic processes.

Independent landslide tracts are landslide massifs occupying large areas within which various mountain meadow soils and plant groups are observed. Landslide areas, which sometimes have a great length, can cut through several landscapes. These sites are distinguished by a certain differentiation of detrital material, which are a concomitant element of all forms of geodynamic relief.

The areas of accumulation of scree and placer material of various sizes are separate facies. Areas with different degrees of clastic material accumulation by meadow or shrubby vegetation are also landscape facies, widely widespread on landslide massifs. The number of such facies can be increased with more detailed geobotanical studies, which will allow to determine the various plant groups in such areas.

Analysis of the degree of subdivision of the surface on landslide massifs makes it possible to further detail the morphological structure of the landscape, to identify areas with weak, medium and strong dissections of various plant groups. Such an analysis can make it possible to determine the most rational combinations of meadow and shrubby plants when planning phytomeliorative work on the dissected surfaces of other territories and even other landscape zones.

For the analysis of the landscape situation in the subnival-nival zone of the north-eastern slope of the Greater Caucasus, a joint analysis of topographic maps and aerial photographs was carried out, the installation of which made it possible to identify the largest rock-nival massifs in order to assess the geodynamic situation in the given territory.

But for these purposes it is also very important to use high-resolution satellite imagery that allows you to view in detail all the differences in the landscape situation and to associate them with the nature and intensity of exogenous relief-forming processes. Images of low resolution can be of an overview nature and can only be used to determine the existence of a particular natural process or the shape of the relief.

A vivid example of the distribution of such sites are the territories around the mountains of Shahdag (4243 m) and Gizilgaya (3,726 m), located near the intersection of the Lateral and Mykhtokyan Ridges. Shahdag, being one of the highest mountains of the entire of Azerbaijan Republic, differs from the saddle shape of the mountain, which determines the specific character of denudation of frost weathering and snow accumulation materials. These materials in the form of placers are actively transported along the south-western slopes of the Lateral Ridge towards the river Gusarchay and its tributary Shakhnabad, but the leveling of the riverine territory, the presence of a stable soil cover reduces the dynamics of denudation, creating a calmer landscape situation.

Brightly manifested tracts around the mountain are steep slopes massive, with a strong degree of dissection, sharply separating it from the surrounding highland territory. The saddle vertex allows active snow accumulation, transforming into ice formation. Unfortunately, the available aerial and space images do not allow us to determine the boundaries of the glacier, but they make it possible to fairly confidently decipher the areas of snow cover distribution, areas with varying degrees and the nature of snow accumulation. This makes it possible to isolate the snow subzone within the subnival-nival zone, forming within this massif, with a large number of peaks of altitude of 3,500-4,000 meters, an especially wide band.

The north-western extension of Shahdag is the Yarydag massif (4116 m), which is a high-mountainous massif that descends gradually in the form of rock ledges to the valley of the river Chekhychay, flowing through the territory of Dagestan in the north-northeast direction. Almost flat areas are located to the west of the mountain Yarydag, and these parts, as well as the Yarydag tract stretching to the south from the top from the south-west to the northeast, are characterized by active snow accumulation, brightly reflected in aerial photographs. Rock cliffs to the north-west of the summit form several steps, forming a complex alternation of processes of frost weathering, denudation and accumulation. In the rest of the study area, high rock cliffs with a strongly dissected surface are characterized by poor snow accumulation, like the slopes of the Shahdag and Gizilgaya massifs, but less accumulation of loamy material at their foot.

This can be explained by his intensive transfer to the foot of the massif in the riverbeds of Shakhnabad, Chutorvac and Chekhychay.

In a geodynamically no less interesting landscape situation is the subnival-nival zone around the peaks of the Gyzylgaya massif, located to the southeast of Shahdag, also having a saddle shape. Despite the significantly smaller absolute height in comparison with Shahdag, the surface of the Gizilgaya massif has no less a wide band of snowfields covering the mountain. The southern slopes of the massif, like Shahdag, form a wide strip of highly disjointed, almost vertical slopes. The weathering materials of these slopes actively accumulate at their foothills, forming a clarified granular strip on aerial photographs, passing into placers, tearing down the slopes of the mountain meadows of the Gudialchai River basin.

Illustrative of the evidence of the impact of climate severity on the development of rocky landscapes covered with extensive snowfields are the highland massifs of the Khinalig and Suttutpe peaks located on the Gaitar-Goja ridge stretching parallel to the Main Watershed and Lateral Ranges.

Despite the relatively lower absolute altitude in comparison with such peaks as Bazarduzi, Tufandag and Shahdag, on Khinalig, characterized by the presence of clearly expressed glacial relief forms, snowy areas with outcrops of rocky and detrital rocks occupy long strips. Apparently, the reason for the predominance of such areas over solid snowfields is the steepness of this part of the northeastern slope of the Greater Caucasus and, in particular, of the Gaytar-Goja Range in comparison with the Lateral Range. Such steepness apparently causes the displacement of snow masses down the slopes and drainage of thawed waters during thawing of snowfields during the warmest periods.

There is a possibility that it is the thawed waters of these massifs in the period of intensive thawing that are responsible for the removal of loose fragments of talus widespread on the southern slopes into the channel of the Gudialchai River flowing through several landscape zones, increasing the mud flow hazard in this fragment of the highland belt of the northeastern slope of the Greater Caucasus. Although this territory is not distinguished by the presence of a large number of settlements and the danger of the impact of exodynamic processes on people's homes is relatively limited, but the situation can drastically change with the continued active involvement of this territory, located in close proximity to the village of Khinalig, which has ethnographic value in tourism activities in a park mode. For this reason, there is a need to include this territory in a number of priority areas in order to implement priority preventive measures to protect the population and tourists from natural disasters.

The interpretation of space images gives the chance to their interpretation for revealing of geomorphologic and landscape features of consequences of landslips both their spatial and time dynamics in the presence of pictures of different years. In Azerbaijan many years were spent works on creation and perfection of various means and methods of interpretation of the space data for definition of directions of development of the fatal natural phenomena (Mekhtiyev 1998).

RESULTS AND DISCUSSION. Materials of numerous researches of an environment of the Great Caucasus available in presence can give the chance to reveal occurrence and development preconditions slope slide processes and to create certain grouping of slope slide files for the purpose of working out of protective actions for prevention of their fatal consequences. The material on physical-geographical and synoptic division into districts of natural area of the Great Caucasus within Azerbaijan has been with that end in view processed and a number of the factors causing a descent of slope slide of weights are defined. So, around the Garauzchai landslip slope slide processes occur in conditions concerning a droughty climate and consequently the role of climatic factors in the given area is insignificant (Figure 2 and 3.). The landslip has a complex surface relief on the steeply sloping terrain, which can be explained by the nature of the alternation of rocks, different resistance to geodynamic energy, and high seismicity characteristic of a given area (Figure 4 and 5).

High-mountainous territories of the Great Caucasus are included into limits of several physical-geographical areas. The Gonagkend area covers in the structural relation Tufan anticlinorium, Shahdag-Hyzi synclinorium, Tengi-Beshbarmag anticlinorium, east suburb Zagatalo-Govdag synclinorium and Hussar monoclinal. In connection with formation at various absolute heights of some intermountain hollows conditions for development of settlements, agriculture and cattle breeding which however, can serve as the reason erosive, but not slope slide process are created. The slope slide phenomena here have the natural character connected, apparently, with fluctuations of seismic activity, character of the spreading breeds, washing away activity of the rivers, especially, during high waters and an atmospheric precipitation, including, storm rains. The intermountain hollow of Shahdjuzju (2400-2700 meters) is used as a summer pasture. The area relief possesses the big range of heights (200-4460 meters) and consequently high-rise zone forming is presented here in a full spectrum. In connection with fall in a southeast direction of absolute height of a relief and strengthening aridity in hillsides reduction of a river drain and disappearance of high-mountainous landscape belts, aridity forming of woods, expansion of areas of dry steppes and

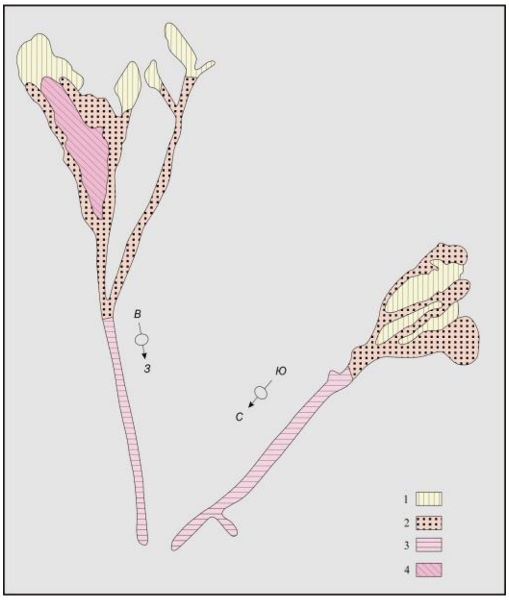
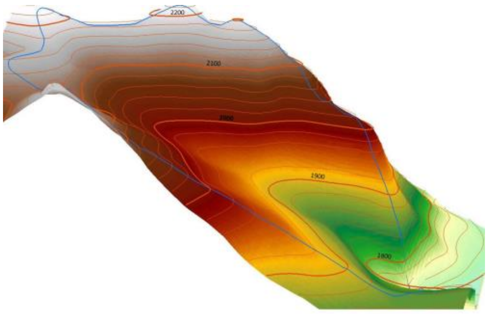


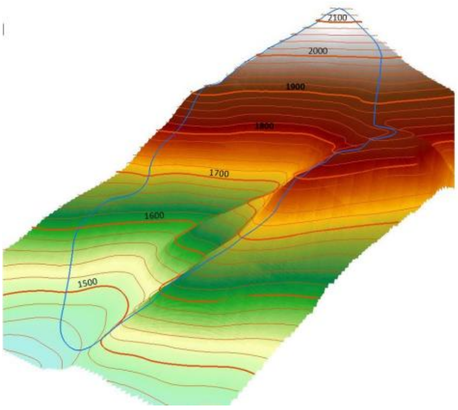
Figure 2. The Garauzchai landslip-stream.
40º 52 ' north latitude, 48º 27 ' eastern altitude

1. Fresh slope slide materials, rare bushes on steep, abrupt, strong dismembered cracks and ravines amphitheatre slopes.
2. Fresh slope slide materials on steep, abrupt, strong dismembered cracks and ravines amphitheatre slopes.

3. Fresh slope slide materials, rare bushes on weak inclined, weak dismembered cracks slopes of a cone of carrying out and a transitive site.
4. Rare bushes, pools on weak inclined, strong dismembered cracks and ravines slopes.



E-W



S-N

Figure 3. The digital model of Garauzchai landslip-stream, situated in mountain-meadow and mountain-forest zone. It has got different relief of cover.

Figure 4. The sleeve of the Garauzchai landslip-stream, which has an east-west strike.

Figure 5. The sleeve of the Garauzchai landslip-stream, having a south-north strike and capturing all new areas, reflected by a light phototone separating them from the adjacent mountain forest and mountain meadow landscapes. A photo of the company "Google" (USA), with a resolution of 1 m, filmed September 29, 2012-th year.

semi-deserts aside low-mountain relief is observed. In dynamic development and formation of a relief a dominant role play gravitational (collapses, landslips) and erosive processes, but a bycicle a role and exaration activity of the rests of an ancient freezing.

Differences of heights on the Southern slope of the Main Caucasian ridge which basically, covers the Zagatalo-Lahich physical-geographical area stretched from the West, from the Georgian border to a river of Girdimanchai valley in the east on 220 kilometers, with abrupt slopes are made by 2800-2900 meters. Surface biases change in limits 30º-45º that probably is the leading factor of development of slope slide processes, along with showers, characteristic and for the Northern slope of the Great Caucasus and high seismicity. A number of the rivers (Mazymchai, Belokanchai, Kurmuhchai, Dashagilchai, etc.) cross the Southern slope across, forming valleys with abrupt slopes. In territory dominate of broad-leaved forests which however can't serve fixing from sliding of breed by the factor, mountain meadows and sub nival landscapes. In connection with the big area of the bared slopes covered with materials of aeration, the rocky exposures, periodically dropping out storm rains in pools of the rivers form have sat down, which work great mischief to the population and economy of foothill areas. The landslips, which occurrence also it is not connected in the direct relation with the anthropogenic factor, are most widely developed on the average a watercourse of Girdimanchai, in the Lahich hollow on slopes of mountains and create obstacles to economy development, settlements.

The Shemahi (Mountain Shirvan) physical-geographical area surrounded from the West the river Ahsu, from the north a watershed of the Main Caucasian ridge, from the east with Gobustan low-mountains, and from the south Shirvan steppe is characterized by high seismicity (8-9 points) which probably plays the leading part in coupling infringement between weights of breeds and a descent of landslips. In area territory where unlike previous, with more damp climate, mountain-steppe, forest-steppe, mountain-wood and mountain-meadow landscape complexes prevail. Here consequences of landslips in connection with low-populated territory, fortunately, didn't lead to the big human victims, but periodically put out of action the main road on which fluid repair the considerable quantity of public funds leaves. Landslips in pools of the rivers Ahsu, Pirsaat and

Gozluchai which work great mischief to settlements, roads and economy are most widely developed. The site of Chuhuryurd-Pirgulu is convenient as a zone of rest and possesses features of the mountain-climatic resort which expansion can will aggravate a problem of its protection against natural accidents.

CONCLUSIONS. The numerous researches directed on working out of actions for prevention of a descent of landslips are based on the purposes of reduction of biases of hillsides, the phytomeliorative works meaning restoration of a close vegetative cover on broken files. Such approach starts with insufficient understanding of an essence of the mechanism of the given process covering not simply terrestrial surface, but powerful enough cover of sedimentary breeds with certain stratification, sometimes some tens meters. Often enough in publications of various character there is an expression "sliding of soils,, that starts with misunderstanding of a geological-geomorphologic essence of slope slide process, the superficial relation to possible consequences of this phenomenon. Cases of the big human victims as a result of landslips, for example, tragedy of the settlement Varna located on the Southeast slope of the Main Caucasian ridge, carried away lives of many inhabitants of village are known. Geologists mark presence of earthquakes of slope slide character, being an element of a geodynamic chain.

At the same time, land improvement attempts of slope slide files which are ineffective are undertaken. They, basically, are directed on alignment of a surface and restoration of a close soil-vegetative cover, including, by realization of forest melioration.

The given measures lead to time stabilization of a geodynamic situation that actually, is the beginning of a new cycle in development of slope slide process. Planting of trees improves soil-ecological, but not a geological-geomorphologic situation as roots of trees aren't capable to constrain movement of weights of breeds sufficiently. As an example numerous landslips within a mountain-wood belt of the Great Caucasus within Azerbaijan, strongly changed all shape of a landscape can serve, introducing before not meeting elements in its horizontal structure.

Thereupon there is a severe need in large-scale inventory of slope slide files, meaning drawing up detailed landscape, geologo-geomorphological, soil and geobotanical sketch maps, including, with use of materials of space shooting (Pike 2000, Shary et al. 2002, Thompson et al. 2001, Zhilin Li et al. 2005, Taud and Parrot 2005, Etzelmuller et al. 2007, Zhou et al. 2008, Rainer Bell et al. 2012, Mehbaliyev et al. 2016). Maps and sharts should be added by the meteorological data including the information on an annual course of temperature of air, quantity, character and a mode of loss of deposits, mid-annual and monthly average temperatures of air.

In the description of slope slide file the information on a humanitarian and economic situation of slope slide site, including the data about quantity of settlements, number of their population, type of settlement, features of their arrangement, quantity and character of the enterprises, the social objects located in given territory should occupy an important place (Mardanov and Aliyev 2016).

Accumulation and processing of great volume of the data presumes to spend comparison of the probable factors causing process of a descent of landslips and to reveal the key factor which has been not considered by initial consideration, for the purpose of search of possibilities of its neutralization (Mardanov 2009, Garibov et al. 2016, Alizade et al. 2016).

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THE TRANSFORMATIONS OF SLOPE SLIDE LANDSCAPES OF GREAT CAUCASUS: POSSIBILITIES OF DISCOVERING OF MAIN FACTORS

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In this work aim was been analyzed the possibilities of prognosis of the slope slides in high-mountainous of Great Caucasus and Apsheron peninsula with use of the geological, geomorphologic, climate and landscape data and visual observation. These data allow us to find main differences of relief situation, hydro meteorological conditions in the various physical geographical and synoptic districts in which slope slides are shown, character and intensity of land using which have the influence to the slope slides. It has been found that in the mountain part of the territory the main factors of slope slides are various natural reasons, but anthropogenic reasons have got the great role in the slope slides of Apsheron peninsula, too.

ECONOMIC GROWTH OF TUSAGA-Aktif

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ABSTRACT:

Officially the unique high precision positioning system is CORS-Tr (TUSAGA-Aktif) in Turkey. CORS-Tr has 146 permanent GNSS station and two control centers. Today there are more than 10.000 individual users who are paying subscription, GNSS data, positioning services monthly or annually since 2011.

In every month More than 30 users joined to CORS-Tr from different sector. User sector, if we categorize surveying, mining, construction, licensed surveyor, etc. But in this paper we will use five categories as Land Registry and Cadastre, Public Institutions, Municipalities, Universities and Licensed Surveyors to determine economic growth of CORS-Tr. Following years increasing rate of user's monthly will be much more higher by establishing additional permanent GSNSS station due to prevent extrapolation. This paper presents CORS-Tr economic growth estimation by last three years log data analysis using valuation approach.

KEY WORDS: CORS-Tr, TUSAGA-Aktif, GNSS Networks, User Log Data, Economic Growth of GNSS networks

1. INTRODUCTION

TUSAGA-Aktif (Continuously Operating Permanent GNSS Reference System –CORS-Tr) is unique GNSS network in the Turkey where established 146 GNSS reference stations including Turkish Republic of Northern Cyprus. Distances between reference stations are around 80-100 km. More than 10.000 user have subscription to use network correction to point positioning.

Two control centers of CORS-Tr are located in Ankara. Master control center operated by General Directorate of Land Registry and Cadastre (TKGM) and other operated by General Directorate of Mapping (HGM).

CORS-Tr operated within the cooperation with TKGM and HGM by executive board. Under the executive board TKGM is operating master control center including user management, reference station management and etc.. HGM is operating protocols with public institutions and other issues.

CORS-Tr System have five categories in user database; Land Registry and Cadastre, Public Institutions, Municipalities, Universities and Private Sectors..

Substantial technological advances have been made in recent years to improve the accuracy of the global positioning system. Today, precise positioning technology uses multiple frequency Global Navigation Satellite Systems (GNSS) receivers to achieve real-time or near real-time accuracy of two centimetres. This degree of accuracy opens up a range of new commercial applications for improving production and processing efficiency in industries such as agriculture, mining and construction [1].

CORS data are used extensively for traditionally horizontal positioning (latitude and longitude), including asset inventory as in locating property boundaries, and for establishing the relative location of natural and manmade structures such as rivers, roads, buildings, water pipes and power lines. CORS data also allows monitoring of the motion of critical structures such as dams, bridges and nuclear power plants. The use of CORS for determining vertical (ellipsoid heights) information is growing, and accuracy needs are getting stricter. CORS plays a central role in maintaining the integrity of the National Spatial Reference System in all three dimensions [2].

Improved efficiency through use of positioning technology in the agriculture, mining, survey and land development, construction, utilities, and transport sectors, reduces costs and has the potential to reduce prices to consumers. While these impacts are more broadly captured in the economic results they are nevertheless important benefits to society in general [3].

This paper presents economic contribution of TUSAGA-Aktif by using valuation technics apart from its official incomes and outcomes.

1.1 CORS-Tr cost, usage fee, incomes and outcomes

CORS-Tr Project was completed in 2008 with a cost of 2.5 million USD including academic researches by funding of TUBITAK.

Operational Costs of CORS-Tr System includes;

- Hardware Costs; GNSS Stations and Control Center (CC)
- Software Costs; CC Software and GNSS Firmware
- Maintenance / Repair Costs; Changing station locations, maintenance, repairing
- Communication Costs; 2XMetro internet and 146 VPN Internet connections
- Promotion costs; Seminars, symposiums, trainings, etc. for CORS-Tr

Expensed cost, usage fees, user and incomes of CORS-Tr are shown following figures [4-5].

YEAR	EXPENSE VARIETY					
	Hardware	Software	Maintenance	Promotion	Communication	TOTAL
2010	$23.000,00	$0,00	$15.000,00	$0,00	$60.000,00	$98.000,00
2011	$7.000,00	$0,00	$0,00	$0,00	$125.000,00	$132.000,00
2012	$413.000,00	$0,00	$25.000,00	$0,00	$112.000,00	$550.000,00
2013	$6.000,00	$0,00	$0,00	$35.000,00	$319.000,00	$360.000,00
2014	$458.000,00	$176.000,00	$0,00	$0,00	$288.000,00	$922.000,00
2015	$0,00	$0,00	$0,00	$0,00	$305.000,00	$305.000,00
2016	$59.000,00	$0,00	$0,00	$0,00	$211.000,00	$270.000,00
2017	$248.000,00	$0,00	$37.000,00	$0,00	$265.000,00	$550.000,00
TOTAL	$1.214.000,00	$176.000,00	$77.000,00	$35.000,00	$1.685.000,00	$3.187.000,00

Figure -1 CORS-Tr cost annually

SERVICE TYPE	DATA TYPE	PRICE*	EXPLANATION
SUBSCRIPTION	-	$30	ONCE
RTK SERVICES	NETWORK-RTK	$20	MONTHLY
		$150	ANNUAL
	NETWORK-DGPS	$10	MONTHLY
		$75	ANNUAL
RINEX DATAS	RINEX 1 SECOND	$0,2	STATION/HOUR
	RINEX 30 SECONDS	FREE	STATION/DAY

Figure – 2 CORS-Tr usage fees

YEAR	Nr of USERS	RTK FEE (USD)	INCOME (X1000 USD)
2011	2900	500	1900
2012	3300	410	1700
2013	3900	395	1600
2014	5200	357	1500
2015	6300	277	1600
2016	7500	258	1500
2017	9000	215	1400

Figure – 3 CORS-Tr Users, fees and incomes annually

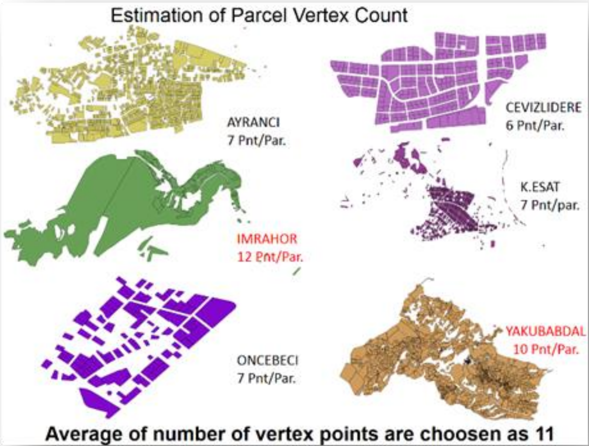
2. ECONOMIC GROWTH OF TUSAGA-AKTIF

2.1 Methodology

User measurements 2015, 2016 and 2017 in SQL database is considered to estimate of TUSAGA-Aktif economic growth. For this purpose firstly we described a parcel average vertex count in Turkey from some examples. Then user measurements converted cadastral parcels counts in different categories. To estimate user measurement values parcel values we use officially declared cadastral detail measurements price, on site cadastral parcel application price, land use conversion price and to show parcel position price. Newly joined GNNS equipment in every year is also considered to estimate TUSAGA-Aktif economic growth. Valuation criteria is explained in following section.

2.2 Valuation criteria

Estimation of parcel vertex count is based different cadastral data which are described urban area and rural area. Our sample and vertex count is shown following figure.



To estimation of parcel detail measurement prices; We refered to forest cadastral works contracts and cadastral renowation contracts by GDLRC in 2015,2016 and 2017. Average of decleared parcel detail measurements is 20 TL/Parcel in 2015, 14 TL/Parcel in 2016 and 7 TL/Parcel in 2017.

Cadastral Parcel Application, Land Use Conversion and Show Parcel Position works are done by licensed surveyors (LIHKAB) in Turkey. Officially decleared Licenced surveyor work process prices shown below used as valuation criters.

PROCESS NAME	2015 PRICE TL	2016 PRICE TL	2017 PRICE TL
PARCEL APPLICATION	381	402	418
LAND USE CONVERSION	139	146	152
SHOW PARSEL POSITION	121	128	133

Aditionally to joined GNSS to TUSAGA-Aktif system in every year is considered to estimated TUSAGA-Aktif ecomonic growth.

SECTOR GNSS	2015 GNSS	2016 GNSS	2017 GNSS
GDLRC	72	0	65
PRIVATE SECTORS	767	838	1166
PUBLİC INS.	225	109	133
MUNICPALITIES	266	149	113
UNIVERCITIES	19	17	18
TOTAL	**1349**	**1113**	**1495**

User measurement in 2015,2016 and 2017 are shown following table in categorized structure.

CATEGORIES	POINTS 2015	POINTS 2016	POINTS 2017
PRIVATE SEC.	71,414,664	67,787,520	101,555,807
GDLRC	7,346,346	2,332,920	3,069,500
MUNICIPALITIES	5,954,490	5,396,568	8,068,438
PUBLIC INST.	4,325,358	4,827,024	14,353,765
UNIVERCITIES	321,072	484,464	472,444
TOTAL	**89,361,930**	**80,828,496**	**127,519,954**

2.3 Valuation of TUSAGA-Aktif Measurements

TUSAGA-Aktif measurements are valued by declared criteria year by year (2015, 2016 and 2017) and shown following pictures.

TUSAGA-Aktif System 2015 Economic Growth						
	PRIVATE	GOVERM.	MUNICIPAL	GDLRC	UNIV.	TOTAL
NEW JOINED GNSS	767	225	266	72	19	1.349
MESURED POINTS	71.414.664	4.325.358	5.954.490	7.346.346	321.072	89.361.930
COROSPONDING PARCELS	6.492.242	393.214	541.317	667.850	29.188	8.123.812
ECONOMIC GROWTH 2015						
KADASTRAL MEAS.VALUE	129.844.844	7.864.287	10.826.345	13.356.993	583.767	162.476.236
PARCEL APPLICATOIN VALUE	2.473.544.271	149.814.673	206.241.881	254.450.711	11.120.767	3.095.172.303
LAND USE CONV.VALUE	902.421.663	54.656.797	75.243.101	92.831.099	4.057.183	1.129.209.843
SHOW PARCEL POS. VALUE	785.561.304	47.578.938	65.499.390	80.809.806	3.531.792	982.981.230
AVERAGE VALUE	**1.072.843.021**	**64.978.674**	**89.452.679**	**110.362.152**	**4.823.377**	**1.342.459.903**
2015 GNSS VALUE	15.340.000	4.500.000	5.320.000	1.440.000	380.000	26.980.000
2015 EKONOMIC GROWTH	**1.088.183.021**	**69.478.674**	**94.772.679**	**111.802.152**	**5.203.377**	**1.369.439.903**

TUSAGA-Aktif System 2016 Economic Growth						
	PRIVATE	GOVERM.	MUNICIPAL	GDLRC	UNIV.	TOTAL
NEW JOINED GNSS	838	109	149	0	17	1.113
MESURED POINTS	67.787.520	4.827.024	5.396.568	2.332.920	484.464	80.828.496
COROSPONDING PARCELS	6.162.502	438.820	490.597	212.084	44.042	7.348.045
ECONOMIC GROWTH 2016						
KADASTRAL MEAS.VALUE	86.275.025	6.143.485	6.868.359	2.969.171	616.591	102.872.631
PARCEL APPLICATOIN VALUE	2.477.325.731	176.405.786	197.220.031	85.257.622	17.704.957	2.953.914.127
LAND USE CONV.VALUE	899.725.265	64.067.773	71.627.175	30.964.211	6.430.159	1.072.814.583
SHOW PARCEL POS. VALUE	788.800.233	56.169.007	62.796.428	27.146.705	5.637.399	940.549.772
AVERAGE VALUE	**1.063.031.564**	**75.696.513**	**84.627.998**	**36.584.427**	**7.597.276**	**1.267.537.778**
2016 GNSS VALUE	16.760.000	2.180.000	2.980.000	0	340.000	22.260.000
2016 EKONOMIC GROWTH	**1.079.791.564**	**77.876.513**	**87.607.998**	**36.584.427**	**7.937.276**	**1.289.797.778**

TUSAGA-Aktif System 2017 Economic Growth						
	PRIVATE	GOVERM.	MUNICIPAL	GDLRC	UNIV.	TOTAL
NEW JOINED GNSS	1.166	133	113	65	18	1.495
MESURED POINTS	101.555.807	14.353.765	8.068.438	3.069.500	472.444	127.519.954
COROSPONDING PARCELS	9.232.346	1.304.888	733.494	279.045	42.949	11.592.723
ECONOMIC GROWTH 2017						
KADASTRAL MEAS.VALUE	64.626.423	9.134.214	5.134.461	1.953.318	300.646	81.149.062
PARCEL APPLICATOIN VALUE	3.859.120.666	545.443.070	306.600.644	116.641.000	17.952.872	4.845.758.252
LAND USE CONV.VALUE	10.635.662.697	198.342.935	111.491.143	42.414.909	6.528.317	1.762.093.910
SHOW PARCEL POS. VALUE	1.227.902.030	173.550.068	97.554.750	37.113.045	5.712.277	1.541.832.171
AVERAGE VALUE	**3.946.827.954**	**231.617.572**	**130.195.250**	**49.530.568**	**7.623.528**	**2.057.708.349**
2017 GNSS VALUE	23.320.000	2.660.000	2.260.000	1.300.000	360.000	29.900.000
2017 EKONOMIC GROWTH	**3.970.147.954**	**234.277.572**	**132.455.250**	**50.830.568**	**7.983.528**	**2.087.608.349**

3. CONCLUSIONS

As a result of this investigation we easily can say TUSAGA-Aktif created 460 million dollars average economic growth annually in positioning/mapping sector. It is %0,054 of Turkey GDP. And TUSGA-Aktif saves 75 million TL annually in this sector.

YEAR	ECOGROWTH [TL]	ECOGROWTH [MIL.USD]	GDP [MIL.USD]	% of GDP
2015	1.369.439.903	460	860.000	0,054
2016	1.289.797.778	370	864.000	0,043
2017	2.087.608.349	550	851.000	0,065
AVE	**1.582.282.010**	**460**	**858.000**	**0,054**

On another hand, socio-cultural and socio-economic effects of TUSAGA-Aktif should be considered within the investigation later.

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TUSAGA-Aktif EXAMPLE WITH RELATED TO LOCATION BASED ACTIVITY INTELLIGENCE

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ABSTRACT:

146 TUSAGA-Aktif (Turkey National Permanent GNSS Network-Active) continuous GPS Stations and Control Centres have been established in Turkey, considering Turkish Republic of North Cyprus (TRNC). With TUSAGA-Aktif, in any place and time, at centimetre accuracy, map and geographical information can be obtained in seconds. TUSAGA-Aktif system is one of the world's largest Contionusly Observing Reference Stations (CORS) systems in terms of number of stations and covers the area.

Every single month more than 50 users are joining to use TUSAGA-Aktif system. Today the system has more than 8000 users who are working for Governmental Organization, General Directorate of Land Registry and Cadastre, Private Companies, Municipalities, Universities and Licensed Surveyors.

CORS systems like TUSAGA-Aktif are producing different type of data such as GPS observation data, user correction data, user connection log data and etc. These data gives much information to system manager not only to improve user services but also to determine cm level of location of things, tectonic movements and water vapour and user activities on the field.

This paper presents initial studying about user activities on the field as a part of Location Based Activity Intelligence (LBAI) and Location Based Activity Recognition (LBAR) by using user connection log data.

KEY WORDS: CORS Stations, GNSS Data, GNSS Data Processing and Analysing, User location, User Activities, Location Based Activity Recognition (LBAR), Location Based Activity Intelligence (LBAI), Location Based Financial Intelligence (LBFI)

1. INTRODUCTION

TUSAGA-Aktif system has been established in May 2010, with cooperation of Istanbul Kultur University (IKU) as executive, The General Directorate of Land Registry and Cadastre (TKGM) and General Command of Mapping (GCM) as joint customers. TUSAGA-Aktif system which is operated by TKGM and HGK collectively, is operated free of charge for test purposes until June 2011. TKGM is operated control center system management, user membership and financial side. GCM is operated institutional protocols and other related work side. After that date it has been operated for a fee that the prices is determined by Inter Ministries Mapping Coordination and Planning Committee (BHİKPK).

TUSAGA-Aktif system which has more than 8000 users, store all user connection logs in SQL database as a location history. User location history file contains Loginwithorganization, Latitude, Longtitude, Height, LogtimeUTC and sessionID parameters. These parameters are useful to recognition of user activities on the field.

1.1 Location Based Activity Intelligence (LBAI) or Location Based Activity Recognition (LBAR)

In recent years we see mostly mobile phone technologies used human activity recognition to assist humans (such as nurses, scientist and parents) in monitoring others and enabling computers that anticipate human needs, so called Activities Daily Livings-ADL [1]. Automatic monitoring of Activities of Daily Living (ADLs, such as eating, drinking, cleaning, and so on) is an important component for the implementation of advanced services in the fields of Ambient Assisted Living and Assisted Cognition. In assessing the level of self-sufficiency of patients, clinicians consider the capabilities of performing basic ADLs such as cooking and eating. The automatic recognition and tracking of these activities may allow for a more reliable and cheaper automatic reporting to clinicians or relatives. At the same time, it allows for the provision of advanced services that can contribute to older people's independent life: services like reminders help in activity execution, etc [2]. Activity recognition and context-aware computing are gaining increasing interest in the AI and ubiquitous computing communities [3].

Massive and passive data such as cell phone traces provide samples of the whereabouts and movements of individuals. These are a potential source of information for models of daily activities in a city. The main challenge is that phone traces have low spatial precision and are sparsely sampled in time, which requires a precise set of techniques for mining hidden valuable information they contain [4].

2. ACTIVITY RECOGNITION BY TUSAGA-AKTIF

2.1 Data Preparation

TUSAGA-Aktif system user location history file contains Loginwithorganization, Latitude, Longtitude, Height, LogtimeUTC and sessionID parameters. This information sends to control centre by rover in NEMA format to get correction parameters to determination position cm level of the rover. Every rover appropriate NEMA coordinates recorded in SQL database in sequentially. Certain user information to be investigated can be separated from SQL database to individual file by certain date or year. Recorded data should be ordered by time and date to do activity analysing. A sample file looks like following table.

LoginWithO	Latitude	Longitude	Height	LogTimeUTC	SessionID
KECIOREN Kad Md/K01066803	39,972094833	32,875120517	939,542000000	14.05.2015 07:17	386866
KECIOREN Kad Md/K01066803	39,972088600	32,875126183	942,033000000	14.05.2015 07:17	386866
KECIOREN Kad Md/K01066803	39,972092650	32,875120367	940,739000000	14.05.2015 07:18	386866
KECIOREN Kad Md/K01066803	39,972094950	32,875116167	939,764000000	14.05.2015 07:18	386866
KECIOREN Kad Md/K01066803	39,972080850	32,875151517	938,951000000	14.05.2015 07:19	386866
KECIOREN Kad Md/K01066803	39,972111150	32,875134950	936,249000000	14.05.2015 07:19	386866
KECIOREN Kad Md/K01066803	39,972113467	32,875110400	936,437000000	14.05.2015 07:20	386866
KECIOREN Kad Md/K01066803	39,972113550	32,875110667	936,485000000	14.05.2015 07:20	386866
KECIOREN Kad Md/K01066803	39,972062750	32,874977200	937,134000000	14.05.2015 07:21	386866
KECIOREN Kad Md/K01066803	39,972029850	32,874898400	937,313000000	14.05.2015 07:21	386866
KECIOREN Kad Md/K01066803	39,972029433	32,874898700	937,377000000	14.05.2015 07:22	386866
KECIOREN Kad Md/K01066803	39,972028900	32,874898833	937,388000000	14.05.2015 07:23	386866
KECIOREN Kad Md/K01066803	39,972028067	32,874893900	937,395000000	14.05.2015 07:23	386866
KECIOREN Kad Md/K01066803	40,017157633	32,855088833	1103,077000000	14.05.2015 08:12	388371
KECIOREN Kad Md/K01066803	40,017155783	32,855104100	1107,258000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017156217	32,855099150	1106,653000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017155217	32,855098583	1106,885000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017155450	32,855097817	1106,959000000	14.05.2015 08:13	388371
KECIOREN Kad Md/K01066803	40,017154717	32,855096167	1107,106000000	14.05.2015 08:14	388406
KECIOREN Kad Md/K01066803	40,017157267	32,855095917	1107,821000000	14.05.2015 08:14	388406
KECIOREN Kad Md/K01066803	40,017157283	32,855097167	1107,601000000	14.05.2015 08:15	388406
KECIOREN Kad Md/K01066803	40,017156533	32,855097700	1107,242000000	14.05.2015 08:15	388406
KECIOREN Kad Md/K01066803	40,017157617	32,855100567	1107,052000000	14.05.2015 08:16	388406
KECIOREN Kad Md/K01066803	40,017156967	32,855095233	1107,565000000	14.05.2015 08:16	388406
KECIOREN Kad Md/K01066803	40,017157700	32,855095683	1107,558000000	14.05.2015 08:17	388406
KECIOREN Kad Md/K01066803	40,017055750	32,855368117	1111,050000000	14.05.2015 08:18	388406
KECIOREN Kad Md/K01066803	40,017024883	32,855456700	1111,901000000	14.05.2015 08:19	388406
KECIOREN Kad Md/K01066803	40,017021733	32,855454967	1111,917000000	14.05.2015 08:19	388406
KECIOREN Kad Md/K01066803	40,017023417	32,855458883	1111,834000000	14.05.2015 08:20	388406

Table- 1. User log data structure

2.2 Used Method

There are many searches about activity intelligence as literatures which are referenced for our application.

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In recent decades, activity-based analysis using GPS equipment as data collector has being a hot issue. Most this kind of researches focus on data from wearable GPS recorder for person because of easy detailed activity logging and interactive validation with users [5]. Euclidean distance between consecutive measurements is proportional with the speed of movement. During stationary periods, the distance values stay relatively small (< 5). The slow and fast walking periods show a distinct difference from the stationary period. The driving traces show the most rapid changes in the radio environment, greater than either walking or stationary. Fast walking and slow driving sometimes overlap in their range of Euclidean distance values, which may result in false recognition between the two states. For a given speed, the Euclidean distance values are not constant because changes in signal strengths are both a function of speed as well as the physical environment, such as buildings, people, or vehicles. Based on these findings we extracted a set of seven different features to use in classifying a set of GSM measurements as either stationary, walking, or driving [6].

GPS (global positioning system) location data is used to recognize the high-level activities in which a person is engaged and to determine the relationship between activities and locations that are important to the user. Everyday activities such as “working,” “visiting,” “travel,” and to recognize and label significant locations that are associated with one or more activity, such as "work place," "friend's house," "user's bus stop." Such activity logs can be used, for instance, for automated diaries or long-term health monitoring can be segmented [7].

Automatic recognition of human activities can support many applications, from context aware computing to just-in-time information systems to assistive technology for the disabled. Knowledge of a person's location provides important context information for inferring a person's high-level activities. This dissertation describes the application of machine learning and probabilistic reasoning techniques to recognizing daily activities from location data collected by GPS sensors [8].

An average walking speed is somewhere around 3 miles per hour, but fast walkers and power walkers can often walk at speeds at or above 5 miles per hour. The speed at which you feel more comfortable running than walking is known as your "break point," and a typical break point would be somewhere between 4 and 5 miles per hour. For most people, a running stride allows a higher overall maximum speed than a walking stride [9]. An interesting example can be found in cell phone and web based application for different purposes [10].

In our work we choose Ankara Provinces users log data. We grouped users in different sectors and calculate Euclidean distance between consecutive measurements is proportional with the speed of movement. We grouped user activity in seven categories. We also include measurement season of day and season of year and some visual anomaly detection such as illegal activity.

Activity	**Velocity**
Stationary	V <= 0,03m/sn
Slow walking	V <= 1,1 m/sn
Fast walking	V <= 2,2 m/sn
Running	V <= 4,5 m/sn
Slow driving	V <= 7 m/sn
Medium driving	V <= 20 m/sn
Fast driving	V >= 21 m/sn

Season of Day	**Season of Year**
Morning	Spring
Noon	Summer
Evening	Autumn
Night	Winter

Table- 2. User activity group

2.3 Visual Checking

In Ankara Provinces user measurements (of course logging data) merged QGIS software sector by sector. In fact SQL database designed according to user identification which can be easily separated in their sectors. We have five sector categories. These are Private Sector, Government Organization, Licensed Surveyors, Universities and Land Registry and Cadastre Organization (GDLRC).

We calculated distance and time differences between user points in the same day and same session ID to identify user activities. As an example a licensed surveyor and local cadastral officers should be work his responsibility area.

And also user measurements have been overlaid digital orthophoto WMS services. And visual checking has been implemented by analyzing; distribution of measured points, distances and time differences between points in the same day and same session ID. On the other side heat map used to understand their regional activities.

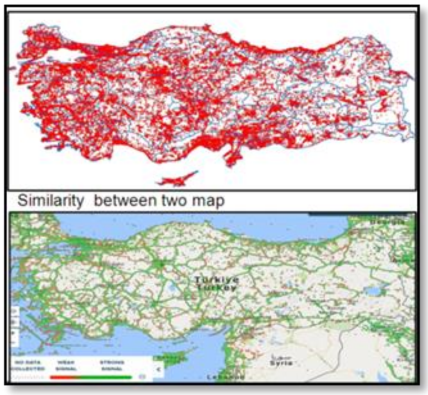
Local cadastral offices managers, licensed surveyors owners, owner of private companies and other managers have a right to check their GNNS activity log data last one month and last 50 session by using TUSAGA-Aktif web platform.

2.4 Calculation and Mapping

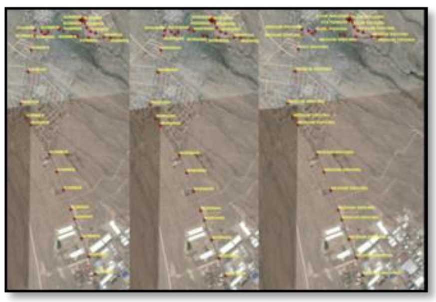
User activity can be questioned by written query from database for daily requeriments. By getting coordinates, date, time and session id of user measurement some activity can be calculated and mapped. Such as;

- User activity map
- Individual user or user sector heat map
- Distance and veloncity between consecutive measurements
- User activity within the day groupped by sension ID
- User activity season of day groupped by time
- User activity season of year groupped by date

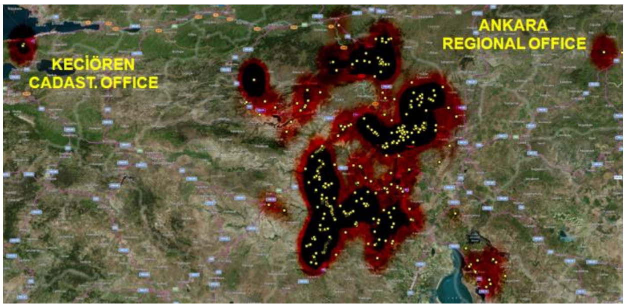
Users measurements can be are mapped and compared GSM signal map to detect signals weak of GSM operators.



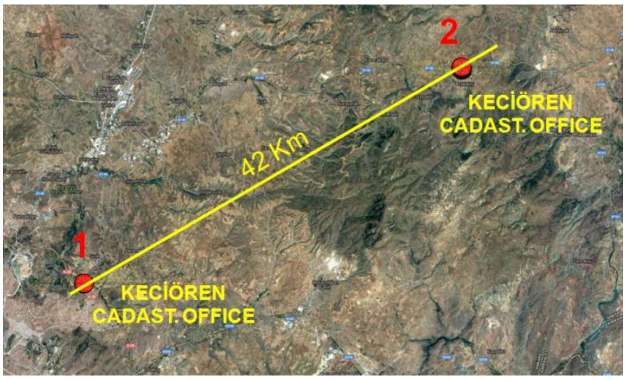
According to user adjacent location history; User activity or behaviour can be detected easily like stationary, slow walking, fast walking, running, driving,etc.



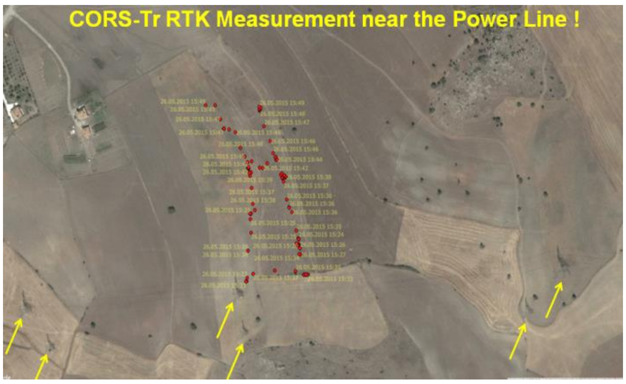
Local authorities and private company's owner can investigate their GNSS activities (measurements last one month or last 50 sessions) which can be mapped by using Trimble Pivot Platform since 2016



Two diffrent GNSS users within the same organization try to use/share usage rights by using same user name and password at the same time



Following picture shows CORS-Tr RTK Measurement near the Power Line.



Licensed surveyor activities out of their responsibility area.

3. RESULTS

As a results of TUSAGA-Aktif user activities;

- CORS-Tr User activity map shows,GSM Operator's coverage and performance.
- User activity on the field can be formulated by their consecutive measurements.
- GNSS Owner or Users are sharing their user name and password.
- İllegal activity out of the certain activity area can be detected easily.
- GNSS Owner and User should have Privacy Policy
- Authorities should investigate their user activities

Consequently, to prevent illegal usage of GNSS, we restricted local cadastral offices usage rights by their responsibility boundaries. On another hand, terminal ID, SIMCard No, User and password authentication is included because of some security reasons. Also universities and educational institutions usage rights are restricted by their campus boundaries.

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USAGE OF VARIANCE IN DETERMINATION OF SINUOSITY INTERVALS FOR ROAD MATCHING

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ABSTRACT:

Geo-object matching is a process that identifies, classifies and matches the object pairs with regards to their maximum similarity in whole datasets. The matching process is used to handle updating, aligning, optimizing, integrating and/or quality measuring of road networks. There are several metrics used in matching algorithms such as Hausdorff distance, orientation, valence, sinuosity etc. Sinuosity is a ratio of actual length of a road to the straight length among start and end points of the same road. Sinuosity defines how curve a road is. In a matching process, it is necessary to determine the sinuosity thresholds or intervals firstly. Sinuosity intervals can be determined by several data classification methods such as equal interval, quantile, natural breaks and geometrical interval. Furthermore, the intervals determined by Ireland Transportation Agency can be used in parallel with this purpose. In this study, it was aimed to find out if the variance can be used in determination of sinuosity intervals as well. An experiment was conducted to compare all of the methods mentioned above. According to the results, the efficiency of the sinuosity intervals determined by the methods in road matching differs from 37.4% to 49.4%, and it seems that the intervals determined by the variance are the most efficient ones.

KEY WORDS: Variance, Sinuosity, Intervals, Road Matching, Data Integration

1. INTRODUCTION

Geo-object matching is a process that identifies, classifies and matches the object pairs, representing the same entity, with regards to their maximum similarity in whole datasets. The matching process is used to handle updating, aligning, optimizing, integrating, conflating and/or quality measuring of road networks. A matching algorithm is generally conducted by using similarity equations (Zhang and Meng, 2007) (Li and Goodchild, 2011). The bigger similarity values the more possibility for matching candidates to be certain matched pairs. In similarity equations, there are several metrics (network alignment, distance threshold, orientation, direction, road length, valence, sinuosity, etc.) make the matching algorithm more efficient (Hacar and Gökgöz, 2016). While distance metric limits the number of matching candidates, orientation and valence (degree of connectivity) can be used to find the certain matches (Olteanu-Raimond, A. M., Mustiere, S. and Ruas, A. 2015) (Mustière, S. and Devogele, T. 2008). Sinuosity is also used to eliminate the incorrect candidates. It is a ratio of actual length of a road to the straight length among start and end points of the same road and defines how curve the road is (Mueller, 1968) (Haynes et al., 2007) (Figure 1).

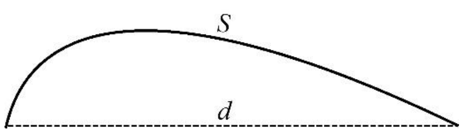

Figure 1. Actual and straight lengths (dashed) of a road

In this study, sinuosity intervals determined by commonly used classification methods and a proposed classification method called '*sinuosity variance*' were compared with standard sinuosity intervals from Ireland Transportation Agency (ITA) under the framework of matching process. The study area and road datasets are described in Section 2. Besides, classification methods and proposed *Sinuosity variance* method are summarily introduced. In section 3, determination of sinuosity intervals were conducted and the results of matching process are presented with regards to the classification methods. Finally, some inferences from these results are given in section 4.

2. MATERIAL AND METHODS

2.1 Study Area and Datasets

This study was conducted using datasets representing roads in Beykoz district, Istanbul, Turkey. It covers the area 1.6km x 1.7km. The road networks, representing the same entities, are one from Istanbul Metropolitan Municipality (IMM) road dataset and the other from Basarsoft navigation road dataset. Their pattern is tree-based. Figure 2 shows the study area, road networks and the differences among networks.

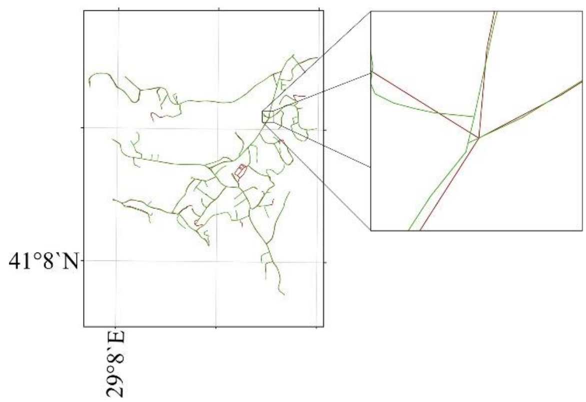

Figure 2. Study area and road datasets: IMM (green) and Basarsoft (red)

2.2 Classification Methods

Roads are classified into predefined sinuosity intervals generally to analyze traffic components such as travel demand, road safety, etc. In the literature, there have been some calculations of sinuosity (Table 1).

Method	Definition
Bend density	The number of bends per kilometer
Sinuosity/detour ratio	The ratio of actual length of a road to the straight length among start and end points of the same road
Straightness index	The proportion of road segments that are straight
Mean angle	The mean angle turned per bend

Table 1. Some of the sinuosity measures (Haynes et al., 2007)

In this study, the sinuosity/detour ratio is used as a sinuosity equation.

$$Sin. = \frac{s}{d} \tag{1}$$

Sinuosity is commonly divided into three classes;
Low → for straight and/or low curved roads
Middle → for relatively curved roads
High → for highly curved roads.

Sinuosity intervals (classes) can be determined by several commonly used data classification methods such as equal interval, quantile, natural breaks and geometrical interval. Furthermore, the intervals determined by ITA can be used in parallel with this purpose. ITA conducted an evaluation and defined three standardized sinuosity intervals for Ireland (Transport Infrastructure, 2016) (Table 2) (Figure 3).

Sinuosity index	Intervals
Low	<1.008
Mid	≥1.008 and <1.031
High	≥1.031

Table 2. Sinuosity interval from ITA (Transport Infrastructure, 2016)

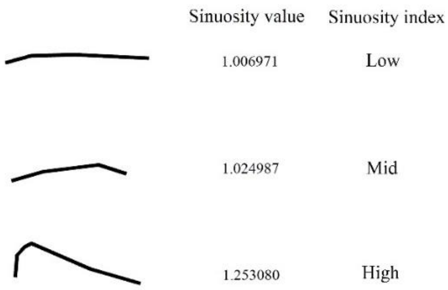

Figure 3. Examples of road lines for each ITA sinuosity index.

In a matching process, the sinuosity index of an object is assumed to be the same sinuosity index of the matched object. For example, if Line A in dataset 1 has Low sinuosity index, then it is expected to search Low sinuosity indexed line/lines in dataset 2 during matching.

The proposed method *sinuosity variance* was also used to determine the intervals. In this method, sinuosity intervals were determined with regards to the variations of sinuosity values of the roads in datasets. Firstly, the sinuosity variance values in both road datasets are calculated. Then, the dataset has the maximum variance value is set to be a reference in order to calculate the sinuosity intervals (Table 3).

Sinuosity Index	Intervals
Low	< 1.0001
Mid	≥ 1.0001 and $< 1 + \frac{max(\sigma_1^2, \sigma_2^2)}{4}$
High	$\geq 1 + \frac{max(\sigma_1^2, \sigma_2^2)}{4}$

Table 3. Sinuosity interval calculations in *sinuosity variance*

3. RESULTS AND DISCUSSION

In this study, the sinuosity intervals were determined by using the proposed *sinuosity variance* approach, equal interval, quantile, natural breaks and geometrical interval. They were compared with standard intervals from ITA (Table 4 and 5).

	IMM			Basarsoft		
	Low	Mid	High	Low	Mid	High
ITA	<1.008	≥1.008 and <1.031	≥1.031	<1.008	≥1.008 and <1.031	≥1.031
Equal Interval	<1.8656	≥1.8656 and <2.731	≥2.731	<2.629	≥2.629 and <4.259	≥4.259
Quantile	<1.0027	≥1.003 and <1.039	≥1.038	<1.002	≥1.0021 and <1.061	≥1.061
Natural Breaks	<1.2834	≥1.284 and <2.095	≥2.095	<1.911	≥1.911 and <3.522	≥3.522
Geometrical Interval	<1.0027	≥1.0027 and <1.085	≥1.085	<1.0009	≥1.0009 and <1.065	≥1.065
Sinuosity Variance	<1.0001	≥ 1.0001 and < 1.073	≥1.073	<1.0001	≥1.0001 and <1.073	≥1.073

Table 4. The sinuosity interval values retrieved from each classification method

	Source	Low	Mid	High
ITA	IMM	65	23	46
	Basarsoft	57	16	45
Equal Interval	IMM	131	1	2
	Basarsoft	115	2	1
Quantile	IMM	45	45	44
	Basarsoft	39	40	39
Natural Breaks	IMM	122	10	2
	Basarsoft	114	2	2
Geometrical Interval	IMM	45	54	35
	Basarsoft	32	47	39
Sinuosity Variance	IMM	23	72	39
	Basarsoft	29	53	36

Table 5. Number of the objects in each sinuosity index with regards to the classification methods and sources

A pre-matching process was conducted by using Hausdorff distance with the threshold 85m. The threshold value should be determined as high as to catch all the possible candidate roads. The roads close to the others less than 85m were assigned to be matching candidates.

Line k and l are matched if the following conditions are met:

- If Line k has ‘Low’ sinuosity index then Line l with ‘Low’ sinuosity index in all candidates of Line k is matched.
- If Line k has ‘Mid’ sinuosity index then Line l with ‘Mid’ sinuosity index in all candidates of Line k is matched.
- If Line k has ‘High’ sinuosity index then Line l with ‘High’ sinuosity index in all candidates of Line k is matched.

Matching processes were conducted after each classification. For the evaluation, the matching results were compared with manually matching results (Table 6).

	Correct	Incorrect	Total	%
ITA	84	94	178	47.2
Equal Interval	95	159	254	37.4
Quantile Interval	82	88	170	48.2
Natural Breaks	95	159	254	37.4
Geometrical Interval	82	91	173	47.4
Sinuosity Variance	84	86	170	49.4

Table 6. Matching statistics with regards to the classification methods.

4. CONCLUSIONS

In this study, a new method determining sinuosity intervals and classifying sinuosity index for road matching process was proposed. Sinuosity intervals were determined with regards to the variations of sinuosity values of the roads in datasets. It is compared with the sinuosity intervals from ITA and mostly used classification methods. Equal Interval and Natural Breaks methods are insufficient for matching process since hardly any roads were classified into ‘Mid’ or ‘High’ sinuosity indices. Quantile method gave the second best result. In this method, the intervals are determined to make each sinuosity class has the same number of objects. Since both datasets in this study have different number of objects, Quantile should be tested better with datasets that have the same number of objects. *Sinuosity variance*, a promising classification method for matching process, gave the best matching result in all classification methods.

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FEATURES OF THE CADASTRAL VALUATION OF LANDS OF SPECIALLY PROTECTED NATURAL AREAS IN IRKUTSK REGION

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ABSTRACT:

The spatial representation of the complex soil cover and especially of such dynamic soil regimes as soil cover temperature is one of the most complicated tasks of modern agrophysics and GIS systems. Complex soil cover of Russian Plate landscapes has peculiarities of paleocryogenic soil scape such as areas with high organic matter content (loose zones) and compacted soil. Typically soil density varies from 0.73 g/cm3 to 1.54 g/cm3 in the arable layer and from 1.0 g/cm3 to 1.68 g/cm3 at the depth of 35-40 cm. Organic carbon content varies from 1.36% to 2.98% and from 0.23% to 4.65% in the arable layer and 35-40 cm layer, respectively. Objective of the study was to identify the spatial distribution in soil water and thermal regimes and to relate regimes to zones with different soil density. Soil water and thermal regime monitoring was conducted during 5 years at different temporal and spatial scales (from 0.01 to 4 ha). Temperature measurements showed that the loose soil layers were slowly warmed up during spring and summer months and became cold in winter due to low thermal diffusivity. The loose horizon accumulates and conserves more water during wet periods and becomes dryer during drought periods, compared to the compacted horizons. The results of the monitoring by GIS-systems illustrate spatial variability of the hydrothermal fields in the studied area and its relationship with locations of the compacted and loose soil zones. For the quantitative assessment of the regimes pedotransfer functions were developed to calculate soil water retention, hydraulic conductivity, thermal diffusivity from soil bulk density and soil organic carbon content on the base of pedotransfer functions. Good agreement was obtained between measured and estimated with the pedotransfer functions water content and temperature distributions in the soil

KEY WORDS: Soil, Specially protected natural area; Cadastral registration and valuation; Geographical Information Systems

INTRODUCTION

In connection with strengthening of anthropogenous influence on nature and reduction of natural landscapes areas the task of using of reserves and national parks for conservation of biological diversity is becoming more urgent. One of the main conditions for its solution is to research of soil state of reserves as the main habitat of plants, animals and microorganisms.

The issues of lands valuation of specially protected areas (SPNA) are still debatable In determining of the land's cadastral value of protected areas the information about their location, area, types of ecosystems, the number of rare species and the degree of preservation of natural ecosystems have been used.

The value of soils as natural-historical bodies hasn't been considered. Federal law No. 221-FZ does not provided for the inclusion in the state cadaster of real estate information about soil's properties and soil cover

Meanwhile, the soils of protected areas, not affected by anthropogenic impact, can be used as background, reference areas. Their characteristics can be applied as monitoring, control objects over the state of environment and, in general, in the management of land resources. The aim of the study is - the justification for necessity of improvement of land's cadastral valuation of protected areas and of considering of soil cover and soils peculiarities.

METHODS AND OBJECTS OF RESEARCH

<u>The objects</u> of the study were the lands of specially protected natural areas of Irkutsk region. These are the objects with a special legal regime of land-uses, which are of exceptional value for maintaining of favorable living conditions on the Earth (Rosreestr Management, 2017).

<u>The subject</u> of the study is the cadastral evaluation of protected land's areas of the Irkutsk region. The results of the cadastral evaluation of specially protected areas can be used: for taxation purposes; for damage calculating to the lands of this category; for analyzing of economic decisions, related to the land'transfer from (or in) this category of lands; also for comparing with the economic costs, arising from the land-use rejection (IAS «SPNA of RU», 2018a).

<u>Source material.</u> The information base of the study was the materials of the Federal service of state registration of cadastre and cartography in the Irkutsk region, reporting materials of the Ministry of natural resources and ecology of the Irkutsk region, cadastral reports of reserves, regulatory and legislative documents (Documents of Ministry of economic development, Russia, 2005; Rosreestr Management, 2017; VNIIpriroda, 2006; Roszemkadastr, RU, 2004; The Federal laws of RF, 2007)

<u>Research methods</u> were based on the application of abstract-logical analysis, comparison, graphical interpretation. The methodical and methodological basis of this study was:

- comparative analysis of the national experience of cadastral valuation of land, including protected natural areas;
- review and analysis of information and cadastral models, which are the basis of legal and methodological documents, defining the goals, objectives, rules and procedure of land assessment of protected natural areas for compliance with the functions of cadastral evaluation from one side and functions of conservation of the natural environment and natural biodiversity – from another;
- study of the existing algorithms and cadastral technologies for adequate determination of land value of specially protected areas and objects;
- analysis of methodological approaches, methods, information and cadastral technologies for cadastral land valuation of protected areas of Irkutsk;
- analysis of the system of criteria for filling with the necessary information and carrying out of cadastral evaluation of the protected areas of Baikal Siberia;

• development of algorithms for adjusting the cadastral evaluation of protected areas in view of the nature and properties of the soil cover.

SYSTEM OF SPECIALLY PROTECTED NATURAL AREAS OF IRKUTSK REGION: GENERAL CHARACTERISTICS

The total area of the land Fund of the Irkutsk region isamount to 774 846 km2 (4.53% of the territory of Russia). The share of specially protected areas and objects of the region accounts for 2.00% (1552.4 thousand hectares) of the protected areas of Russia.

A large part of the territory are occupied by the forest lands Fund – 89,48% (69331,6 thousand hectares). The share of remaining six categories is accounted to a total of 10.52%, of which: the share of agricultural land – is 3.72% (2883,9 thousand hectares), the lands of settlements – are of 0,51% (398,6 thousand hectares);the industry and other special purposes lands are of 0.75% (577,3 thousand ha); there serve lands are of 0.64% (499,5 thousand ha)), the lands of water Fund are amount of 2.89% (2241,5 thousand hectares) (Service for the protection of nature and lake Baikal, 2018).

The specially -protected areas of the Irkutsk region include: area of world heritage - lake Baikal; state natural reserves: "Vitimskiy", "Baikalo-Lensky; the state national Park "Pribaikalskii"; the Federal reserve "Tofalarskii»; nature sanctuaries(zakazniks) of Irkutsk area importance with complexprotection regime (8 objects); nature sanctuaries of local regional importance with the protection of a single species (4 objects). In addition, within the boundaries of Irkutsk area there are distributed of nature monuments, including: geological (24 objects), aquatic (19 objects), botanical (9 objects), zoological (2 objects), landscape (6 objects), complex (14 objects) natural monuments,the Botanical garden of Irkutsk State University (IAS «SPNA of RU», 2018a; IAS «SPNA of RU», 2018b; Service for the protection of nature and lake Baikal, 2018; VNIIpriroda, 2006).

12 specially protected natural areas, including 5 reserves, 3 national parks, 6 nature sanctuaries, are directly adjacent to the Baikal-lake coast.

In General, the share of specially protected areas and objects of the Siberian Federal district accounts to 45% [13] of the protected areas lands of Russian Federation. The distribution of specially protected areas and objects by Federal districts of Russia is shown at Fig.1 (State report, Ministry of Natural Resources and Environment RF, 2011). Of these, the share of protected lands of the Irkutsk region accounts to 4, 9 %, which is 1871.97 thousand hectares (see table 1).

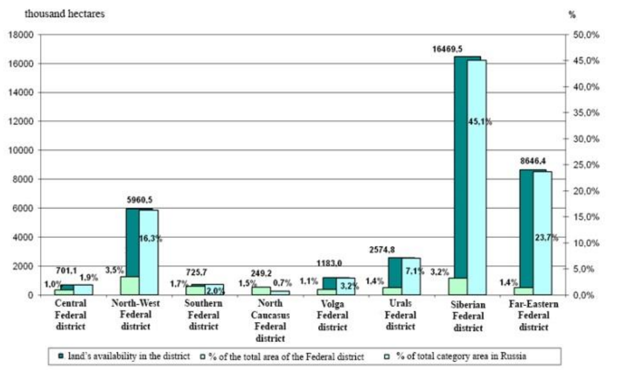

Figure 1. Distribution of lands of the category of specially protected areas and objects by Federal districts (Ministry of Natural Resources and Environment RF, 2011)

Comparative analysis of distribution of protected areas and objects of Federal importance in the Irkutsk region, as part of the Siberian Federal district and of Russian Federation as a whole has been conducted by us. The results of the study showed that the largest areas in the Irkutsk region are occupied by nature reserves, which area is 66.5% of the protected lands of Irkutsk region, 9.4 % of protected lands of Siberian federal district and 4.6 % of protected lands of Russian Federation (table. 1). The share of national parks represented by national park «Pribaikalsky», which occupies 22.3% of the specially protected natural areas (which is 16.2% of protected national parks areas of Sibirian Federal district), is also quite high in Irkutsk region.

Table 1. Distribution of specially protected natural areas of federal significance at the Irkutsk region as parts of the Siberian Federal District and Russian Federation
(excluding marine areas)

Land categories of Federal protected areas	Protected land's area, thousand hectares			Land area of specially protected natural areas, in % of			
	Russian Federation (RF)	Sibirian Federal district (SFD)	Irkutsk region	Irkutsk region	Sibirian Federal district from RF	Irkutsk region from SFD	Irkutsk region from RF
Reserves	26995,17	13310,81	1245,76	66,5	49,3	9,4	4,6
National parks	8462,32	2583,29	417,30	22,3	30,5	16,2	4,9
Sanctuaries	9773,99	2875,33	181,82	9,7	29,4	6,3	1,9
Natural monuments	36566,80	17405,00	0	0	47,6	0	0
Botanical gardens	7683,62	1653,55	27,10	1,5	21,5	1,6	0,4
Subtotal:	89481,89	37827,98	13310,81	100	42,3	4,9	2,1

The protected lands of the Irkutsk province are distributed by types of land on: protected areas, recreational areas and lands of historical and cultural purposes. The largest area of the total protected areas (1552.4 thousand hectares) is occupied by the land of specially protected natural areas - 1550.3 thousand hectares or 99.9% (see table 2).

Table 2. Distribution of protected lands by types of use, as of 01.01.2017 (Rosreestr Management, 2017)

№	Name uses	Area, thousand hectares	% of the total area of protected areas
1	Lands of specially protected natural areas	1550,5	99,878
2	Lands of recreational purposes	1,8	0,116

3	Lands of historical and cultural purposes	0,1	0,006
	Subtotal	1552,4	100

Here is an example of a description of the unique objects of cadastral registration of Federal importance, which is the national Park "Pribaikalskii", created to preserve the nature of the West coast of the lake Baikal.

Departmental affiliation: Ministry of natural resources and environment of the Russian Federation;

The international status of the protected areas: UNESCO world cultural and natural heritage site "Lake Baikal»:

Location: Siberian Federal district, Irkutsk region, districts: Irkutsk, Olkhon, Slyudyansky./

The position of protected areas in the typology of landscapes: the area of 418 ha (1999) and 417.3 ha (2017) includes the most typical landscapes for this part of the Baikal region (see table 3).

Table 3. The position of protected areas of national park «Pribaikalsky» in the typology of landscapes

Type of landscape	% areas
South taiga and taiga (zone of mountain larch and pine forests) low mountains	43,7
Waterbody	18,3
Central Asian (mountain-steppebelt) low-mountain	18,3
West Siberian (zone of light coniferous and birch forests) low-mountain	9,6
South taiga and East Siberian taiga plains (elevated)	5,6
South taiga and taiga (belt of mountain dark coniferous taiga) mid-mountain	4,4
Boreal Siberian and far Eastern (bald zone) Alpine	0,1

The total length of the park's borders along the Baikal coast is ~ 500 km (1999) and ~ 470 km (2017). We can say that this is the most "extended" of the national parks of Russia (Lyamkin V. F, 2008).

The Park includes 14 specially protected areas of regional importance. Around the Park is allocated a protective zone with a total area of 1203.7 thousand hectares, including 246 thousand hectares of the Baikal water area. 5 zones has been allocated as a result of zoning of the territory within the protected area: protected zone, recreation and educational tourism zone, the area for visitors and economic purpose, the area of traditional extensive nature management (IAS «SPNA of RU», 2018a).

Information on protection decision-making: the park was organized by solution of the Ministry of natural resources of Russia from 13.02.86 № 71. The organizing regulation document of "Pribaikalsky" park was approved in 1987.The forest management of the Park was completed at 1988.At present time, park's activities are regulated by the Regulation document N 600-PP from 27.11.2014on implementation of regional state environmental supervision on Irkutsk province territory.

Description of objects: 997 species of plants belonging to 107 families and 426 genuses there are registered in the Park, 76 of them are classified as rare and 20 species are included in the Red book of Russia. It is home to 55 species of mammals, about 300 species of birds, 9 species of reptiles and amphibians (Lyamkin V. F., 2008).

The Red book of Russia includes 46 species of the Pribaikalsky national Park; the regional Red book –include of 44species, the list of rare and endangered species – consist of 9 species.

The relics of tertiary broad-leaved forests have been preserved under the canopy of the Primorsky range, which were distributed in our region during 15-20 million years ago. In the area of the Small sea of lake Baikal (on the Islands of the lake and at the North-East of the Olkhon island) there are small rookeries of the seal-Baikal endemic [6]. And no information about soil and soil cover.

The main objectives of the national park "Pribaikalsky": preservation of reference and unique natural complexes and objects, as well as monuments of cultural history and other heritage sites (IAS «SPNA of RU», 2018b);

- creation of conditions for regulated tourism and recreation in natural conditions;
- development and implementation of scientific methods for conservation of natural complexes in conditions of recreational use;
- recovering of disturbed, historical and cultural complexes; organization of environmental education of the population;
- environmental monitoring.

FEATURES AND SHORTCOMINGS OF CADASTRAL EVALUATION OF PROTECTED LANDS OF THE IRKUTSK REGION

The lack of soil's information at the state real estate cadastre, makes an impossible the task set before the protected areas. The absence of SoilsRed Book of Irkutsk region aggravates the situation. Currently, the level of environmental impact is so high, that it can cause a serious threat to environmental safety. Therefore, the issue requires an immediate solution. In addition, the process of removing lands of other categories from the protected areas requires urgent completion.

Lands, that before the creation of regional protected areas have been used by the local population,were included in the structure of protected areas without their alienation and removing them from the traditional economic use (arable land, hayfields and pastures). The distribution of lands in protected areas is presented in table 4.

Table 4. Land distribution of protected areas by land of Irkutsk province, on 01.01.2017 (Rosreestr Management, 2017).

№ п/п	Name of land in the protected areas	Area, thousand hectares	% of the total area of protected lands
1	Agricultural land	4,4	0,28
2	Land under forests	1188,9	76,58
3	Forest plantations not included in the forest Fund	0,3	0,02
4	Land under roads	1,4	0,09
5	Building land	0,3	0,02
6	Land under water	13,9	0,90
7	The land under the marshes	12,1	0,78
8	Other lands	331,1	21,32
	Subtotal	1552,4	100

Similarly, the lands of protected areas can be part of the land' structure of other land's categories. So, 01.01.2017 at the composition of land of settlements their area amounted to 40.7 thousand hectares.

1.1.1 The issue of ownership of land plots has not been resolved. So, in Federal ownership there are lands of protected areas, which area consist 660.1 thousand hectares (or 42.5% of the total area of protected lands).

There is 0.5 thousand hectares of land for recreational purposes in municipal and private property. In private ownership now is 0.3 thousand hectares, including; in property of citizens - 0.1 thousand hectares, in property of legal entities – there is 0.2 thousand hectares.

The special legal regime of the lands of the protected areas provides for a prohibition to the privatization of the land plots within the reserves and national parks, full or partial withdrawal from the turnover of land plots of the protected areas, the transfer of land plots from the category of protected lands areas to the lands of other categories. Meanwhile, the owner can not be aware of the protected status of their land, so as the Federal law № 221-FZ does not contain of special rules that oblige of the state cadastral registration authority to reflect information about full or partial location of the land plots in the composition of protected areas or it's surrounding protected zones when issuing cadastral information about certain land plot is providing to their owners (Documents of Ministry of economic development, Russia, 2005; Roszemkadastr, RU, 2004a).

There are also some questions in determining of the specific indicator of the cadastral value (SICV) of protected areas. To determine the land valuation of protected areas 2 groups of land have been allocated (Roszemkadastr. 2004b). The first group include the lands of specially protected natural areas (with the exception of lands of therapeutic areas and resorts), land for environmental purposes, land for historical and cultural purposes, land plots with educational and tourist trails, especially valuable land). In the second group there are land of recreational purposes (except for land plots on with educational and tourist trails), the land of therapeutic areas and resorts.

The land plots of the first group are excluded from the economic turnover by law, they can not be the subject of privatization and they are significantly limited in the lands turnover (Code of laws of RF, 2001). For this group the specific indicator of cadastral value (SICV) is calculated on the cost of the grounds (farmlands), which are occupying the greatest area in structure of protected lands (for example, agricultural or forest lands), taking into account of the ecosystem'value coefficient (Kev) and coefficient of biodiversity uniqueness (Kbu), characterizing of the share of plants and animals species,listed in the Red Book of the Russian Federation. At the evaluation of the second group of lands the market method of evaluationis applied (Roszemkadastr. 2004b).

Average specific indicator of cadastral cost of protected lands in the Irkutsk region for the first group is 3.24. RUB/m^2, for the second - 336,53 RUB/m^2 (Rosreestr Management, 2017). The cost of the protected lands of Irkutsk region as part of the Siberian district is shown at the figure 2.

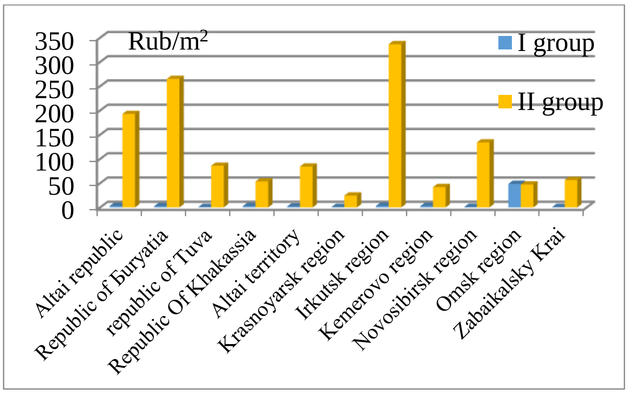

Figure 2. Average specific indicator of cadastral cost of protected lands in Sibirian region Rub/m2 (Rosreestr Management, 2017) Note: for the Tomsk region no information was available

Today, the features of the organization and cadastral registration of protected areas are solved with using of modern information technologies.

In 2012, the information and analytical system "Specially protected natural areas of Russia" (IAS "SPNA RF") was created, which contributes to implementation of following tasks:

1) to unite within the framework of a single information system of knowledge about specially protected natural areas of different status (Federal, regional, local), with access to editing and updating of protected areas data;

2) to provide of the inventory of protected areas;

3) to provide an information and cartographic support in monitoring of protected areas.

The GIS tools for cadastre and assessment are being improved. An electronic Map of protected areas of Russian Federation have been created. Now it's working on the basis of software of "JAVASCRIPT". Now the problems encountered by users whose browsers did not support Silver Light are eliminated. In the near future there will be a guide to work with an electronic map, and maps in the sections "biodiversity" and "climate", will also be transferred to the control of JAVA SCRIPT.

In the ASI «Protected areas of the Russian Federation» also added a new tool "Text parsing". It is designed to process text documents to search for species names in them and the formation of appropriate lists of species in MS Excel format.

CONCLUSION

Our study revealed the following current problems:

- inventory of existing objects of the network of protected areas to identify their exact location, status and a complete description;
- determination of the cadastral value of protected areas;
- completion of the land's transfer of another category or another activity from the lands of protected areas;
- improvement of methodological and theoretical bases of cadastral evaluation of protected land areas, taking into account their soil cover characteristics;
- creation of the Red Book of soils of the Irkutsk region;
- inventory creation of the reference standard and disappearing soils for preservation of unique ecosystems and management of natural resources of the Irkutsk province.

Thus, the issues of cadastral registration and valuation of lands of specially protected natural areas are still debatable today. The importance of their solutions for the conservation of natural resources and biodiversity justify the urgent needless for development and application of a new methodological approaches, which need to be based on modern information technologies, GIS tools and accompanying with legal documents and instructions for their implementation.

At carrying of the cadastral land's evaluation and in determining of specific indicators of their cadastral value (especially for protected land's areas) the information about soils and their properties, also as a characteristics of soil cover should be necessarily taking into account and include in the state real estate cadastre. Assessment of soil cover in the composition of protected areas, as a link between natural and anthropogenic-disturbed and anthropogenic-transformed ecosystems should become an essential component of biodiversity conservation.

Thus, all of the above points strongly justify, that the cadastral evaluation of land protected areas should be highly improved.

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ENHANCED USE OF GIS AND REMOTE SENSING FOR THE RESTORATION MONITORING OF CONSTRUCTION FOOTPRINTS AND PREDICTION OF SOIL EROSION RISKS ALONG PETROLEUM AND GAS PIPELINES

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ABSTRACT:

The main goal of this research was to perform vegetation cover restoration and soil erosion risk assessment based on multi-temporal NDVI monitoring and deterministic USLE erosion prediction model along Baku–Tbilisi–Ceyhan Oil and South Caucasus Gas pipelines. The categorization of NDVI derived from IKONOS 2007 and PLEIADES 2012 high-resolution multispectral satellite images into the bare lands, sparse and dense vegetation revealed the positive vegetation cover restoration along oil and gas pipelines. USLE model run with cover-management factor derived from PLEIADES NDVI 2012 showed higher number of polygons with predicted erosion class of ‘0–10 ton/ha’ which is acceptable and not critical to pipelines. For higher erosion classes more than ‘0–10 ton/ha’, USLE model run with IKONOS NDVI 2007 revealed higher number of polygons. Therefore, the predicted erosion rates more than 10 ton/ha reduced in 2012, which is a positive factor. USLE model run predicted 37 % of total number of erosion occurrences identified during 2005–2014.

KEY WORDS: NDVI, USLE, PLEIADES, IKONOS, BTC, SCP, Erosion

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1. INTRODUCTION

The construction of Baku–Tbilisi–Ceyhan (BTC) Oil and South Caucasus (SCP) Gas pipelines was completed in 2005 and 2006, respectively. Both pipelines are underground with the average depth cover of 1.5 m, therefore the process of their construction significantly disturbed vegetation and soil cover along the 44-m wide and 443-km long pipeline corridor in Azerbaijan. BTC and SCP pipelines pass parallel to each other within 44-m wide corridor of pipelines. After the completion of construction which results in the disturbed vegetation cover along the corridor of pipelines, one of the risks is severe erosion which can lead to the removal of backfill to depths of several meters and exposure of pipe (Morgan *et al.* 2004). Considering the length of 443 km of pipeline section in Azerbaijan, it is very costly to maintain regular in situ visual inspections of erosion occurrences along the corridor of pipelines by human beings. Therefore, there is a necessity for running of the erosion models to make preliminary prediction of sites vulnerable to soil degradation processes. This would significantly contribute to the planning of erosion control measures because the verification of the particular sites (Duzant 2008) is more sophisticated than the regular widespread patrolling of 443-km long corridor of pipelines. GIS-based assessment and spatial prioritization of erosion risks is an important instrument for planning of natural resources management through the implementation of correct environmental monitoring and management strategies with long-term sustainability (Beskow *et al.* 2009). The general goal of this research was to perform the soil erosion risk assessment based on multi-temporal NDVI monitoring and deterministic USLE erosion prediction model along BTC Oil and SCP Gas pipelines.

The detailed goals of this research are following:
1. Quantification of bare lands, sparse and dense vegetation cover based on multi-temporal NDVI analysis along oil and gas pipelines

2. Prediction of soil erosion-prone areas along oil and gas pipelines based on cover-management factors derived from IKONOS NDVI 2007 and PLEIADES NDVI 2012

2. MATERIAL AND METHODS

Quantitative assessment of vegetation restoration along oil and gas pipelines

Spectral indices of vegetation derived from satellite images in the near-infrared and visible wavebands are widely used as measures of green vegetation density (Townshend and Justice 1986). The most commonly used index is the Normalised Difference Vegetation Index (NDVI). Quantification of bare lands, sparse and dense vegetation cover was performed based on multi-temporal NDVI analysis along oil and gas pipelines. NDVI was derived from IKONOS 2007 and PLEIADES 2012 high-resolution multispectral satellite images. The NDVI was reclassified in accordance with following classes: 0–110 (bare lands), 110–160 (sparse vegetation), 160–200 (dense vegetation).

USLE erosion prediction model along oil and gas pipelines

The upland erosion model used in the research is the USLE applied to the corridor of pipelines (Wischmeier and Smith 1978). USLE model was selected to be used in this research because of several reasons: its relative simplicity, the possibility in using of quite basic data, previous studies by Morgan *et al.* (2004) for determination of terrain units prone to erosion processes along Georgia BTC pipeline section (Morgan et al. 2004).

3. RESULTS AND DISCUSSION

Quantified bare lands, sparse and dense vegetation cover

The categorized IKONOS NDVI 2007 and PLEIADES NDVI 2012 allowed to observe 3.86 and 9.88 km^2 of bare land, respectively (Figure 1; 2). Therefore, the coverage of bare lands significantly decreased in 2012 which is a positive factor. The sparse vegetation increased to 15.34 km2 in 2012 relative to 9.58 km^2 in 2007. Therefore, the coverage of sparse vegetation as grasslands, scrubs and senescing crops increased in 2012. The area of dense vegetation as crops at peak season or trees also showed the increase in 2012. It is also possible to observe the general increase in the NDVI values of 2012 relative to 2007. The distribution of higher NDVI values was also observed in 2012 within croplands, grasslands/scrublands and industrial land-use classes. Therefore, this revealed the positive restoration of vegetation cover along oil and gas pipelines.

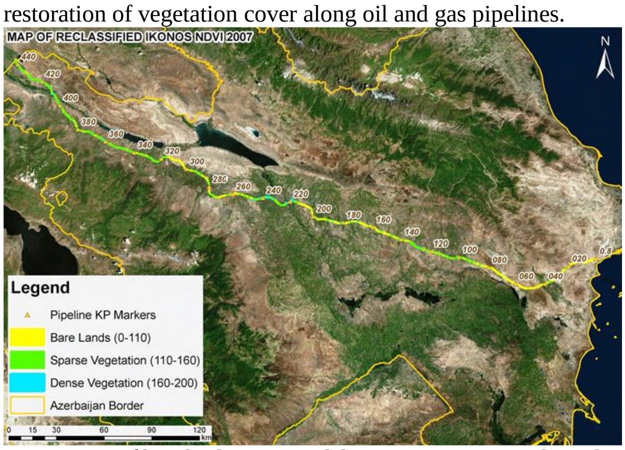

Fig.1 Map of bare lands, sparse and dense vegetation cover derived from NDVI 2007

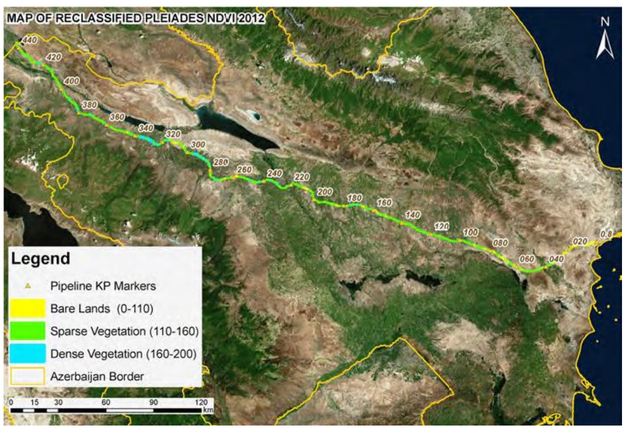

Fig. 2 Map of bare lands, sparse and dense vegetation cover derived from NDVI 2012

Prediction of erosion-prone areas along oil and gas pipelines

The maps for USLE model runs with C-factors of 2007 and 2012 and recommended average annual C-factors are presented in Figure 3 and Figure 4. USLE model run with C-factor computed from NDVI 2012 for grasslands/scrublands and recommended average annual C-factors by Wischmeier and Smith (1978) and Morgan (2005) for cultivated lands showed higher number of polygons with erosion class of ‘0–10 ton/ha’.

According to Morgan et al. (2004), the erosion rate of ‘0–10 ton/ha’ is considered as acceptable and not critical to pipelines. For higher critical erosion classes, USLE model run with C-factor computed from NDVI 2007 for grasslands/scrublands and recommended average annual C-factors by Wischmeier and Smith (1978) and Morgan (1995) for cultivated lands revealed larger number of polygons. Therefore, the predicted erosion rates more than 10 ton/ha reduced in 2012, which is a positive factor.

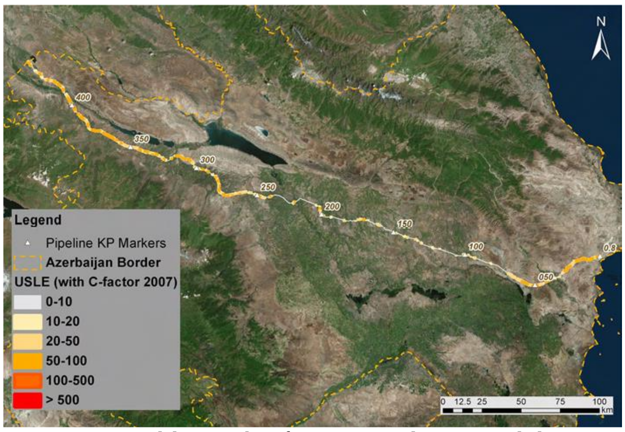

Fig. 3 USLE model run with C-factor 2007 and recommended average annual C-factors

Fig. 4 USLE model run with C-factor 2012 and recommended average annual C-factors

4. CONCLUSIONS

1. The categorized PLEIADES NDVI 2012 and IKONOS NDVI 2007 allowed to observe 3.86 and 9.88 km2 of bare land, respectively. The coverage of bare lands significantly decreased in 2012 which is a positive factor. The sparse vegetation increased to 15.33 km2 in 2012 relative to 9.58 km2 in 2007. Therefore, the coverage of sparse vegetation as grasslands, scrubs and senescing crops increased in 2012. The area of dense vegetation as crops at peak season or trees also showed the increase in 2012. The spatial distribution of PLEIADES NDVI 2012 values was observed to be higher relative to IKONOS NDVI 2007 within croplands, grasslands/scrublands and industrial land-use classes. Therefore, this reveals the positive trend for the restoration of vegetation cover along oil and gas pipelines and reduced risks from erosion processes.

2. The USLE model run with C-factor of 2012 and recommended average annual C-factors for cultivated lands showed higher number of 10-m section polygons with erosion class of ‘0–10 ton/ha’ which is acceptable and not critical to pipelines. For higher critical erosion classes, USLE model run with C-factor 2007 revealed larger number of 10-m section polygons along pipelines. Therefore, the predicted erosion rates more than 10 ton/ha reduced in 2012, which is a positive factor.

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COMPARISON OF IMU PARAMETERS OBTAINED FROM DIGITAL AIR PHOTOGRAPS WITH DIFFERENT SPECIFICATIONS

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ABSTRACT:

Digital orthophoto maps are numerical products that combine the accuracy of maps and readability of aerial photographs. They are prepared using colored or black and white digital aerial photographs and they have a fixed scale like maps. Digital orthophotos offer more flexible, cost-effective, and higher-quality outputs than classical methods. Today, the need for up-to-date maps is increasing in almost every field, and as an alternative to classical methods, orthophoto maps meeting the criteria of accuracy and precision of a standardized map are mostly preferred in a wide range of applications. However, the geometrical accuracy of orthophoto mosaics used in geomatics applications is of even greater importance.
In this study, three different orthophoto mosaic images were produced by using digital aerial photographs of 7 cm, 15 cm and 25 cm ground sample distance taken in 2011 of Aksaray University campus area and the root mean square errors for the "ω, φ, and Ϗ" IMU parameters of these images were calculated after triangulation and compared with the values recommended according to international standards. For IMU values in the direct referencing system in the a-priori standard deviations during photogrammetric triangulation for photogrammetric blocks in international standards; It is recommended that root mean square error of ω, φ, Ϗ $\leq 0°.010$. When the IMU values are calculated for three different sample distance, it is seen that the results are very close and below the recommended values. Therefore, it was seen that IMU values for orthophoto mosaic images produced at 7 cm, 15 cm and 25 cm ground sample distance gave close results to each other and these orthophoto mosaics can be used as bases in various studies where too much accuracy is not desired.

KEY WORDS: Accuracy, Ground sample distance, IMU parameters, Root mean square error

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1. INTRODUCTION

With the latest advances in technology, images obtained by digital aerial cameras contain many of the advantages that satellite imagery has. At the same time, digital air photos with higher spatial resolution and positional accuracy can be produced in these days, which can be used in many different areas, even conditions in high-resolution satellite images are insufficient. In addition, in studies with the use of aerial photographs taken by digital aerial cameras and the integrated GNSS-IMU (Inner Measurement Unit) systems, fewer ground control points are needed than analog photographs. So, the geodetic activities approximately significantly reduced (Yildiz, 2015; Cankurt, 2016).

During flight, if the GPS and IMU are available in the aerial vehicle, GPS records the camera coordinates (X, Y, Z) and IMU records the camera orientation (omega, phi, kappa) of image exposure. Both parameters merged into Exterior Orientation (EO) parameters (Rizaldy and Firdaus, 2012).

This parameters required for next steps in the photogrammetric projects, such as DTM generation, orthorectification and orthophoto mosaic. For accuracy of orthophoto mosaics, the IMU parameters are very important.

High position and velocity accuracy, precise attitude determination, high data rate, navigational output during GPS signal outages, cycle slip detection and correction are some advantages of GPS/IMU integration (Wegmann, 2002).

In this study, three different triangulation were done by using digital aerial photographs of 7 cm, 15 cm and 25 cm ground sample distance taken in 2011 of Aksaray University campus area in "Erdas LPS" software and the root mean square errors for the "ω, φ, and K" IMU parameters of these images were calculated after triangulation and compared with the values recommended according to international standards. Then, three orthophoto mosaic images were produced of the study area.

2. MATERIAL AND METHODS

For the study, digital aerial photographs that have 7 cm, 15 cm and 25 cm ground sample distances in 2011 of study area were available. The number of digital photographs taken was 106 for 7 cm ground sample distance, 38 for 15 cm and 40 for 25 cm. The interior and exterior orientation parameters were obtained from the calibration report of the "Intergraph DMC" digital aerial camera. In addition, 32 ground control points distributed across the region, and the coordinates were available. The study area (Aksaray University Campus Area) is shown in Figure 1 and distribution of these points are shown in Figure 2.

Figure 1. Study area: Aksaray University Campus area

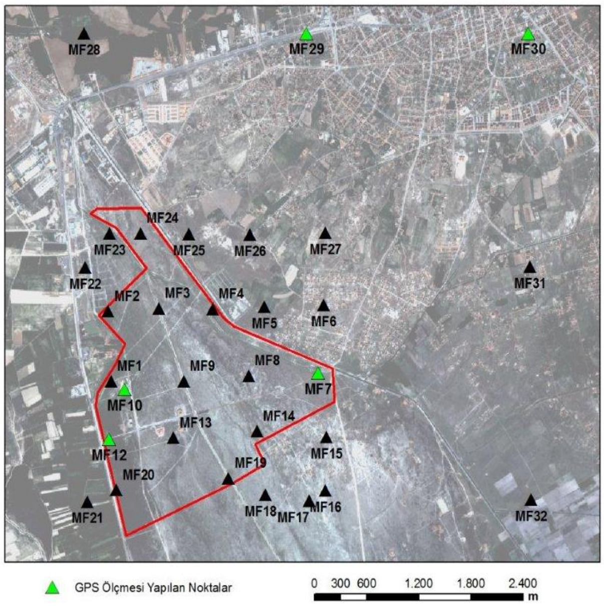

Figure 2. Distribution of ground control points in the study area.

The exterior orientation parameters for digital aerial photographs with7 cm is shown Figure 3.

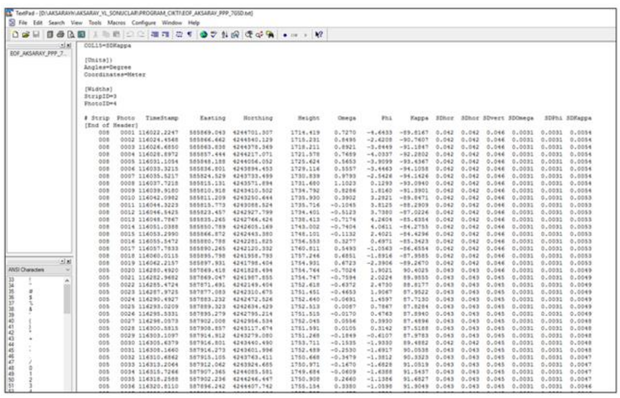

Figure 3. The exterior orientation parameters for digital aerial photograps with 7 cm GSD.

For digital aerial photographs with 15cm and 25 cm GSD, the exterior orientation parameters are available.

After triangulation, the triangulation reports and exterior orientation parameters in report for each GSD are obtained.

For 7 cm GSD, the triangulation report is shown in Figure 4.

```
THE OUTPUT OF BUNDLE BLOCK ADJUSTMENT WITH ROBUST BLUNDER CHECKING


  the no. of iteration =1    the standard error =  0.2110
  the maximal correction of the object points =  19.18030

  the no. of iteration =2    the standard error =  0.2112
  the maximal correction of the object points =   0.02191

  the no. of iteration =1    the standard error =  0.2094
  the maximal correction of the object points =   0.08035

  the no. of iteration =2    the standard error =  0.2084
  the maximal correction of the object points =   0.07854
```

Figure 4. The triangulation report for 7 cm GSD.

For 15 cm GSD, the triangulation report is shown inFigure5.

```
THE OUTPUT OF BUNDLE BLOCK ADJUSTMENT WITH ROBUST BLUNDER CHECKING

  the no. of iteration =1    the standard error =  6.8618
  the maximal correction of the object points =  22.76024

  the no. of iteration =2    the standard error =  7.0564
  the maximal correction of the object points =  14.21542

  the no. of iteration =3    the standard error =  7.0720
  the maximal correction of the object points =   0.43941

  the no. of iteration =1    the standard error =  0.6179
  the maximal correction of the object points = 134.12067

  the no. of iteration =2    the standard error =  0.1797
  the maximal correction of the object points = 118.55876

  the no. of iteration =3    the standard error =  0.1470
  the maximal correction of the object points =  20.73105

  the no. of iteration =4    the standard error =  0.1338
  the maximal correction of the object points =  10.64402

  the no. of iteration =5    the standard error =  0.1251
  the maximal correction of the object points =   7.93152

  the no. of iteration =6    the standard error =  0.1202
  the maximal correction of the object points =   2.27046

  the no. of iteration =7    the standard error =  0.1174
  the maximal correction of the object points =   5.88116

  the no. of iteration =8    the standard error =  0.1162
  the maximal correction of the object points =   1.64403
```

Figure 5. The triangulation report for 15 cm GSD.

For 25 cm GSD, the triangulation report is shown in Figure 6.

```
THE OUTPUT OF BUNDLE BLOCK ADJUSTMENT WITH ROBUST BLUNDER CHECKING


  the no. of iteration =1    the standard error =  0.1317
  the maximal correction of the object points =   0.42603

  the no. of iteration =2    the standard error =  0.1317
  the maximal correction of the object points =   0.00001

  the no. of iteration =1    the standard error =  0.1310
  the maximal correction of the object points =   0.04221

  the no. of iteration =2    the standard error =  0.1310
  the maximal correction of the object points =   0.00001
```

Figure 6. The triangulation report for 25 cm GSD.

After the calculation of IMU parameters, orthophoto mosaic images were generated at three different sample distances of the study area in “ERDAS LPS” software.

The produced orthophoto mosaic images are shown in Figure 7 for 7 cm GSD, Figure 8 for 15 cm GSD and Figure 9 for 25 cm GSD.

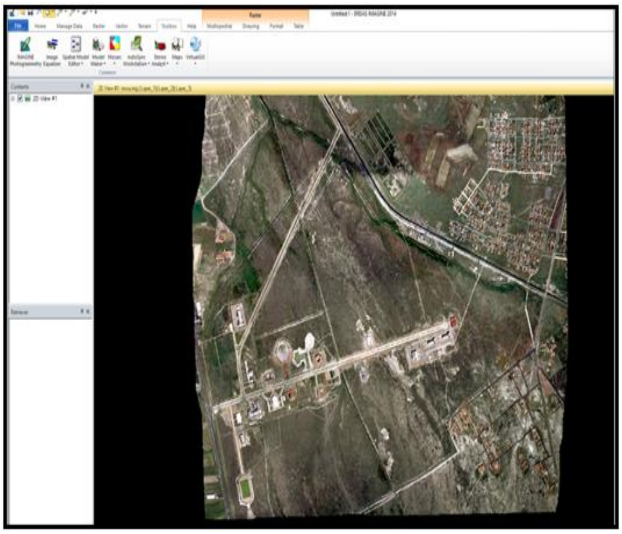

Figure 7. The orthophoto mosaic image of study area with 7 cm GSD.

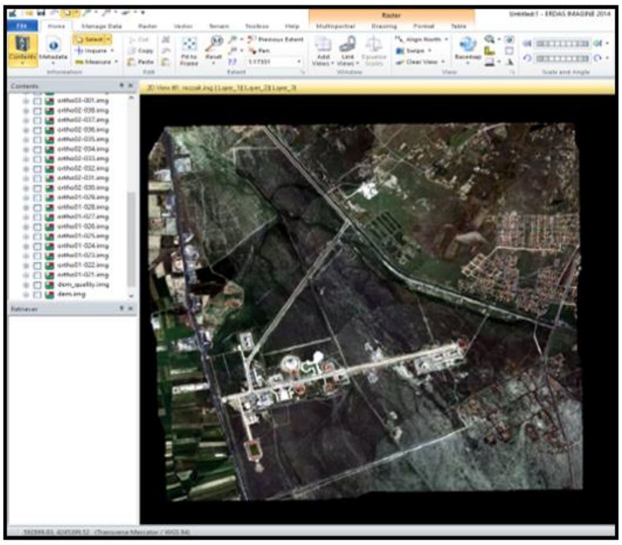

Figure 8. The orthophoto mosaic image of study area with 15 cm GSD.

Figure 9. The orthophoto mosaic image of study area with 25 cm GSD.

3. CONCLUSIONS

After triangulation, the root mean square errors for the "ω, φ, and K" IMU parameters of these images were calculated and compared with the values recommended according to international standards.

For IMU values in the direct referencing system in the a-priori standard deviations during photogrammetric triangulation for photogrammetric blocks in international standards (default data set); It is recommended that root mean square errors of ω, φ, $K \leq 0°.010$.

The IMU values were calculated for three different sample distance and the results were as follows:

For 7 cm ground sample distance the root mean square errors; $\sigma\omega = 0°.0144$, $\sigma\varphi=0°.0147$, $\sigma K = 0°.0115$ were found.

For 15 cm ground sample distance the root mean square errors; $\sigma\omega = 0°.0179$, $\sigma\varphi=0°.0123$, $\sigma K = 0°.0128$ were found.

For 25 cm ground sample distance the root mean square errors; $\sigma\omega = 0°.0004$, $\sigma\varphi=0°.0006$, $\sigma K = 0°.0012$ were found.

In the study, it was seen that for three different sample distance IMU values' root mean square errors close to each other. And the results were very close to and below the recommended values by a-priori standard deviations during photogrammetric triangulation for photogrammetric blocks in international standards (default data set).

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COMPARISON OF POINT ACCURACIES ON DIGITAL ELEVATION MODEL OBTAINED FROM DIGITAL AIR PHOTOGRAPS WITH DIFFERENT SPECIFICATIONS

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ABSTRACT:

Photogrammetry is a map production technique or science applied by measurements made from terrestrial images with terrestrial cameras or more commonly used images taken with airborne cameras. With the development of technology, digital photogrammetry has been widely adopted in almost all areas of mapping. Especially digital orthophotos and digital elevation models, which are photogrammetric products, are being intensively utilized by the private sector due to their easy interpretability. Digital photogrammetry is also a good method to automatically collect digital elevation models. Digital elevation model production is an important process in photogrammetry. A digital elevation model is an important product by itself as well as plays an important role in creating products such as orthophoto. The geometrical accuracy of digital elevation model used in geomatics applications is of even greater importance. In this study, three different digital elevation models were produced using digital aerial photographs of 7 cm, 15 cm and 25 cm ground sample distance taken in 2011 of Aksaray University campus area. Then, by using the heights measured by gps and read the same heights from the digital elevation model, root mean square errors of ground control points, check points and tie points were calculated and compared with recommended standards. When the results are examined, it is seen that the values were close to and below the recommended values. Therefore, it can be seen that the digital elevation models produced with the aerial photographs taken at 7, 15 and 25 cm ground sample distances can be used for studies that do not require much sensitivity.

KEY WORDS: Accuracy, Digital elevation model, Ground sample distance, Root mean square error

* Corresponding author. This is useful to know for communication with the appropriate person in cases with more than one author.

1. INTRODUCTION

Photogrammetry is a map production technique or science applied by measurements made from terrestrial images with terrestrial cameras or more commonly used images taken with airborne cameras. The basic data produced by photogrammetric methods are topographic vector maps, orthophoto maps, digital terrain models, and digital elevation model data, which have varying scales. Aerial photographs and satellite images are the most used sources for the production and revision of this type of data and current maps (Özbalmumcu, 2007).

With the development of technology, digital photogrammetry has been widely adopted in almost all areas of mapping. Especially digital orthophotos and digital elevation models, which are photogrammetric products, are being intensively utilized by the private sector due to their easy interpretability (Rabiu and Waziri, 2014).

Digital photogrammetry is also a good method to automatically collect digital elevation models. Digital elevation model production is an important process in photogrammetry. A digital elevation model is an important product by itself as well as plays an important role in creating products such as orthophoto. The geometrical accuracy of digital elevation model used in geomatics applications is of even greater importance.

DEM is a quantitative representation of the Earth terrain which gives basic information about its relief and elevations.

Choosing a correct DEM accuracy and quality is important to ensure that a orthophoto produced with DEM generated is accurate and precise.

In the European Union countries, the accuracy of the digital elevation model is derived from the check points. The accuracy for the digital elevation model under the instruction of "Assessment of the Quality of Digital Terrain Models" issued by EuroSDR (European Spatial Data Research) is determined according to "0.53 × GSD" for heights (Kapnias, 2008).

According to the national standarts in Turkey (2018), the accuracy for the check points should be smaller than ± 0.75 × GSD for "x" and "y" coordinates (BÖHHBÜY, 2018).

In the "Accuracy Standards for Digital Geospatial Data, March, 2014" issued by the American Society for Photogrammetry and Remote Sensing (ASPRS), the accuracy of ground control points is classified according to the method used and accuracy. Accordingly, it is recommended that the root mean square errors of the ground control points are less than 0.00625 × map scale formula for Class I studies that require very high accuracy (ASPRS, 2014).

This paper presents a case study of generating digital elevation models (DEMs) with digital air photographs of Aksaray University Campus area taken at different ground sample distances and compared the values with recommended standars.

Figure 1 present the campus of Aksaray University, Turkey, in which the current study was undertaken.

Figure 1. Study area: The campus of Aksaray University.

2. MATERIAL AND METHODS

For the study, digital aerial photographs that have 7 cm, 15 cm and 25 cm ground sample distances in 2011 of study area were available. The number of digital photographs taken was 106 for 7 cm ground sample distance, 38 for 15 cm and 40 for 25 cm. The interior and exterior orientation parameters were obtained from the calibration report of the "Intergraph DMC" digital aerial camera. In addition, 32 ground control points distributed across the region, and the coordinates were available. Distribution of these points are shown in Figure 2.

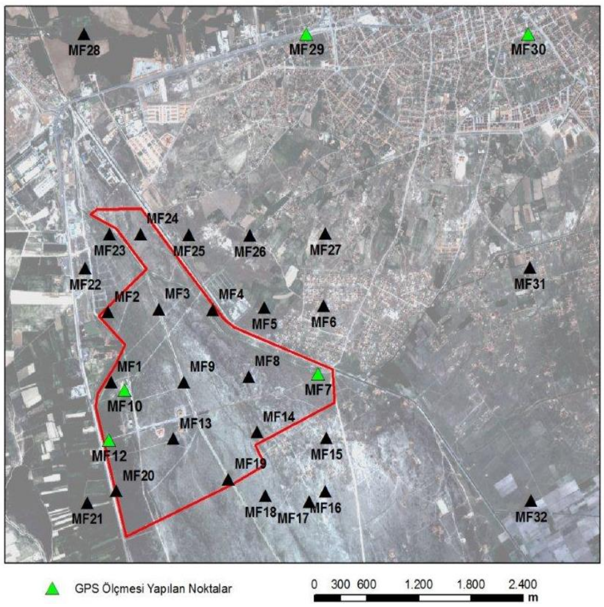

Figure 2: Distribution of ground control points in the study area.

The three different digital elevation models of the study area produced using "Erdas LPS" software based on different ground sample distance of 7 cm, 15 cm and 25 cm are presented in Figures 3 to 5, respectively.

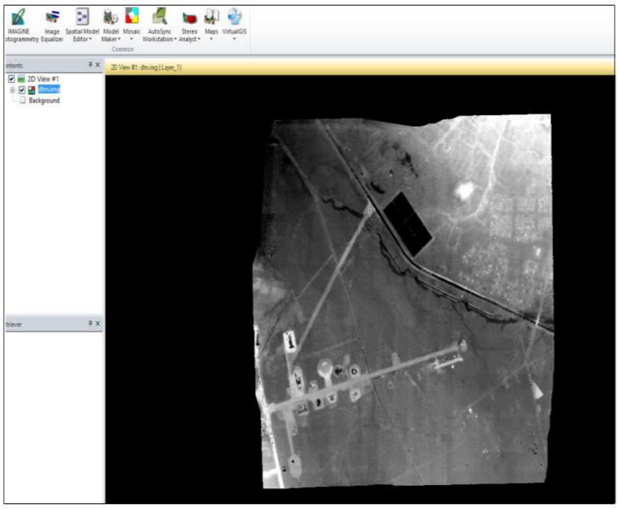

Figure 3: Digital elevation model obtained from 7 cm gsd digital air photographs.

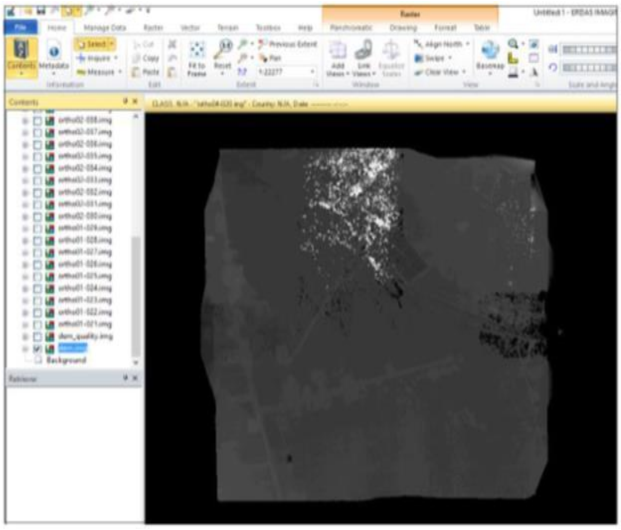

Figure 4: Digital elevation model obtained from 15 cm gsd digital air photographs.

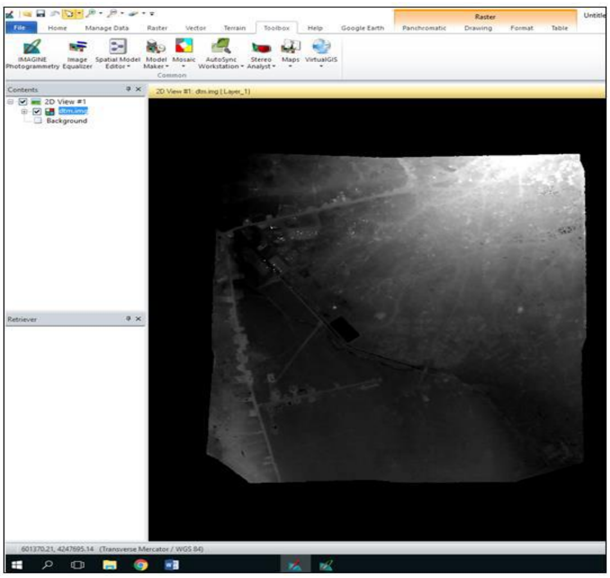

Figure 5: Digital elevation model obtained from 15 cm gsd digital air photographs.

Then, by using the real heights and read the same point's heights from the digital elevation model, root mean square errors of ground control points, check points and tie points were calculated.

In the European Union countries, it is recommended that the check points' accuracy have to be small or equal "0.53 × GSD" for the accuracy of the digital elevation model.

According to the national standarts in Turkey (2018), the accuracy for the check points should be smaller than "± 0.75 × GSD" for "x" and "y" coordinates.

In the "Accuracy Standards for Digital Geospatial Data, March, 2014" issued by the American Society for Photogrammetry and Remote Sensing (ASPRS), the accuracy of ground control points is classified according to the method used and accuracy.

Table 1 presents the horizontal accuracy standards and root mean square errors for digital orthophotos based on this classification.

Table 1. The horizontal accuracy standards and root mean square errors.

Horizontal Accuracy Data Production Class	Photogrammetric Triangulation RMSE.(x), RMSE. (y) (cm)	Ground Control Points RMSE.(x), RMSE.(y), RMSE.(z) (cm)
Class-I	0.0125 × map scale	0.00625 × map scale
Class-II	0.0250 × map scale	0.01250 × map scale
Class-III	0.0375 × map scale	0.01875 × map scale
...	...	...
Class-N	N × 0.0125 × map scale	N × 0.00625 × map scale

3. CONCLUSIONS

Root mean square errors were calculated for the check points, the ground control points, and the tie points in all three sample distances.

The found results and the recommended values were compared as shown in Table 2.

Table 2. The found results and recommended values.

7 cm GSD		
For Check Points	Found value: σz = 16.58 cm (2.4 pixel)	Recommended value: σz= 0.53 × GSD (by EuroSDR) σz= 0.75 × GSD (by national standards)
For Ground Control Points	Found value: σz= 18.92 cm (2.7 pixel)	Recommended value: σz= 0.00625 × map scale (For class I)
For Tie Points	Found value: σz= 17.86 cm (2.5 pixel)	Recommended value: -
15 cm GSD		
For Check Points	Found value: σz = 11.80 cm (0.8 pixel)	Recommended value: σz= 0.53 × GSD (by EuroSDR) σz= 0.75 × GSD (by national standards)
For Ground Control Points	Found value: σz = 20.08 cm (1.3 pixel)	Recommended value: σz= 0.00625 × map scale (For class I)
For Tie Points	Found value: σz = 22.28 cm (1.5 pixel)	Recommended value: -
25 cm GSD		
For Check Points	Found value: σz = 23.25 cm (0.9 piksel)	Recommended value: σz= 0.53 × GSD (by EuroSDR) σz= 0.75 × GSD (by national standards)
For Ground Control Points	Found value: σz = 26.04 cm (1.0 piksel)	Recommended value: σz= 0.00625 × map scale (For class I)
For Tie Points	Found value: σz = 45.67 cm (1.8 piksel)	Recommended value: -

When the results are examined, it is seen that the values are close to and below the recommended values. Therefore, it can be seen that the digital elevation models produced with the aerial photographs taken at 7, 15 and 25 cm ground sample distances can be used for studies that require sensitivity.

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INVESTIGATION OF THE INFLUENCE OF CLIMATE CHANGES TO THE FORMATION OF SURFACE STRUCTURE OF LANDSCAPES BASED ON GIS (AJINOHUR LOWMOUNTAIN AND SURROUNDING AREAS)

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Keywords: Land Surface Temperature - LST, Land Surface Emissivity-LSE), Normalized Difference Vegetation Index-NDVI, Operational Line Imager & Thermal Infrared Sensor (OLI & TIRS), Remote sensing

We used Land Surface Temperature (LST) to study climate changes in this article. LANDSAT 8 satellite, from LANDSAT series, has given lot of opportunities to study the land processes (to study temperature of land, atmosphere, Normalized Difference Vegetation Index and etc.) using remote sensing methods. In this article we calculated LST over Ajinohur lowmountain and surrounding areas, using LANDSAT 8 – Operational Line Imager & Thermal Infrared Sensor (OLI & TIRS) satellite data. The LST was investigated with respect to Normalized Difference Vegetation Index (NDVI) values for different land cover types determined from the Landsat visible and NIR channels. In this study we used an ERDAS IMAGINE image processing method using the LANDSAT 8 thermal imagery of band 10 and band 11 data. The difference between retrieved LST and Meteorological Stations data indicates that the technique works by giving an error of ±3ºC.

As a result of processing of The Center for Hydrometeorology & Remote Sensing's data were compiled on average monthly and yearly precipitation and analyzed results for the area.

The total area of Ajinohur low mountainous area and the surrounding areas is 4 476 km². 12% (545 km²) of them are the mountainous semideserts, 65% (2 892 km²) are the dry steps, 7% (312 km²) are the arid forests and shrub landscapes, while16% (726 km²) are the forest landscape of plains (Figure 1).

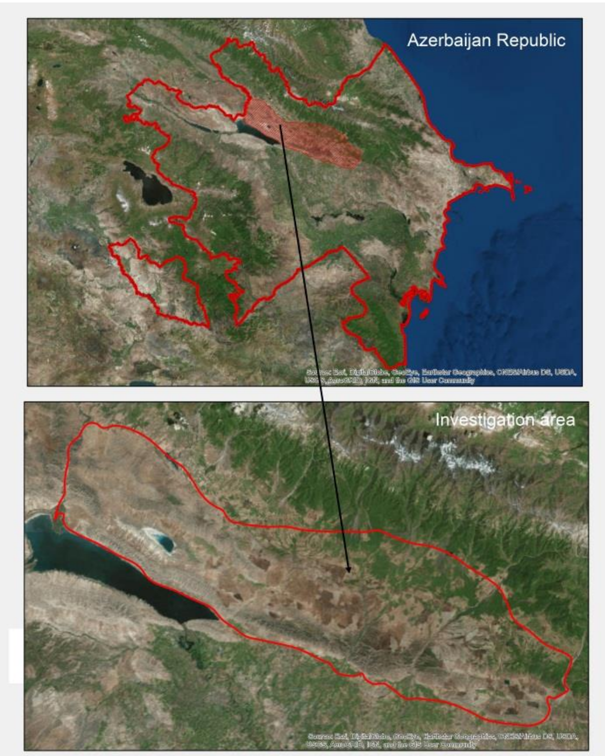

Figure 1. The investigation area

Methodology. In order to determine the anthropogenic transformation and differentiation, the following cartographic sources are used by us.

- Landscape Map of Ajinohur (scale: 1:100 000);
- Topographic Maps of Azerbaijan (scale: 1:100 000);
- Google Earth Maps.
- Landsat 8 sattelite data
- ERDAS IMAGINE

A.S.Ayubov, Q.A. Hajiev (1984), A.Madzetzade (1960), A.M.Shikhlinski (1969) and others studied climate of this area. But we have learned based on modern research methods.

This technique can only be used to process LANDSAT 8 data. In this study, band 10 is used to estimate brightness temperature and bands 4 and 5 are used to calculate NDVI.

First of all, we converted the original DNs of TIRS into Top of Atmospheric Radiance (TOAr). Therefore, the original digital numbers (DN) of LANDSAT 8 TIR bands were converted into radiance based on the methods provided by Chander and Markham (2003) and the LANDSAT 7 Science Data Users Handbook (2006). We used the following equation 1 to convert original DNs into TOAr as shown below:

$$TOAr = M * DN+B \quad \text{(eq.1)}$$

M - Radiance Multiplier
B - Radiance Add

The M, B values are in the metadata file of Landsat 8 data. Table 1 below shows the parameters that we need for this task.

Table 1.
The metadata of Landsat 8- TIR

	Band 10	Band 11
Radiance Multiplier (M)	0.0003342	0.0003342
Radiance Add (B)	0.1	0.1
K1	774.8853	480.8883

K2	1321.0789	1201.1442

K1 and K2 are parameters of band-specific thermal conversion constant.

After we have got the TOAr values, now we are able to calculate brightness temperature (Filiz Bektaş Balcik, 2013) using the equation 2 below:

$$T_{kelvin} = K2/\ln(K2/TOAr + 1) \text{ (eq.2)}$$

By using K1 (Band-specific thermal conversion constant from the metadata - K1_CONSTANT_BAND_x, where x is the band number, 10 or 11) and K2 (Band-specific thermal conversion constant from the metadata - K2_CONSTANT_BAND_x, where x is the band number, 10 or 11) parameters, we have converted the TOAr values into temperature in degrees kelvin .

To calculate temperature map we did the following sequence:

Raddiance → Sattemp → Cell statistics → Proveg → LSE (Land Surface Emissivity) → LST (Land Surface Temperature)

Rainfall data have been got from the database of the Hydrometeorology and Remote Sensing Center (Center for Hydrometeorology and Remote Sensing) and after consistent processing me have made maps. At this time, the grid data of the area was loaded from the site, using the Data Managment tool in the ArcGIS software, the Raster data was converted to point data, and the polygon file was generated from the received results.

Results and Discussion. Climate (temperature, pressure, humidity, precipitation, evaporation) is one of the main natural components that affect landscape differentiation. It affects the differentiation of landscapes indirectly and indirectly as well.

The average annual amount of precipitation was 1085.5 mm in 2003, 748 mm in 2008, 1105 mm in 2013. The precipitation indicator descends to 856.5 mm in 2017 in the area of republic (Figure 2) .

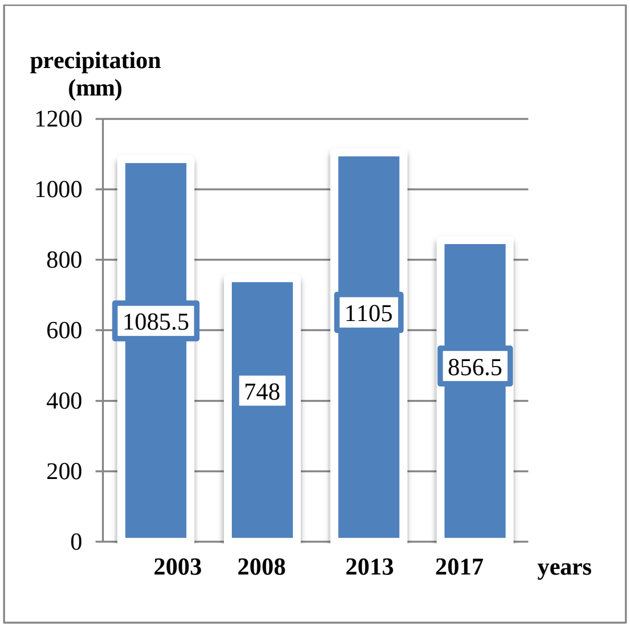

Figure 2. Schedule of five-year precipitation changes in the territory of the Republic of Azerbaijan in 2003-2017

But this amount decreases in the area of investigation. The average annual precipitation was 788 mm in 2003, 744 in 2008, 631 mm in 2013 and 486 mm in 2017 (Figure 3).

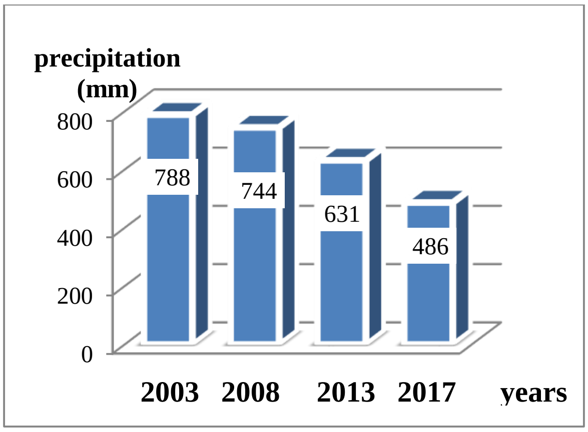

Figure 3. Schedule of five-year precipitation changes in the territory of Ajinohur lowmountain and surrounding areas in 2003-2017

We have prepared five-year precipitation maps and maps of the average monthly precipitation for March, 2017-March, 2018 (Figure 4 and 5).

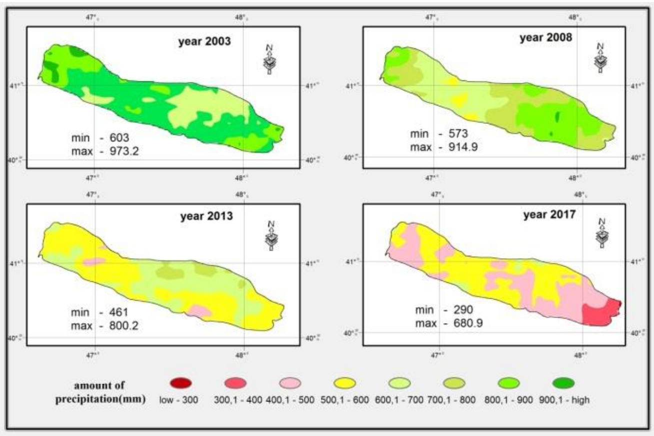

Figure 4. Maps of five-year precipitation changes in the territory of Ajinohur lowmountain and surrounding areas in 2003-2017

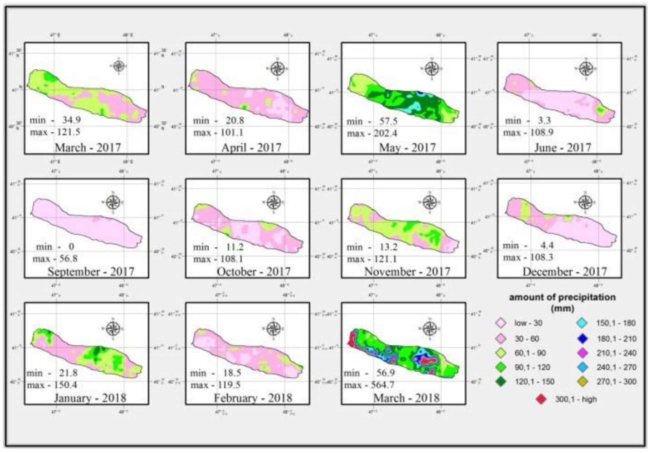

Figure 5. Maps of the average monthly precipitation in the territory of Ajinohur lowmountain and surrounding areas in March, 2017 – March, 2018

While following changes of the average monthly precipitation amount we can see that the highest amount of the precipitation is in January-May. The amount of the average monthly precipitation in March, 2017 increases for three times (from 78 mm to 311 mm) in comparison with March, 2018 (Figure 6).

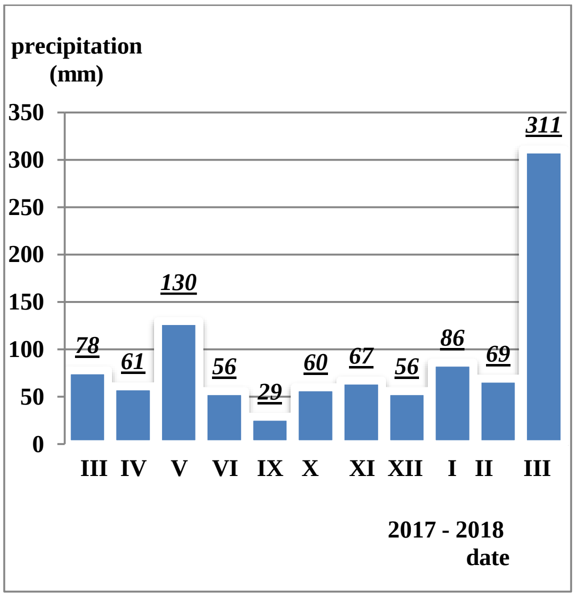

Figure 6. Schedule of the average monthly precipitation in the territory of Ajinohur lowmountain and surrounding areas in March, 2017 – March, 2018

The average annual precipitation in semidesert landscape increased for 40 mm in 2003-2008, but then decreased from 400 mm to 300 mm in 2013- 2017 (Figure 7). Consequently, the driest period was observed in 2017.

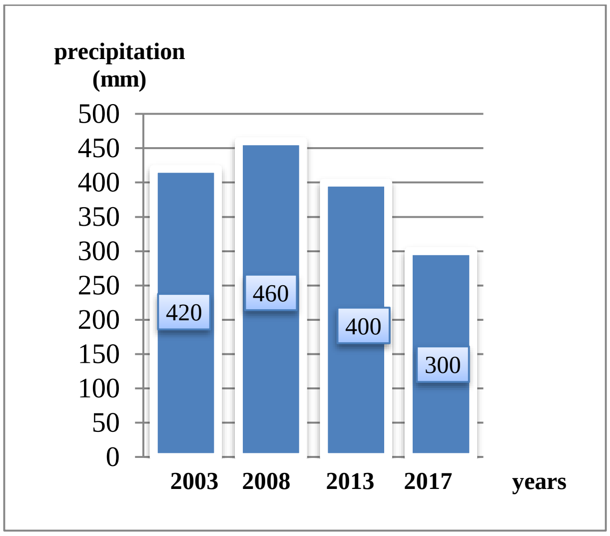

Figure 7. Schedule of five-year precipitation changes in the territory of semidesert landscapes in 2003-2017

As it is seen from below the highest monthly precipitation is in March-May and September-December. If we compare the amount of precipitation, we can see that it increased for three times (Figure 8). Therefore, September was the driest month with the rainfall of 11 mm.

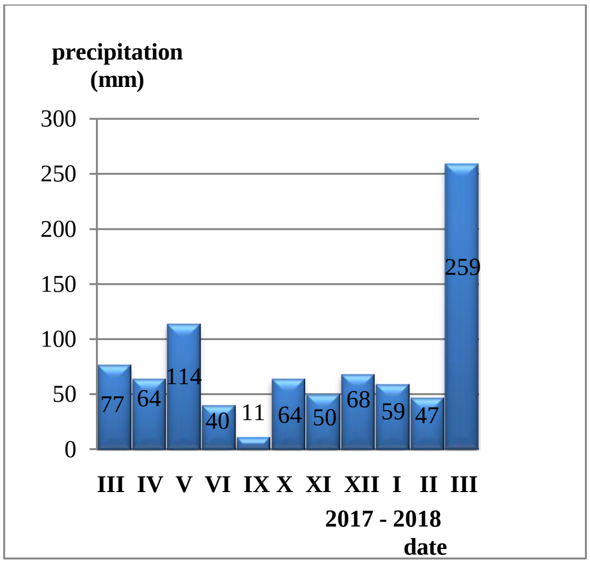

Figure 8. Schedule of the precipitation changes in the territory of semidesert landscapes in March, 2017 – March, 2018

Comparison of the average annual precipitation variations in dry steps landscapes shows that the average annual precipitation decreased for 80 mm in 2008 than in 2003. However, it increased to 743 mm in 2013, decreased to 450 mm in 2017 (Figure 9). Thus, the driest period among these years was 2017.

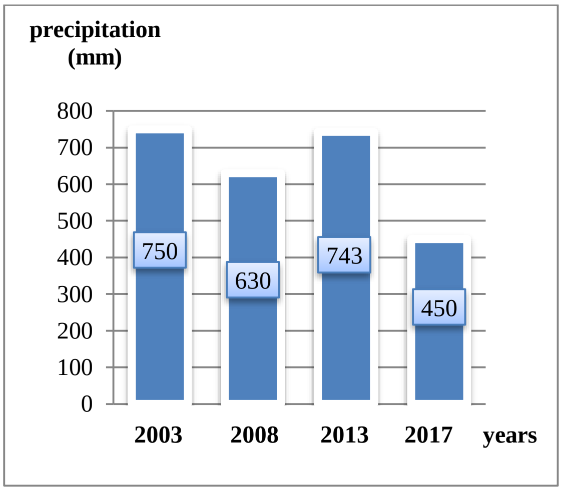

Figure 9. Schedule of five-year precipitation changes in the territory of dry steps landscapes in 2003-2017

According to the diagram of the average monthly precipitation in 2017-2018, the highest precipitation period was in March-May, 2017 and December, 2017-February, 2018. (Figure 10). If we compare March, 2017 and March, 2018 we can see that the average monthly precipitation increased for four times. In dry deserts, September is considered to be a dry month with the rainfall of 15 mm.

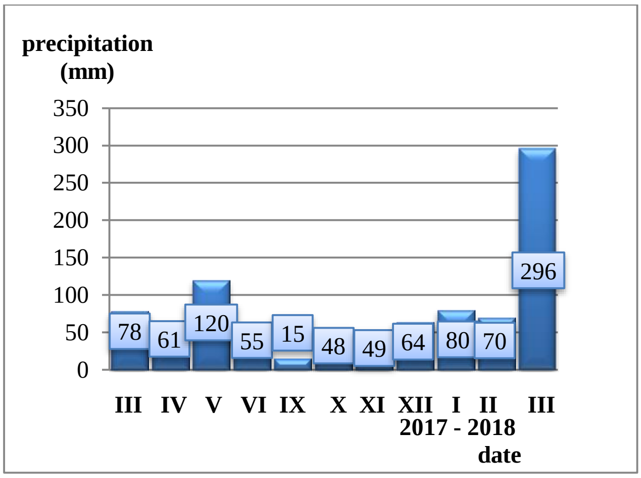

Figure 1. Schedule of the precipitation changes in the territory of dry steps landscapes in March, 2017 – March, 2018

In arid forests, the average annual precipitation was 802 mm in 2003 and 585 mm in 2008, 766 mm in 2013, 473 mm in 2017 (Figure 11). Thus, the driest year was 2017.

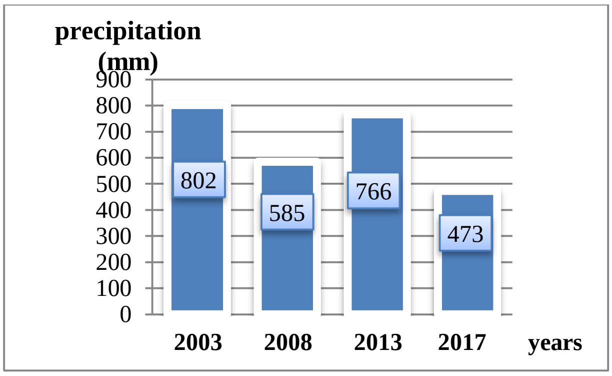

Figure 11. Schedule of five-year precipitation changes in the territory of arid forest landscapes in 2003-2017

When considering the average monthly precipitation in 2017-2018 we can see that most precipitation in arid forests was observed in March-May, 2017 and December, 2017 – February, 2018. The least precipitation was in September with the rainfall of 5 mm (Figure 12).

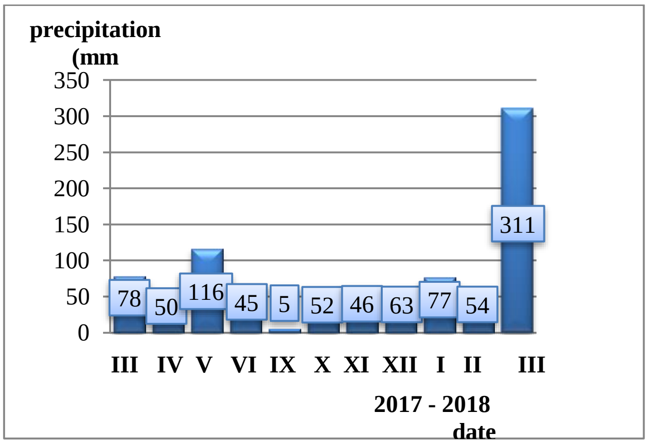

Figure 12. Schedule of the precipitation changes in the territory of arid forest landscapes in March, 2017 – March. 2018

There was no significant change in the amount of precipitation in plain forest lanscape in 2003-2013. Thus, the average annual precipitation was 713 mm in 2003, 659 mm in 2008 and 768 mm in 2013. Therefore, comparatively with the previous years 2017 is considered to be the driest year with the rainfall of 555 mm (Figure 13).

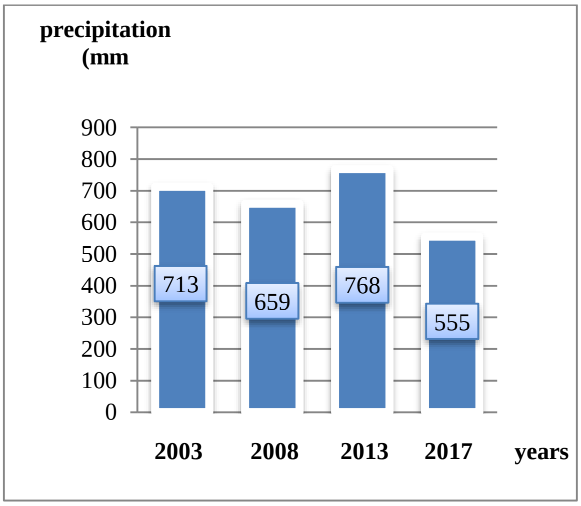

Figure 13. Schedule of five-year precipitation changes in the territory of plain forest landscapes in 2003-2017

When considering precipitation changes in these landscapes in 2017-2018, it is clear that the most precipitation was observed in March, May, December, 2017 and January, 2018. In March, 2018 the average monthly amount of precipitation increased for four times in comparison with March, 2017 (Figure 14).

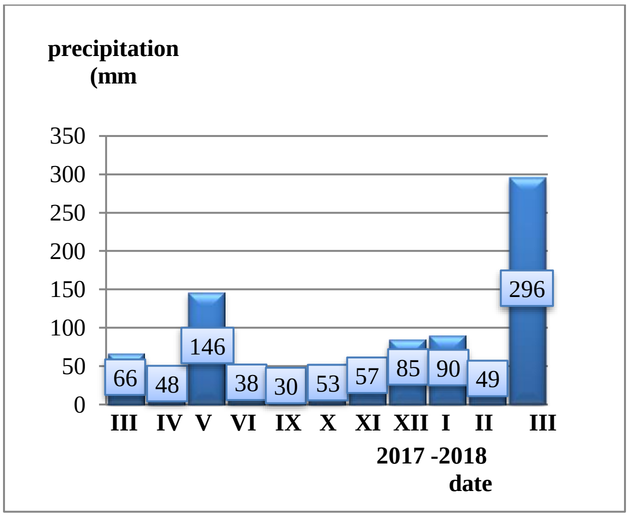

Figure 14. Schedule of the precipitation changes in the territory of plain forest landscapes in March, 2017 – March, 2018

The main factor affecting the temperature is the relief of the area. The average January temperature in the east is 0-4°C, north and south, -3-0°C in the north-east. The average July temperature in the west and south-west is 24-27ºC, the east and north-east is 21-24ºC (National Atlas, 2014).

The temperature maps of research territory (for June, September and December 2017) have been made using modern methods. The maps have been constructed in ArcGIS software based on the images obtained from Landsat 8 satellite. It was determined that in June, 2017 the temperature was 15-25º in the western part of the research territory, 30º and above in the east. It was impossible to accurately determine the temperature due to the cloudiness in the highest area of Ajinohur and surrounding areas. In semi-desert landscape, the temperature is above 30ºC, in plain forests 15-30°, in arid forests - 15-25°, in dry steps the temperature is different. In western part the temperature is 15-30°, the eastern part - 30° (Figure 15).

At the beginning of September the temperature indicator is above 20º. In semi-deserts it is 30-35º, on the shore of Ajinohur lake it is above 35°, in the western part of dry deserts - 35° and in the eastern part -30-35º. In arid forests it is 20-35º.

The temperature in December is -13-(+19)º. This indicator varies depending on he landscape types, in arid forests -13-(+5)º, in plain forests 5-10º, in dry steps and semi - desert landscapes it is 5-15º.

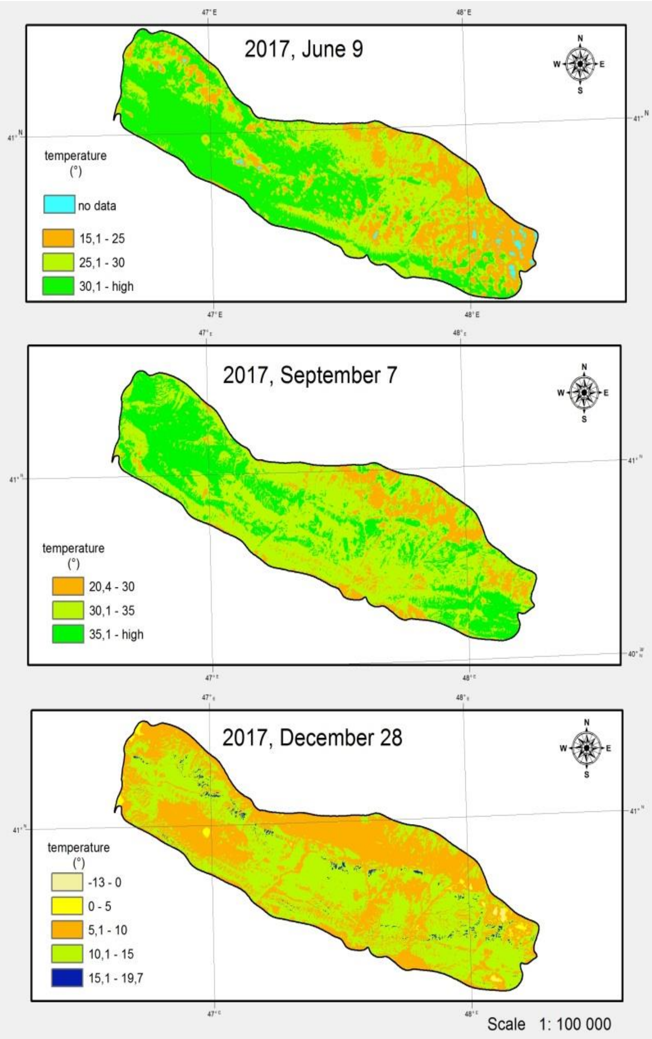

Figure 15. Temperature map of Ajinohur lowmountain and surrounding areas for 2017

Temperature and precipiotation also affect vegetation cover. We used NDVI maps in constitution of temperature maps for investigated territory. They clearly demonstrate the contact between climate and vegetation cover. NDV index is high in plain forests in June, medium covering with vegetation areas is river valleys, the lowest vegetation cover is in semidesert and dry steps landscapes.

The vegetation cover in research territory in December is completely weak (Figure 16).

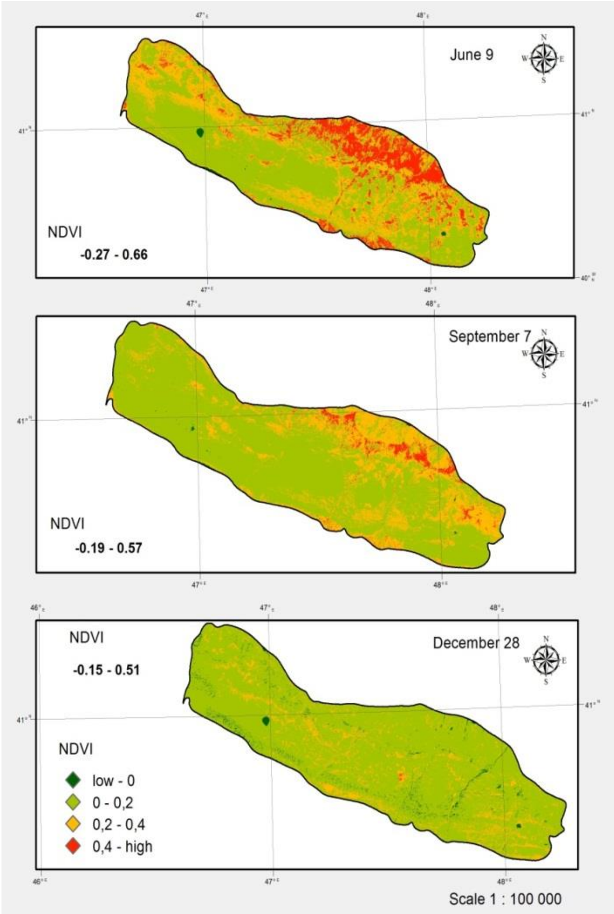

Figure 16. NDVI map of Ajinohur lowmountain and surrounding areas on 9 June, 7 September and 28 December, 2017

The annual amount of the radiation in research territory is 124-132 kcal/cm². (Ecological Atlas, 2010; Ayyubov, 1984). Generally, the amount of solar radiation depends on the height of the area, the amount of cloudiness, vegetation cover and so on. So the climate affects the differentiation of landscape as a natural component, other natural components can directly affect the climate (Madatzade, 1960; Shixlinski, 1969).

Conclusion: Comparative analysis of the formation and functional characteristics of landscape structure creating large scale map layers in the geographic information systems environment of climate observation materials allows to organize various farm areas in the area integrated landscape planning system.

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INDOOR SURVEYING WITH TERRESTRIAL PHOTOGRAMMETRY: A CASE STUDY FOR SIRCALI MASJID

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ABSTRACT:

In this study, indoor 3D modeling study of Sırçalı Masjid in located in the Karatay district of Konya province was carried out by using the terrestrial photogrammetry method. The Masjid was built in the single-domed masjid type of Seljuk period. The single-domed masjid type is a type of building with square or rectangular base area. However, in order for the dome design to fit in to a square or rectangular sub-structure, a transitional element is needed. The Turkish Triangle was used as transition elements of facilitate the transition from a square-shaped sub-structure to a circular structure in Sırçalı Masjid. With this study, the dome transition elements, which are difficult to model in terms of classical architectural survey, have been modelled successfully by the terrestrial photogrammetry technique in a short time. It has also been proven that terrestrial photogrammetry can be used effectively in the indoor 3D modelling projects

KEY WORDS: Indoor 3D Modelling, Terrestrial Photogrammetry, Indoor Architecture, Masjid or Mosque Architecture

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1. INTRODUCTION

Anatolian lands have many valuable cultural heritages in herited from the past to present because they have been home to many different cultures and civilizations throughout history. Nowadays restoration and documentation studies are carried out in order to keep these works alive and transfer them to next generations. For this purpose, classical or modern techniques are preferred. The digital photogrammetric techniques which are the modern measurement and evaluation techniques, offers economical, practical, accurate and 3D solutions for architectural surveys. When the 3D modelling studies are examined in the literature, it is generally observed that weight is given to external facade surveying of works. However, many of the works hosted by Anatolia are also actually rich with interior architecture. Numerous Masjid and Mosque examples can be given of these works. In particular, the domed interior spaces geometry of mosques and masjids provide information about the architectural and engineering knowledge of the period they were built. Nowadays, it is quite difficult and time consuming to modelling and documentation of these special architectures with traditional measurement methods. It is possible to document by 3D modelling for difficult objects with the developments in software and computer technology. In this context, close range photogrammetry technique has been used as one of the most effective and efficient methods (Karabork et al.2015). The aim of this study is to extract the transitional components to dome using close range photogrammetry technique.

2. CASE STUDY AND METHODS

2.1 The Sırçalı Masjid

The building is located at the Nakipoğlu neighbourhood in the Karatay district of Konya. There is no information anywhere on the structure who is the builder and the construction date it was made (Konyalı 1997). It is understood that according to the architectural style that was built towards to ends of the XIII th century (Önder 1971). These small size buildings with one dome built in between neighbourhoods. The building, which was built as a masjid, is still used as a masjıd today. These masjids are covered with a dome with changing a square or semi-square plan, and there are dome switch elements between the dome and the substructure (Turan and Yaldız, 2018). The structure is located of three places mosques group as a structure with a square plan, an open end communal aerial to the east and minaret. The last community place of the masjid was built with a vault and the harim part is covered with a dome. In the harim part, a triangular band that makes a corner group was used as a dome transition member (Turan, 2018).

Figure 1. The location of study area on google maps

Figure 2. Sırçalı Masjid

2.2 Data Acquisition and 3D Modelling

The photogrammetric workflow in general is as shown below. With these process steps, 3D models are obtained by matching similar points on pairs of images taken from different angles according to the epipolar geometry principle.

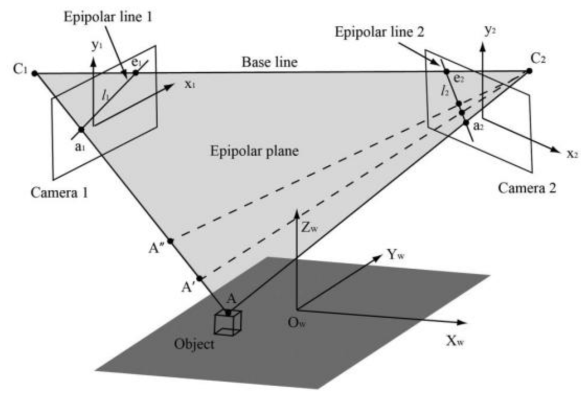


Figure 3.Epipolar Geometry (Nakazawa and Samara, 2014)

In the epipolar geometry (Fig. 3), the epipolar plane consisted by the two projection centres and the object point defines the epipolar lines as its intersections with the two image planes (Jebara, 1999)

Table 1. Photogrammetric workflow

- 1. Planning survey
- 2. Camera calibration
- 3.Acquire images
- 4. to measure of the control points on the object
- 5. Process images/Triangulated and orient images
- 6. Deliverables/stereo model, textures, or-thoimages, object/surface models

If a non-metric camera is used, the camera calibration is required to obtain reliable and accurate metric information from stereo image pairs.

In this study, the Sırcalı Masjıd were photographed by using Canon EOS 650D digital cameras. The simple test pattern known as calibration paper consisting grid points was used for calibration. This calibration paper is fixed on a plane and photographed from different angles and positions.

The camera interior orientation parameters were determined using the camera calibration process of the Photomodeler Scanner software.

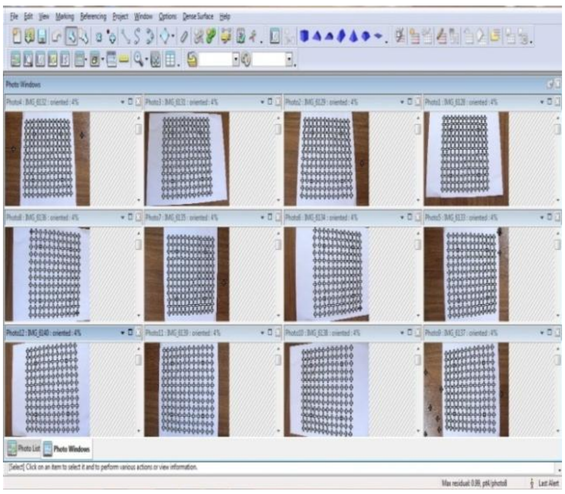


Figure 4. The camera calibration process

The parameters related to the camera calibration are given in table 1.

Table 2. Camera calibration parameter of Canon EOS650D

	Canon EOS 650D
Focal lenght	18.6907
Pirincipal point	(11.4264, 7.5369)mm
Sensor format	(22.7494, 15.1638)mm
Distortion parameter: K_1	0.0005327
Distortion parameter: K_2	-0.000001142
Distortion parameter: P_1	-0.00004736
Distortion parameter: P_2	0.0041125

The Sırcalı Masjıd has a different architecture. The architectural structure, called the Turkish triangle, is provided by the transition from a square shaped building element to a triangular element under a single-dome (Figure 4).

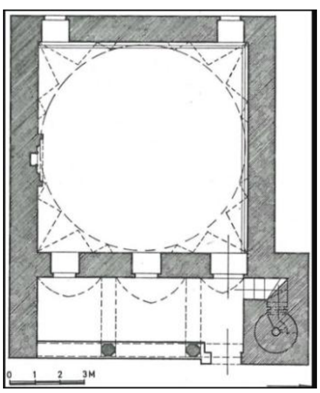


Figure 5. The top view of Sırcalı Masjid

Due to the square plan of the mosque and the small size (approximately 6.85m*6.85m), the indoor photographs were taken by calibrated camera with good measurement planning from different angles. It was noted that all images must have overlap area with each other. To estimate coordinates of points on any object or surface on overlapping image pairs, camera position and orientation information must be known. These are known as exterior orientation which can be determined if at least three control points are available in the overlapping image area. The control points, that defines relation between image and object coordinate system, is needed to find out these parameters. It was paid to attention to distribute control points on the brick surface homogenously and determine them easily via the photographs (Figure 5). In the study, the control points selected on brick surfaces measured by Topcon OS-103 total station.

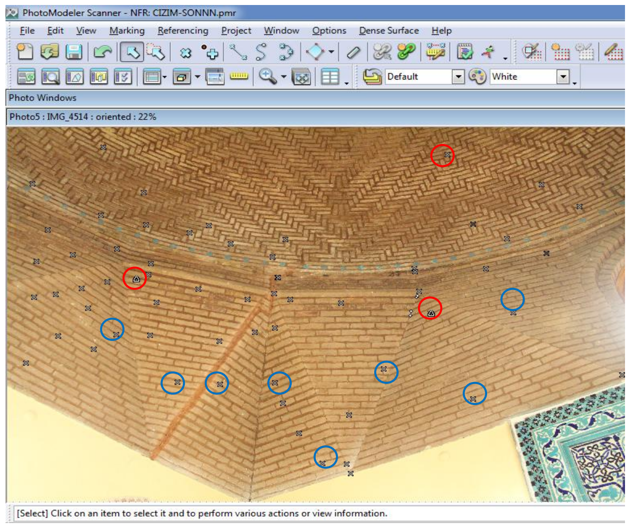
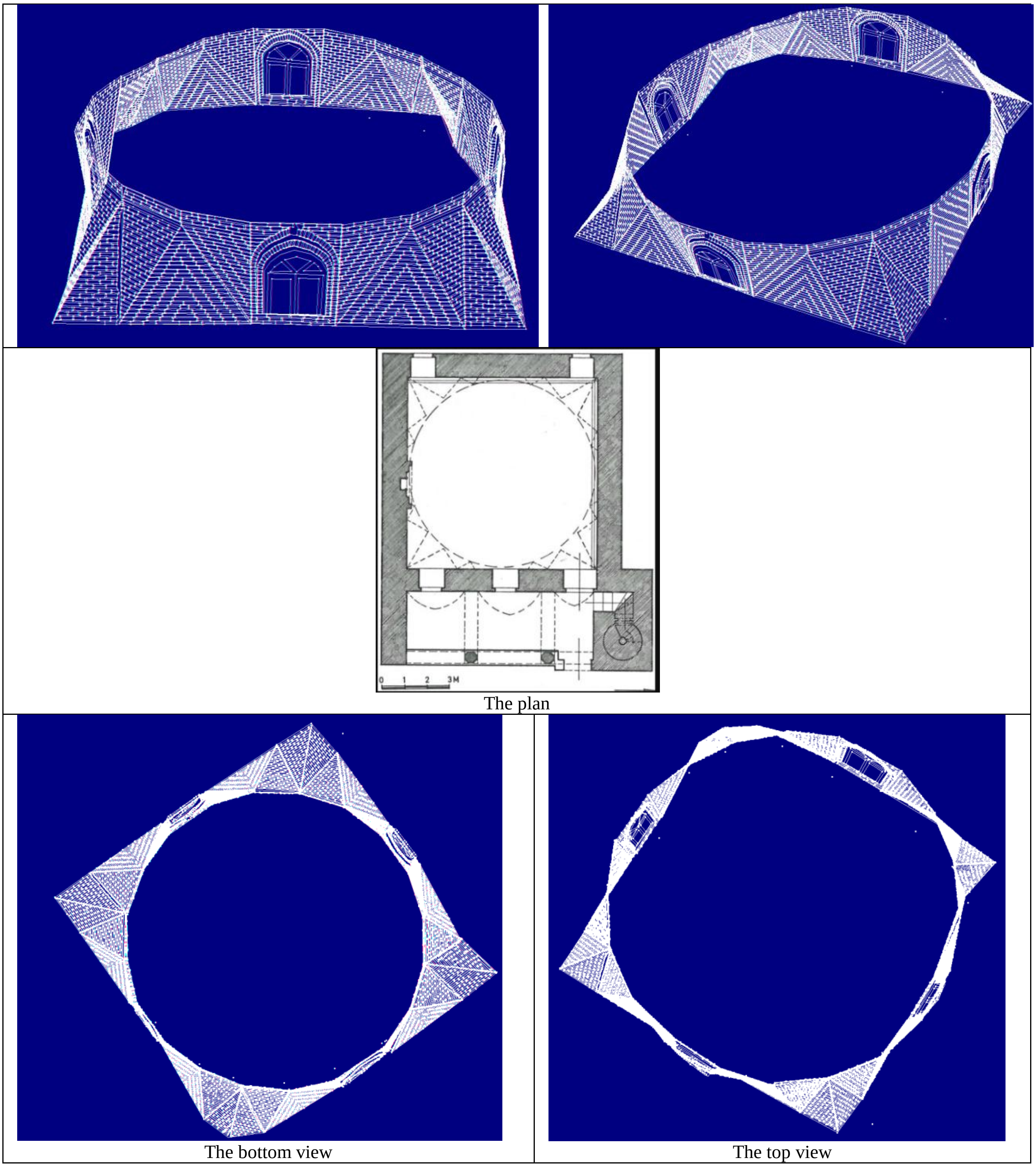


Figure 6. Distribution of the tie points and the control points

After the first 4 steps in the photogrammetric workflow given in Table 1 were completed, the photogrammetric evaluation process steps were started. The photogrammetric evaluation and indoor 3D modelling of Sırçalı Masjid were made with Photomodeler software. The all images, camera calibration parameters, and the coordinates of the control points were transferred to Photomodeler Scanner Software. In order to extract 3D accurate information from 2D images, it is necessary to match stereo pairs with sufficient number of tie points and control points (red circle control points, blue circle tie points in Figure 5)

Photogrammetry uses the bundle block adjustment technique for directly computing the relations between the image and the object coordinates (Aicardi et al, 2018). The relationship between image and object coordinate system are computed using (ground) control point coordinates in the bundle block adjustment ,thus the camera position and orientation elements are resolved. As a result, of the adjustment, root mean square error of Sırcalı Masjıd Project is 4.87 pixels. According to this result, 3D drawings of the brick surface were realized in Photomodeler software.



The plan

The bottom view

The top view

Figure 7. Three dimensional view of the dome transitional components

3. CONCLUSION

The aim of this study is to reveal the 3D the dome transitional components by measuring and evaluating it with photogrammetric methods of Sırcalı Masjid which is a single domed mescit belonging to the Seljuk period. There are many historic mosques and masjids in our country with this feature. 3D modelling studies in the literature indicates that weight is given to external facade modelling. 3D models of similar structures have been previously created but there are no studies that modelled the transition elements that provide connection to the dome with modern techniques in interior space. The triangular band that makes a corner group as the dome transition members have been successfully achieved with close-range photogrammetry method. Also, the drawing and modelling of these geometric elements it shows that will be successfully modelled of the mosque dome with this technique. The terrestrial photogrammetry will shed light on the easily modelling and documentation of these structures. Besides, the pixel size of the used camera is important for the clarity of the photograph and it provides the easiness in drawing small objects such as bricks in the drawing stage. It has experienced problems due to the height of the building in the photo shooting stage. The angles of the photographs that were inclined due to the height make the adjustment phase difficult.

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APPENDIX (OPTIONAL)

This study was carried out by the students who selected the project of Geomatics Engineering Photogrammetry Application of Selcuk University.

3D MODELLING OF GEOMETRIC TRIANGLE CONSTRUCTION ELEMENTS IN INDOOR SPACES: A CASE STUDY FOR TAHIR AND ZUHRE MASJID

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ABSTRACT:

Tahir and Zühre Masjid, which is one of the works of Konya and Anatolian Seljuk Period, serve daily from the 13th century and draw attention with its interior architecture. The Masjid is seated on a square plan and covered with a dome using triangular transitional elements. These artifacts are the most important proofs of the architectural perspectives and orientations of the past period. Demonstrating and documenting past architectural and engineering skills has become much easier with modern measurement and evaluation techniques at the present time.
In this study, interior 3D modeling study of Tahir and Zühre Masjid was made by using close range photogrammetry. Also the triangular transitional elements between the square plan and the dome of the structure were picked out. As a result, it has been observed that the method of close range photogrammetry for documentation and restoration works is not only successful in outdoor facade but also indoor modelling.

KEY WORDS: Close-range Photogrammetry, 3D Modelling, Indoor Space Modelling, Tahir and Zühre Masjid

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1. INTRODUCTION

Among the most important works of Anatolian Seljuk architecture survived to the present day the structures in Konya can be shown as an example. Konya has been the capital of the Anatolian Selcuks for many years. They have built architectural structures such as madrasah, caravansary, bath, mosque and masjid in Konya and surrounding. Especially the architectural structure of the Masjids are an important problem to be solved. Because these structures are usually square plan and the transition from a square-shaped structure to an upper-circle structure is an important issue. The connection between the two different geometric structures is provided by the transition elements. The transition elements show some differences according to the period and the place they were built. The dome first emerged in Mesopotamia according to architectural sources. This element needs a carrier surface. The use of the dome as the top covering element at square and rectangular plan has been the result of the development of transition components between a circular cover and a square infrastructure (Kuban, 2015; Turan and Yaldiz, 2018). Different solutions have been developed to solve the problem of transition components to the dome such as trompe, plane triangular belt and prismatic triangle belt. It is quite difficult and time consuming to modelling and documentation of these special components with traditional measurement methods.

Within the scope of the study, Tahir and Zuhre Masjid which has a square plan and plane triangular belt was evaluated close range photogrammetry technique that is combined photogrammetric and computer vision techniques. 3D models of the transition components to the dome have been successfully achieved. It has been proven that this method can be used effectively for 3D architectural solutions. With this method, the intermediate elements used for sitting the circle-based dome to the flat walls have been documented numerically.

2. CASE STUDY AND METHODS

2.1 The Tahir and Zuhre Masjıd

The building is located at the Abdülaziz neighbourhood in the Meram district of Konya. The Masjid was built by Sahip Ata Fahreddin Ali. It is known to have been built by the Anatolian Seljuks in the 13th century. (Konyalı 1997).

Figure 1. The Tahir and Zuhre Masjıd

The building, which was built as a masjid, is still used as place of worship. The building with a square plan is located in a group with three place masjids as harim part, the last community place and the tomb. The masjid was covered with a vault of the last community, the harim and the tomb part covered with a dome.

In the harim section the triangular belt was used which makes the corner group as the dome transition member and the plane triangle band was used in the tomb part (Turan 2018). The most remarkable parts of the masjid are the mihrab and the tile medallion in the dome center.

2.2 Close-range photogrametry and workflow

"Photogrammetry is the art and science of determining the position and shape of objects from photographs" (Kraus, 1994). Thanks to the computer vision the 3D shape, 3D metric informations and appearence of objects reveals from 2D images. The aim of this study is to get 3D model and to reach the correct metric information from images using close-range photogrammetry technique. Close range photogrammtery is one of the modern measurement and evaluation techniques, offers economical, practical, accurate and 3D solutions for architectural surveys.

The close-range photogrammetry workflow in general is defination as below.

i. Planning survey
ii. Calibrate camera
iii. Aquire digital images
iv. Aquire external control; referans/datum total station survey or GPS survey
v. Process images
vi. Triangulate/Orient Block
vii. Defined referans survey
viii. Deliverables
    a. Stereomodels
    b. 2D Planimetric
    c. Textures
    d. Dense point cloud
    e. Ortoimage/rectifed image
    f. Object/surface model CAD

In order to be able to carry out the photogrammetric processing steps outlined above, we preferred Photomodeler Software which has many advantage like as ease of field use, cost saving, time reduction and office safety.

2.3 Camera calibration procedure

A non-metric camera was used in the study. If a non-metric camera is used, the camera calibration is required to obtain reliable and accurate metric information from stereo image pairs. The camera calibration is related to find the real parameters of the camera such as focal length, principal point, format size, and lens distortion.

In this study, the Tahir and Zuhre Masjıd were photographed by using Finex S2980 digital cameras. The calibration paper consisting grid points was used and photographed from different angles and positions. To calibrate the Fujifilm Finex S2980 digital camera the photomodeler software was used that included the camera calibration function. **PhotoModeler** calculates the **camera's** focal length, lens distortion, format aspect ratio, and principal point. High accuracy work requires a well calibrated camera (URL1). The parameters related to the camera are given in table 1.

Table 1. Camera calibration parameter of Finex S2980

	Finex S2980
Focal lenght	5.1227
Pirincipal point	(3.2314, 2.3662)mm
Sensor format	(6.1224, 4.5995)mm
Distortion parameter: K_1	0.002577
Distortion parameter: K_2	-0.0001528
Distortion parameter: P_1	-0.0001170
Distortion parameter: P_2	0.001367

2.4 Data Acquisition

The **Tahir and Zuhre Masjıd** has a architecture elements that provide transition to the circle-based dome cover. This transition is provided by the transition from a square shaped building element to a triangular element under a single-dome (Figure 3-4).

Figure 2. The transition components to the dome

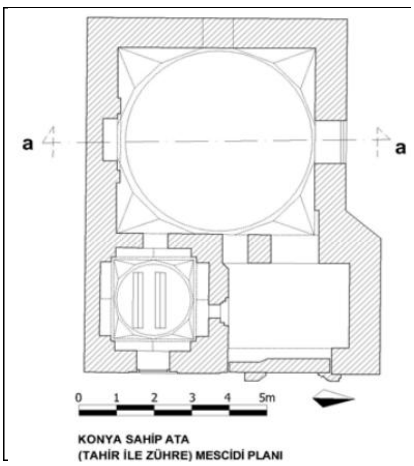

Figure 3. The plan of the masjid

After camera calibration, third photogrammetric process is the acquisition of the images. It must strong angle between photos. Due to the narrow interior space and the height of the dome of the masjid, the indoor photographs were shot with good planning. In the study the control points, for determining accuracy external information is used, **Tahir ve Zuhre** selected on brick surfaces measured by TOPCON GPT-7003i Imaging Total Station (Figure 5). The distribution of measured points on the object surface is as shown in figure 5. It was noted that the control points on the brick surface were uniformly distributed. Also to estimate coordinates of points on any object or surface on image pairs, camera position and orientation information must be known. These are known as exterior orientation parameters which can be determined with least three control points on image. The control points defines relation between image and object coordinate system.

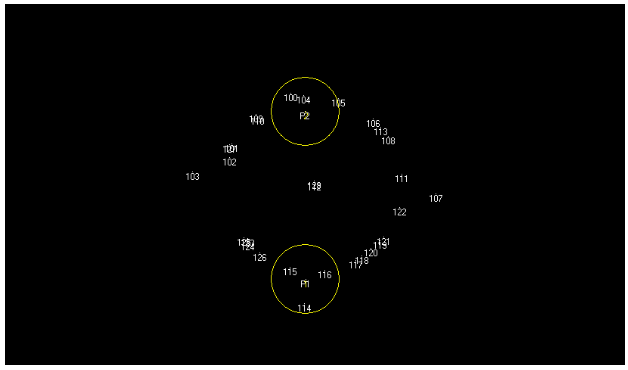

Figure 4. Distribution of the control points

2.5 3D modelling

The photogrammetric evaluation of the images of Tahir and Zuhre Masjıd were made with Photomodeler software. The all images, camera calibration parameters, and the coordinates of the control points were transferred to Photomodeler Scanner Software. This software's basic processing algorithm is a bundle adjustment. The exterior orientation parameters of the images and the 3D point coordinates are computed in the bundle adjustment process. Also, it is used calculating of the camera calibration parameters. '**Bundle**' word comes from the bundle of light rays from 3D points in the images**. Adjustment** word meaning is the process of adjusting camera positions and 3D point positions given the defined bundle of light rays. In other words to find the best 3D positions of rays the overall errors are minimized (URL1).

In order to extract 3D accurate information from 2D images, it is necessary to match all image pairs with sufficient number of tie points and control points.

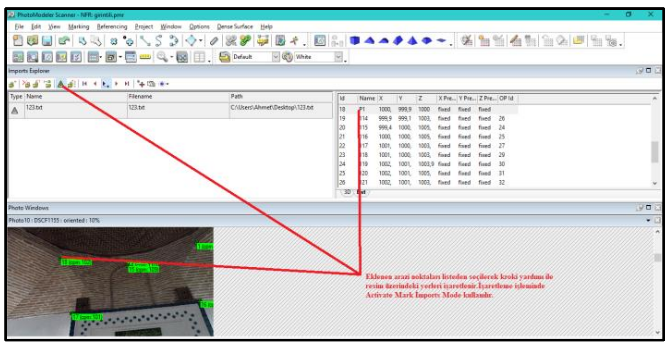

Figure 5. Identification of control points

After matching all images accurately and the final bundle adjustment, the root mean square error of the project was computed as 4.75 pixels. According to this result, 3D drawings of the brick surface were realized in Photomodeler software. When drawing, the surface definition was done from the Surface Draw menu. The existing brick drawings were made over the created surfaces.

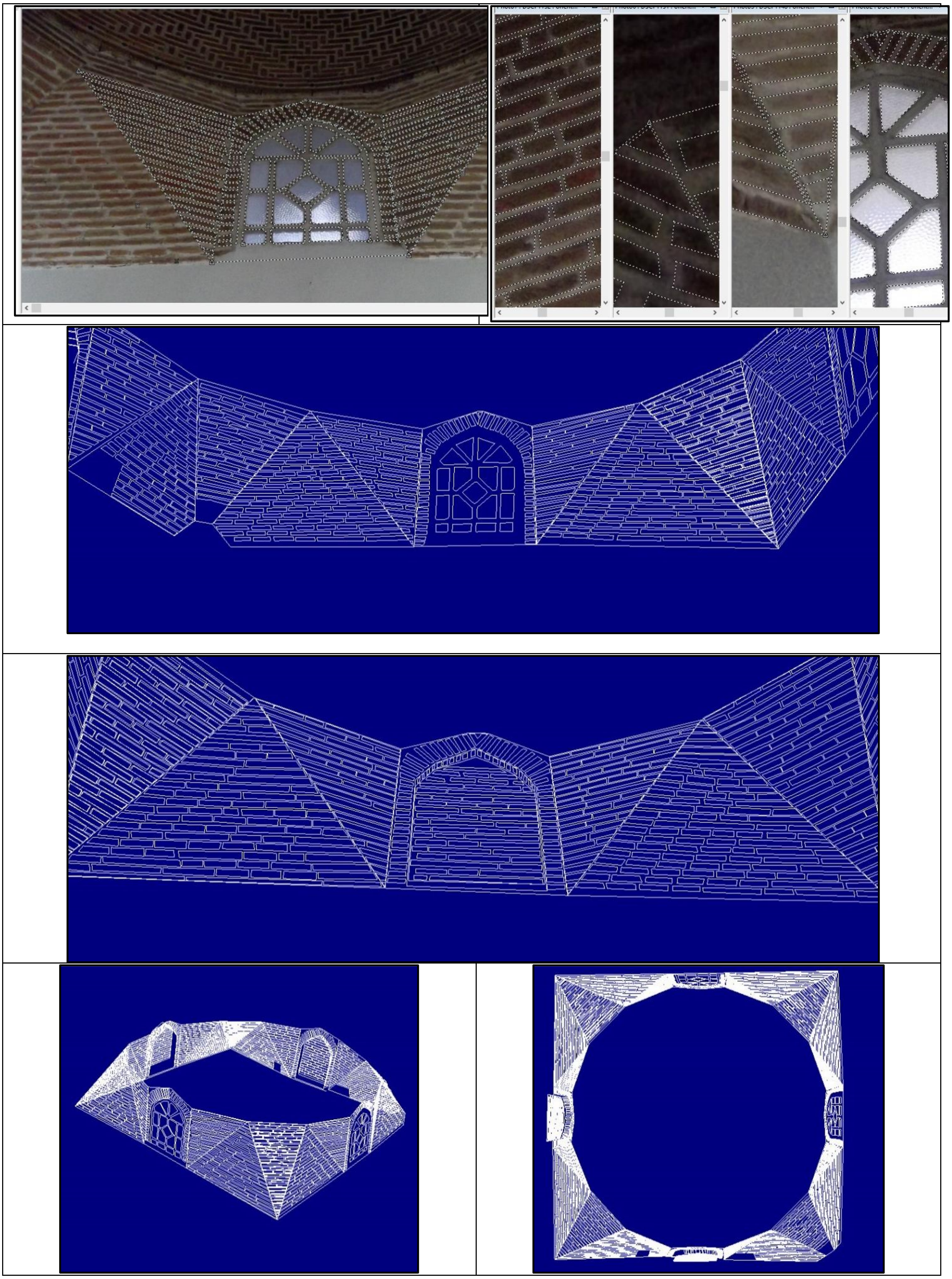

Figure 6. Three dimensional view of the dome transitional components

3. CONCLUSION

The aim of this study is to reveal the transitional components to dome by measuring and evaluating it with photogrammetric methods of the Tahir ve Zuhre Masjid. The the plane triangular belt that makes a corner group as the dome transition members have been successfully achieved from terrestrial digital images. It has been determined that the dome transition elements are "the plane triangle belt" model.
A strong photogrammetric project has strong angles between photos, a large number of 3D points, high precision marking, large coverage in each photo, and a good camera calibration. It has experienced problems due to the height of the building in the photo shooting stage. The angles of the photographs that were inclined due to the height make the adjustment phase difficult.

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URL 1. http://www.photomodeler.com/index.html

APPENDIX (OPTIONAL)

This study was carried out by students who selected the project of Geomatics Engineering Photogrammetry Application of Selcuk University.

ON THE IMPROVEMENT OF THE ORTHOMETRIC HEIGHTS WITH GNSS LEVELING: THE CASE OF SELCUK UNIVERSITY CAMPUS AREA

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ABSTRACT:

Whether in engineering projects or for scientific purposes, the determination of point heights is one of the main tasks of Geomatics Engineering. GNSS/Leveling is the current method applied in height determination.

In recent years, as in the whole world positioning determination techniques are widely used in Turkey as well. Concordantly, it has been the subject of updating the current regulations on the production of large-scale maps. In this context, the Large Scale Map and Map Information production regulations have been updated in 2018. The relevant regulation also includes measurement and calculation methods to be used for obtaining orthometric heights with GNSS/Leveling.

For this study, a test area of 32 points including 12 triangulation points and 20 traverse points was created within Selcuk University Alaeddin Keykubat Campus Area. The methods suggested in the regulation were applied in selected test areas and the results were compared. It has been observed that the TG03 geoid model should be improved and the local geoid model gave that appropriate results.

KEY WORDS: GNSS Leveling, Orthometric Heights, Ellipsoidal Heights

1. INTRODUCTION

The latitude, longitude and ellipsoidal heights (φ, λ and h) of the points relative to the selected reference ellipsoid (WGS84 or GR80) are obtained with global positioning systems (GNSS). The ellipsoidal heights (h) obtained with the GNSS must be converted to a orthometric height that takes into consideration the physical parameters of the earth since it is a geometric height. Orthometric heights (H) are also used in engineering projects in our country. Therefore, the ellipsoidal heights obtained with GNSS (h) must be converted to the orthometric height (H). In this transformation;

$$H=h-N \tag{1}$$

equation (1) is used. N is the geoid height in this equation. The accuracy of the transformation is widely dependent on the accuracy of the geoid height (N). Geoid heights show alteration because of the fact that the world's mass structure is not homogeneous. Global geoid models (OSU91A, EGM96, and EGM08), astro-geodetic method, gravimetric method, regional or local geoid models are used to determine the geoid heights. Large-scale Map and Map Information In the production regulation, in Turkey, four methods are suggested for conversion from ellipsoidal heights to orthometric heights. These methods are sorted such as direct use of the current TGyy geoid model, GNSS/Leveling network balancing by calculating the orthometric height differences for each base vector of the TGyy geoid model, updating the current TGyy geoid model with the local GNSS/Leveling points and determining the local geoid model based on the local GNSS/Leveling points. In this paper, the methods applied to calculate the orthometric heights by using the ellipsoidal heights obtained with GNSS have been explained. In the selected test network, the results of the implementation related to methods suggested in the regulation are given.

2. JEOID OF TURKEY

Geoid modeling studies have been accelerated by the General Command of Mapping (GCM) after years of the 1990s. In 1990, for the whole of Turkey; the first gravimetric geoid model is TG-91 which obtained using gravity, digital terrain model, and global geopotential model. After that date, three different geoid models such as TG-99, TG-99A, and TG-03 have been calculated by gravimetric method and presented to the users (Figure 1). In 2008, first using the EGM08 global geopotential model TG-09 and then the Turkey hybrid geoid-2009 (THG-09) was calculated. The mean accuracy of the THG-09 geoid model is ±8 cm, and the accuracy of the model decrease in mountainous, border and wetlands where the gravity data are sparse (Simav et al., 2015, Kılıçoğlu et al., 2003).For height determination based on the vertical reference system, orthometric heights, and geoid height values of the Turkey National Vertical Control Network points, which are entered into working territories, provided with the General Command of Mapping.

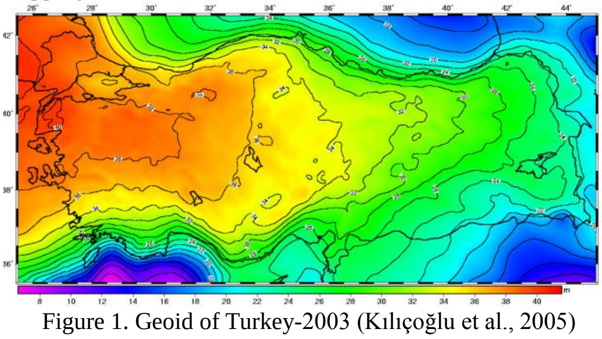

Figure 1. Geoid of Turkey-2003 (Kılıçoğlu et al., 2005)

3. APPLICATION

In the Large Scale Map and Map Information Production Regulations (BÖHHBÜY, 2018), the following methods were suggested to convert the ellipsoidal heights obtained by GNSS into orthometric heights.

- Directly use of TGyy geoid,
- The use of the TGyy geoid model by updating with the local GNSS/Leveling measurements,
- Adjustment of the orthometric height differences on the base vectors
- Determination of a local GPS/Leveling geoid.

3.1 Test Area

For the application, a test network consisting of 32 points in total was established, including 12 triangulation points (bent bar) and 20 traverses within Selcuk University Alaeddin Keykubat Campus area (Figure 2).The ellipsoidal heights of the points were determined by GNSS, and the orthometric heights were determined by geometric leveling at TUDKA datum. From these points, 7 of them were used as the reference points and the rest of 25 were used as control points. The reference points were chosen as homogeneous in distribution as possible. Five Javad brand GNSS receivers were used in the GNSS measurements. GNSS measurements were performed by a static and fast static method with 30 minutes at the triangulation points and 10 minutes at the traverse points. The geometric leveling measurements were executed duplicate level line using TOPCON DL503 digital level.

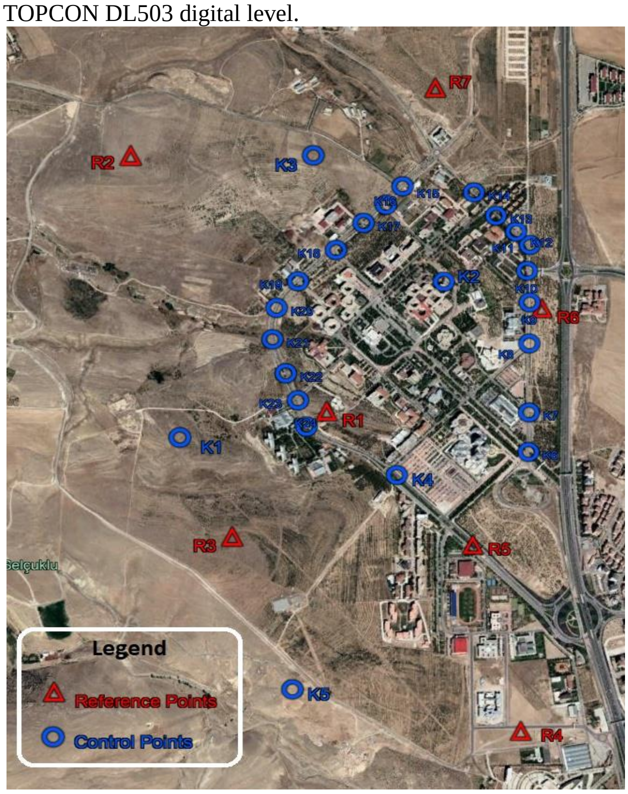

Figure 2. Test Network

3.2 GNSS/Leveling

3.2.1 3.2.1. Directly use of TG03 geoid

In this method, the geoid heights of 32 points in the test network, was obtained by interpolation from the geoid of Turkey (TG-03) model with the weighted mean method. The

Turkey (TG-03) model with the weighted mean method. The orthometric heights of the points were calculated from the equation (1) and compared with the orthometric heights of the points acquired by the leveling. The results are given in Table 1.

Table 1. Directly use of TG-03 Geoid

Number of Points	32
Minimum (cm)	-28.95
Maximum (cm)	-13.35
Mean (cm)	-21.01
Rmse (cm)	± 21.19

3.2.2 Use of TG-03 geoid by updating with local GNSS/Leveling measurements

By updating TG-03 in obtaining locally geoid (NTG-03), from the differences between the GNSS/Leveling geoid heights and the NTG-03 geoid heights at the 7 reference points, (δN) first, the trend surface (t) was taken out by calculating, then the residual measurements is modeled by continuously curved surface gridding algorithm. Thus, the updated geoid height (UNTG-03) at any points calculated with the equation (2).

$$\text{UNTG-03} = \text{NTG-03} + t + \delta N \qquad (2)$$

In application, 7 points are taken as the reference point (known) and the orthometric heights of 25 points are calculated. The statistics for the results are given in Table 2.

Table 2. Use of updated NTG-03 data

Number of Points	25
Minimum (cm)	-4.63
Maximum (cm)	1.00
Mean (cm)	-2.66
Rmse (cm)	± 3.07

3.2.3 Adjustment of the orthometric height differences on the base vectors

This method is to determine the orthometric height differences in the selected base vectors in the network and to adjustment them by taking them as a measurement. The orthometric height difference in any base vector with GNSS measurement at both tips can be calculated by equation (3) or equation (4) (Mainville et al., 1992).

$$\Delta H_{ij} = (h_j - h_i) - (N_j - N_i) \qquad (3)$$

$$\Delta H_{ij} = \Delta h_{ij} - \Delta N_{ij} \qquad (4)$$

Hereby;

ΔH_{ij}: the orthometric height difference between the i and j points of the base vector,

h_i, h_j: height of ellipsoid at points i and j,

N_i, N_j: TG-03 geoid height calculated by interpolation at i and j points.

In the leveling network balancing, the calculated orthometric height differences are taken as a measure, and the orthometric heights of the GNSS/Leveling points calculated by the geometric leveling measures are taken as known. In this paper, the geoid heights used in the calculation of orthometric height differences are calculated from interpolation from the TG-03 geoid model. In application, 7 points are taken as the reference point (known), and the orthometric heights of 25 points are calculated. The statistics related to the results are listed in Table 3.

Table 3. Leveling network adjustment results according to base vectors

Number of Points	25
Minimum (cm)	-2.67
Maximum (cm)	4.71
Mean(cm)	2.72
Rmse (cm)	±3.35

3.2.4 Determination of a local GPS/Leveling geoid

In this method, in addition to the ellipsoidal heights of the 32 GNSS points in the work area, Helmert Orthometric Heights are calculated based on the geometric leveling measurements and TUDKA. Thereby, GPS/Level Geoid Heights (N = h-H) were obtained at 32 points. From these points, 7 points were chosen as the reference point and 25 points as the control point. According to the geoid heights of GNSS/Leveling the of 7 reference points, a local geoid model was developed for the region by fitting the surface of the second-degree. The Equation (5) is used as a second-degree surface polynomial.

$$N(x, y) = a_o + a_1 x + a_2 y + a_3 x^2 + a_4 xy + a_5 y^2 \qquad (5)$$

The surface parameters (a_i) attained by the Least Squares method are given in Table 4.

Table 4. Surface parameters

Parameters	**Coefficients**
a_0	35.98841616
a_1	-0.098717989
a_2	1.075621082
a_3	-0.092545146
a_4	-0.092526609
a_5	-0.245710953

The statistics relating to the orthometric heights calculated from the local geoid model are given in Table 5.

Table 5. Use of local geoid model

Number of Points	25
Minimum (cm)	-0.92
Maximum (cm)	4.87
Mean (cm)	2.82
Rmse (cm)	±3.25

4. CONCLUSIONS AND RECOMMENDATIONS

The suggested methods for determining the orthometric heights in the BÖHHBÜY (2018) regulation were carried out in the test network. In this application, the orthometric heights (calculated) calculated by GNSS/Leveling are compared with the orthometric heights based on the national system (TUDKA) determined by the geometric level measure and the statistics are given above.

When the TG-03 geoid model is used directly, the root means square of the differences between the calculated heights at 32 GNSS/Leveling points and the measured heights have been determined as ± 21.2 cm and the result is that TG-03 geoid in the region can not be directly used for large scale map production.

The RMSE of the differences between the heights measured by orthometric heights calculated by direct use of the NTG-03 geoid obtained by local updating of the TG-03 geoid with 7 GNSS/Leveling reference points has been determined as ± 3.07 cm. It is understood that the NTG-03 geoid obtained by local updating of the TG-03 geoid model can be used directly from these results.

Acceptance of orthometric height differences as a measurement determined in selected base vectors among network points and the differences between the measured values in the orthometric heights calculated with the leveling network balancing obtained by taking constant the orthometric height of the 7 GNSS/Leveling reference points have been investigated. The RMSE of the height differences has been found as ±3.35 cm. For this reason, TG-03 geoid can be used.

The RMSE of the difference between the orthometric heights calculated using the local geoid model and calculated by passing the second-degree surface model as the reference of 7 points from 32 points and the heights determined by geometric leveling is calculated as ±3.25 cm. It is understood that the local geoid model can be used directly from these results.

It should not be forgotten that this application was carried out on a small, relatively flat terrain. It is suggested that similar studies should be conducted for broader and mountainous regions and re-evaluation of the results.

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A SPATIAL APPROACH FOR PUBLIC TRANSPORTATION NETWORKS IN ANTALYA/TURKEY

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ABSTRACT:

Public transportation increases people life especially in big cities due to money and time saving. Transportation is one of the important factors of urban life. Services of city transportation are multi-faceted subjects provide to connect business-residential areas and socio-cultural areas for people. In this respect, urban transport plans are not considered separately from spatial planning. GIS, which is used for various transportation planning and visual analysis with its spatial data and data base structure, is an appropriate decision support system. GIS contribute greatly to the decision-making and applications of city managers in projects such as planning and implementation of public transport that depend on a number of criteria.

In this study, the existing public transportation network in Antalya province was analysed and the level of adequacy of the transportation network was determined by population data, university and hospital places. Spatial distribution of public bus routes in Antalya Province was determined and spatial analysis was performed with GIS. As a result of the analysis, the impact areas of public transportation were determined. Accordingly, the public transportation of Güzelbağ and Duraliler neighborhood in Antalya was observed to be insufficient. In addition, public transportation in the city center is very complex. It is suggested that public transportation should be carried out by transfer in these regions in order to overcome this complexity.

KEY WORDS: Public transportation, spatial analyse, decision-making, GIS

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1. INTRODUCTION

Transportation is one of the important elements of urban life. Increasing population, increased build-up, increased transport networks are leading to reduced transport efficiency.
In this context, the lack of accessibility of urban transport systems leads to transportation and traffic problems. People living in the city are faced with adversities such as traffic density, financial losses, noise, environmental pollution due to transportation problems (Akbulut, 2016).

In countries such as our country, which continue to develop in terms of economy, urbanization and population, city plans and land uses are constantly changing. It is important to obtain up-to-date spatial data to ensure that the long-term and comprehensive transport schemes to be established and to identify the necessary solutions are up-to-date. In order to make this possible, it is necessary to establish a system in which other data related to transportation planning such as road network, public transportation system and transport planning such as land use, socio-economic and demographic data are fully constructed and updated continuously by relevant institutions (Mutlu and Alver 2015). GIS is a very suitable decision support system for decision makers. GIS, which can be used for solving and visual analysis of various transportation problems due to the inclusion of spatial data and database structures, has many transport applications that can only be achieved using the road network model. The example applications are as follows.

- Route assignment procedures for use in planning activities such as four-stage transportation planning,
- Simultaneous route assignment for emergency aid vehicles,
- Simultaneous traffic management and accident detection,
- Road and transport facilities management,
- Internet based traffic and intelligent transportation information systems,
- Navigation systems for vehicles,

The above transportation practices can be realized by using the GIS infrastructure (Thill, 2000). Transportation applications of GIS have become increasingly popular in recent years. There are already whole conferences devoted to GIS and transportation and there have been special issues of traditional transportation journals devoted to GIS (Waters et al, 1992).

Liu and Zhu (2004) presented an integrated GIS approach to assess accessibility in urban transportation planning. Mavoa et al. (2012) conducted a detail review on accessibility evaluation with respect to public transfer service level and walking modes used to measure potential access to destinations. Their GIS-based approach extends public transfer accessibility measures by including transfer stops, routes, schedules and transfer data. Salonen and Toivonen (2013) reviewed two accessibility assessment methods which include traveling time by car or by public transportation, respectively. A “door-to-door” approach was adopted to calculate traveling time which considers more factual factors, such as, waiting time, walking time, transfer time between buses, and sitting time in a bus (Liu et. al., 2018).

In this study, on the existing public transportation routes, the situation of the region and the evaluation of the related issues, the troubles in the lines were determined for the province of Antalya. Attempts have been made to determine whether the existing public transport facilities are adequate by examining the region's hospitals, buildings and university populations that are indicative of sustainable transport.

2. MATERIAL AND METHOD

2.1. Study Area

Major headings are to be centered, in bold capitals without The study area, Antalya province, is located on the southwestern part of Turkey. It is placed on the Mediterranean coast of Turkey and covers 20,587.438 km2 (Figure. 1). Antalya province is one of the rare places of Turkey that has the highest number of clear nights convenient for astronomical observations with its appropriate climate properties and weather conditions Mediterranean climate, which is dry and hot in summer and rainy and warm in winter, is the dominant climate regime in this region. The area contains western part of Taurus Mountains, known as Beydaglari Mountain, having peaks above 2500 m. (Aslan et al., 1989).

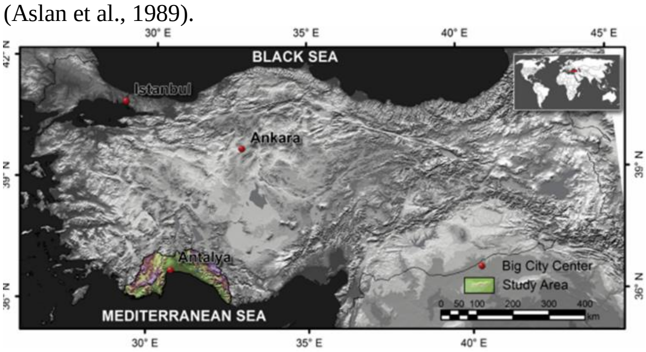

Figure 1. Study Area (Koc-San et al., 2013)

- In Antalya, the average time spent by people using public transport is 63 minutes. 14% of these passengers spend more than 2 hours on public transport each day.
- Percentage of at least one transporter in Antalya is 35%. On average, 7% of passengers are transferring at least twice in a single journey.
- The average distance traveled in a single journey in Antalya is 7.6 km. 13% of passengers are traveling more than 12 km in one direction.
- In Antalya, the passengers await an average of 23 minutes durability (Url 1).
- In Antalya, provincial and state road lengths decreased slightly in 2009-2013 period, reaching 1 720 km while the village road length increased by 6.5% in the same period (Url 2).

The road, parcel, neighborhood, building data of Antalya used in this study is from Antalya Metropolitan Municipality. It has already been taken as a map in the NCZ environment. In order to extract and analyze numerical data, NETCAD and GIS package program ArcGIS 10.3 was used. Criteria for analysis were downloaded numerically via university, home, hospital Open Street Map. Neighborhood populations were entered into the attribute table of the neighborhood layer by using the population censuses based on the year 2017 of TURKSAT (Url 3) (Table 1).

Table 1. Popululations Results Based on 2017 of Antalya Neighborhoods

2017	neigborhood	population
	Antalya(Aksu/Aksu Man./Barboros neigborhood.)	1423
	Antalya(Aksu/Aksu Man./Çamköy neigborhood.)	3719
	Antalya(Aksu/Aksu Man./Cihadiye neigborhood.)	3251
	Antalya(Aksu/Aksu Man./Fettahlı neigborhood.)	1330
	Antalya(Aksu/Döşemealtı Man./Ahırtaş neigborhood.)	403
	Antalya(Aksu/Döşemealtı Man./Akkoç neigborhood.)	305
	Antalya(Aksu/Döşemealtı Man./Yeşilbayır neigborhood.)	4959
	Antalya(Aksu/Kepez Man./Ahatlı neigborhood.)	14985
	Antalya(Aksu/Kepez Man./Duacı neigborhood.)	2253
	Antalya(Aksu/Kepez Man./Duraliler neigborhood.)	3562
	Antalya(Aksu/Kepez Man./Gaziler neigborhood.)	3281
	Antalya(Aksu/Kepez Man./Göçerler neigborhood.)	5844
	Antalya(Aksu/Kepez Man./Kütükçü neigborhood.)	3654
	Antalya(Aksu/Kepez Man./Santral neigborhood.)	685
	Antalya(Aksu/Kepez Man./Sütçüler neigborhood.)	6499
	Antalya(Aksu/Kepez Man./Zeytinlik neigborhood.)	4785

The route is digitized on the road layer based on Moovit mobile application and Antalya transportation site where all kinds of information related to public transportation are obtained.

2.2. Method

The GIS database to be created for transportation purposes analysis can be made up of all the factors for planners and decision makers by combining with city planning, environmental items, demographic, socio-economic and other similar spatial data interacting with transportation, it can be used as a decision support system. In the system formed by the population, building, hospital, university and public transportation routes, buffer zones that determine the pedestrian walking distances were created. Then density maps were created.

Kernel Density Analysis, two different density analysis methods were used as linear density analysis. Kernel Density calculates the density of point features around each output raster cell. Conceptually, a smoothly curved surface is fitted over each point. The surface value is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point. Only a circular neighborhood is possible. The volume under the surface equals the population field value for the point, or 1 if NONE is specified. The density at each output raster cell is calculated by adding the values of all the kernel surfaces where they overlay the raster cell center. The kernel function is based (Silverman, 1986).

The Line Density tool calculates the density of linear features in the neighborhood of each output raster cell. Density is calculated in units of length per unit of area.

Conceptually, a circle is drawn around each raster cell center using the search radius. The length of the portion of each line that falls within the circle is multiplied by its population field value. These figures are summed, and the total is divided by the circle's area. If a population field other than NONE is used, the length of the line is considered to be its actual length times the value of the population field for that line (Silverman, 1986).

3. DISCUSSION

Neighborhood names and people (TURKSAT 2017) were entered in the attribute table and associated with the dot symbol. The point symbol is divided into 5 classes according to the population distribution with Quantities-Graduated Colors Feature. The yellow places indicate where we have low population and the red places indicate where the population is most concentrated (Figure 2).

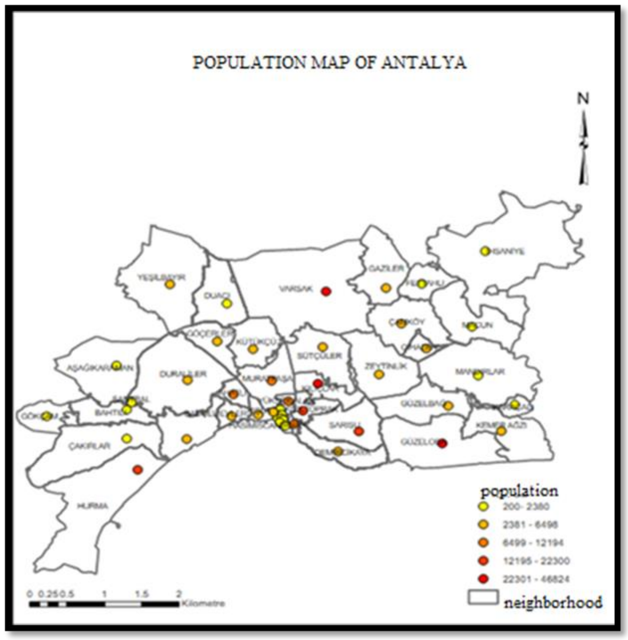

Figure 2.Antalya Province Neighborhood Population Map

Public transport routes within the study area are digitized by comparing Moovit application (Url 4) and Antalya transportation site (Url 5). Separate layers for each route were opened and after the digitization process these layers were merged and a 'Route' layer was created. (Figure 3).

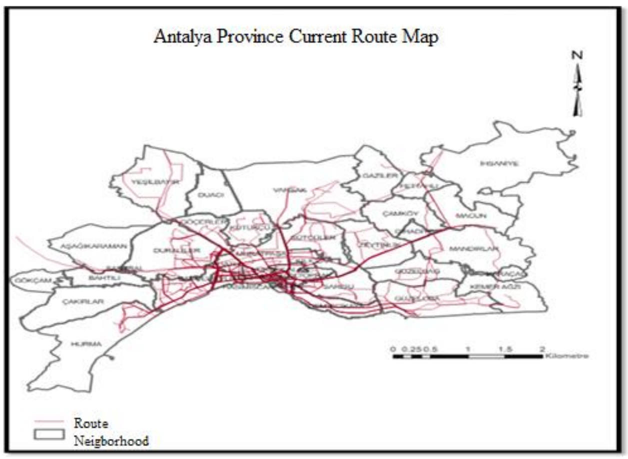

Figure 3. Antalya Province Current Route Map

It was taken as 300 m from the public transportation routes to determine the locations of the places that could benefit most effectively (Figure.4).

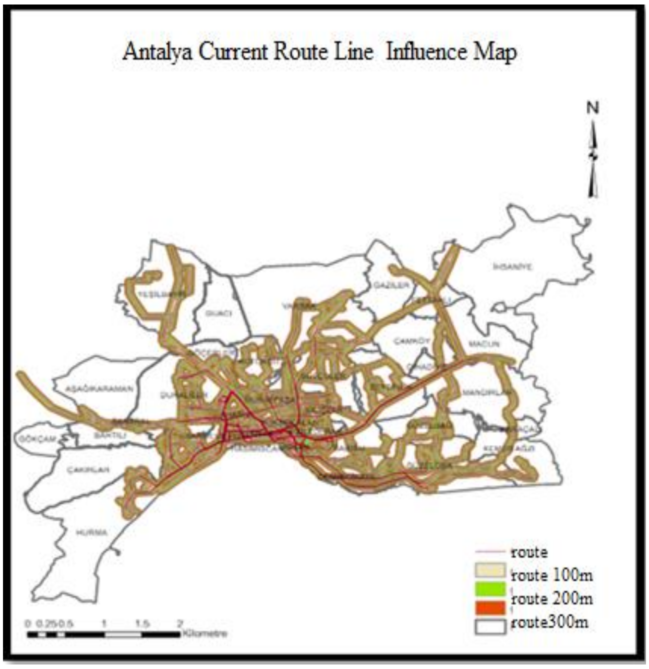

Figure 4. Antalya Current Route Line Influence Map

A part of the building data, which is another impact factor, is digitally downloaded via the Open Street Map (OSB) (Url 4) and the remaining part is digitized from the current map of Antalya used. These data are combined in ArcGIS 13.3 (Figure 5). Observing the distribution of the buildings obtained, it is seen that there is an intensive construction around the Konyaaltı coast, which is considered as the center of the city. The surplus of building in parallel to the shore is also increasing.

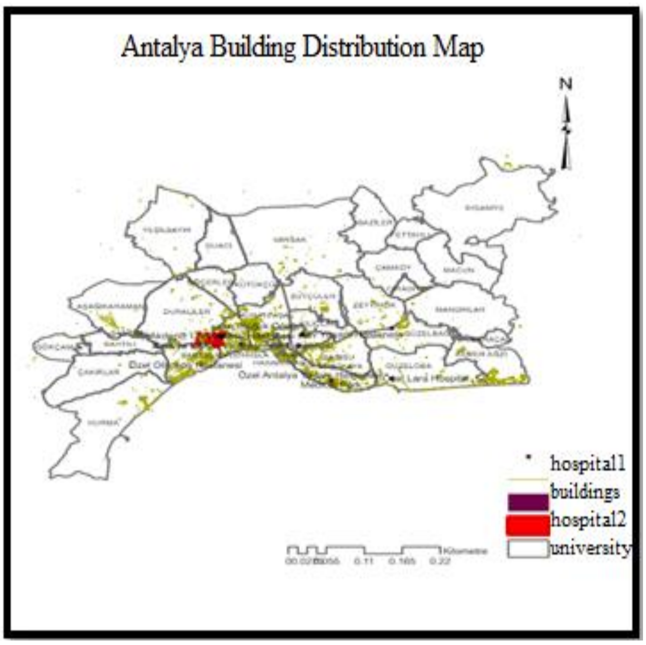

Figure 5. Antalya Building Distribution Map

Sites such as hospitals and universities, which are frequented by people during the day, were used as analyzes for this Project. The hospital is an institution that every human needs, so every person should not have to worry about accessing the hospital. Although there is a hospital concentration in the city center in Antalya, it seems that it is not an evenly distributed structure. In this case, existing hospitals should have access to all parts of the city. The hospital data was obtained digitally from the OSM. The walking distance to the hospitals was determined as 300 meters. Buffer methods have been used to create buffer zones around the hospital.

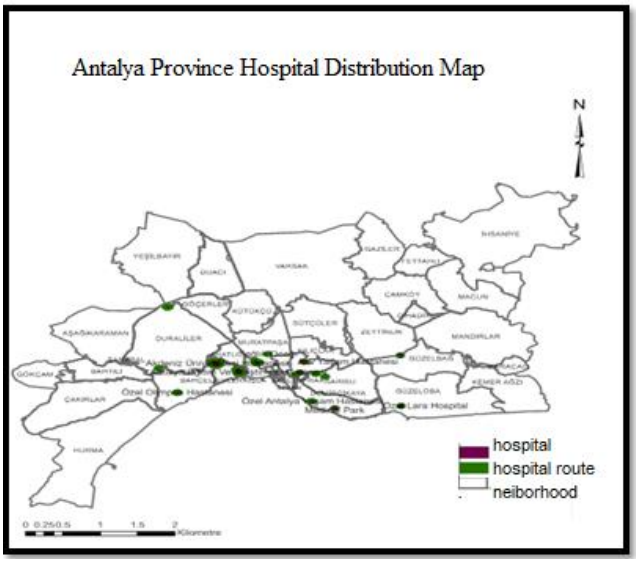

Figure 6. Antalya Province Hospital Distribution Map

Since universities are home to thousands of students and students usually opt for public transportation for transportation, this is the criterion in this study. A 300-meter influence has been set up so that each student, employee, university student can easily reach the university.

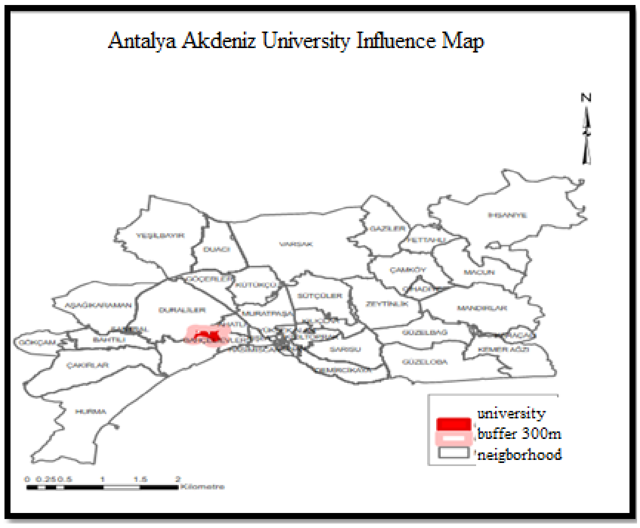

Figure 7. Antalya Akdeniz University Influence Map

Using Kernel Analysis module, 5 classes were separated to determine areas where houses and buildings are concentrated in Antalya (Figure 8).

As a result of the classification, it is observed that the density increases along the coast and the structural development of the city increases parallel to the coast in the east-west direction. (Figure 8). In the planning and analysis of public transportation it is necessary to take this development into consideration.

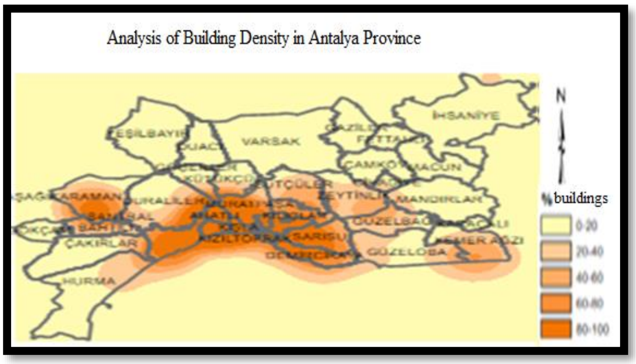

Figure 8. Analysis of Building Density in Antalya Province

Linear density analysis was also conducted on public transportation routes. As shown in Figure. 9, the areas with the lowest linear density are shown with light blue color, while the areas with the most intense density are shown with pink color. It can be said that almost every route line passes through Antalya center.

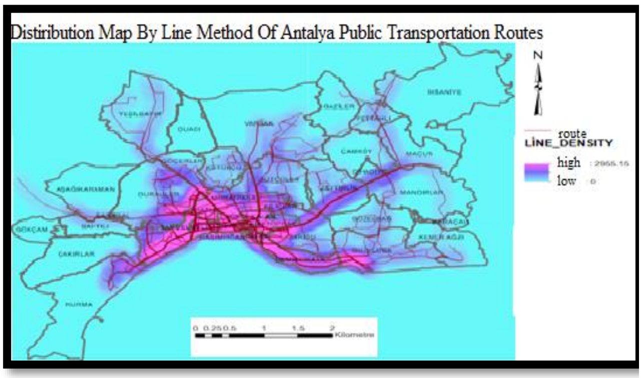

Figure 9. Distribution map by line method of Antalya public transportation routes

As a result of the mapping of the maps for the building density and population density, it is seen that the population density in the city is in Konyaaltı, Muratpaşa, Aksu part depending on the building density (Figure 10).

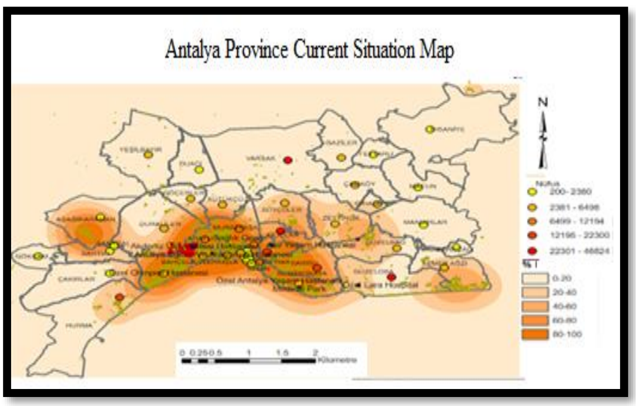

Figure 10. Antalya Province Current Situation Map

Compared to population maps of population density map, building density map and public transportation routes, the density of buildings in the areas between Çakırköy, Cihadiye, Gaziler, Güzelbağ and Zeytinlik districts with medium population is low and there are places outside the 300 m walking distance (Figure 11). Since the Duacı and İhsaniye neighborhoods are far from the city center and they are small in population, there are very few routes within the neighborhood boundaries. Generally, public transportation routes are located in places where the population of the city and the density of the building are large.

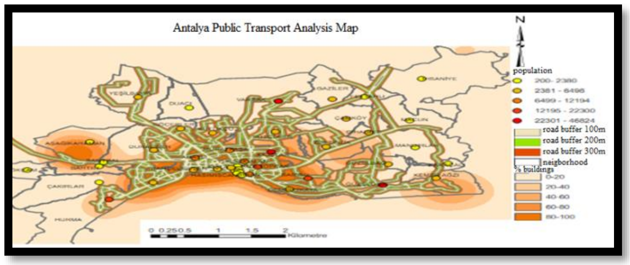

Figure 11. Antalya Public Transport Analysis Map

When the maps for the population, hospital, university and public transportation line were overlapped, it was determined that there was not enough public transportation route within the domain of the patients in the circle with red circles (Figure 12). It has been determined that people cannot easily reach public transportation although the health unit, especially between the Zeytinlik and Güzelbağ districts, is in a place where the density of buildings and the population are moderate.

The area of influence of the central hospitals and the university coincides with the domain of many routes. Because of their position at the intersection of the routes, citizens do not need to organize additional routes or rings, and even if they transfer, they can easily reach these hospitals.

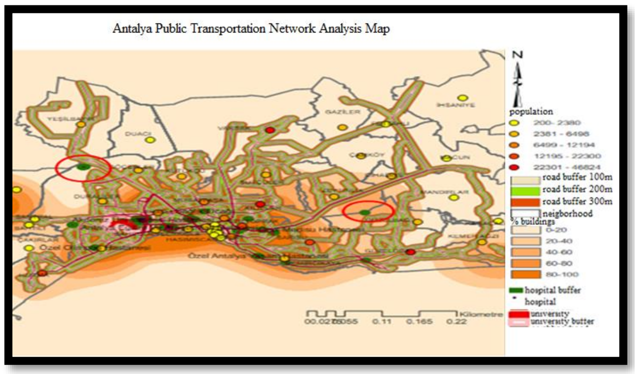

Figure 12. Antalya Public Transportation Network Analysis Map

There are concerns about the adequacy of the public transport network in the three areas of the red circle with the registration of all layers determined for this study (Figure 13). There is no public transportation network within the scope of the health unit located in Güzelbağ district. According to the kernel analysis of the same area, it is seen that the building density is higher and the population is moderate. Although the population in the Gaziler and Çamköy districts is moderate and the density of buildings is low, the domain defined on the route line is not sufficient for neighborhood boundaries. The health unit between Göçerler and Duraliler neighborhoods is one of the missing places in terms of utilizing the public transportation network. This area, which is in the development direction of the building density, is also medium in population. The domain created for the health unit does not coincide with the domain of the route line. The existing public transportation routes are concentrated in the center of the city and exhibit a complex structure.

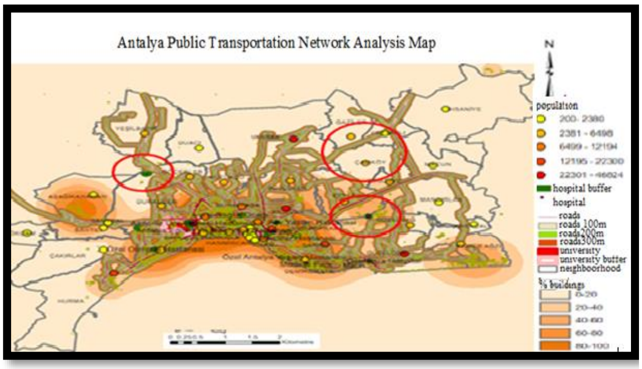

Figure 13. Antalya Public Transportation Network Analysis Map

4. CONLUSIONS

Since Antalya, which is selected as the study area, is the most important tourism center for our country, it has to be easy and practical to reach everywhere. Therefore, it is important that the efficiency of public transportation, the satisfaction of the public and decision-makers make the right and effective decisions. The GIS created for transportation purposes analysis should be used as a decision support system for all decision makers. The building density is parallel to the population and the direction of development of the city, the shoreline is parallel. Citizens' satisfaction and management must be proportionate to the direction of city development in planning public transportation to be able to deliver effective results. According to the results, the public transportation network for the province of Antalya is insufficient. In order to complete deficit, it is necessary to determine new route lines, rearrange transportation in public transport and reevaluate the line concentrated in the city center.

Public transportation, which has become an indispensable part of everyday life for many people, is an extremely important issue for local administrators. Having more correctly defined criteria in determining public transport routes will lead to better results. The achievement of this is possible with the establishment of a GIS infrastructure in which all institutions can jointly enter and export data. Also to ensure that, in terms of saving time and resources in our country urgently Turkey's National Geographical Information System must be fully realized.

ACKNOWLEDGEMENTS

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INVESTIGATION OF THE TEMPORAL CHANGE OF LAND USE BY CORINE AND LANDSAT SATELLITE IMAGES; A CASE OF KONYA

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ABSTRACT:

Satellite images are the most basic data used in remote sensing. Today, the spectral and spatial resolutions of these data have increased and parallel to this, they have gained the ability to scan very large areas. Therefore the process of change in land classes can be monitored and managed more easily, faster and more economically.
In this study Konya province was chosen as the application area. In the application, Satellite images and Corine data for 1990, 2000, 2006 and 2010 were used. The maximum likelihood method is the preferred method of classification for satellite images. The land classes derived in the Landsat were obtained with accuracy of 72%, 80%, 85% and 90% for the years respectively 1990, 2000, 2006 and 2012. Land use changes in industry, agriculture, settlement and other areas obtained in the Corine and classification process, are calculated as area and evaluated as a percentage. As a result, the values obtained by Corine and classification gave consistent results. In addition, it was observed that urbanization was towards the north of the city and industrialists advanced towards the northeast of the city for the Konya province

KEY WORDS: Land Use, Urban Development, Classification, Corine

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1. INTRODUCTION

The rapid development of technology, parallel to this, the increase of industrialization and production fields has significantly increased the employment of the cities. This has accelerated migration from rural areas to urban areas, and planned urbanization has begun to be of great importance to local governments. Nowadays, much more attention has been paid to urban land use/land cover change because ecosystems in urban areas are strongly affected by human activities and have close relations with the life of almost half of the world's population (Stow and Chen, 2002.)For urban planning and sustainable management of land resources, we need accurate and regular mapping of the changes in landcover (Hu and Ban, 2008; Khalil et al., 2018). Information regarding landcover and landuse is an important element in forming policies regarding economic, demographic, and environmental issues at national, regional, and global levels (Ban et al. 2010).Recently, remote sensing has been used in combination with Geographical Information Systems (GIS) .It has already proved useful in mapping urban areas, and as data source for the analysis and modeling of urban growth and land use/land cover change (e.g., Grey et al., 2003, Herold et al., 2003, Wilson et al., 2003,Boori et al.,2015). Many studies have previously used Landsat for the classification of the urban landcover and landuse with different techniques. The long archive period of Landsat images offers researchers a chance to gain insights into past trends which are important when monitoring land cover changes [Turner et. al., 2015; Wulder et. al., 2016]. Haack indicated that Landsat images are used to solve problems of having inadequate information on the quality and quantity of resources, especially in developing countries (Haack,1982), Furthermore, studies which cover larger areas can be more costly if commercial satellite images are used. However, the free access to Landsat images offers opportunities to researchers who cannot afford commercial satellite images because of the higher prices [Woodcock et. al., 2008; Mayes et. al., 2015; Ernsta et. al., 2010)This solves the problem of many resource constrained researchers as these images can be accessed free of charge(Phiri and Morgenroth,2017).

In 1985 the Corine programme was initiated in the European Union. Corine means 'coordination of information on the environment' and it was a prototype project working on many different environmental issues. The Corine databases and several of its programmes have been taken over by the EEA. One of these is an inventory of land cover in 44 classes, and presented as a cartographic product, at a scale of 1:100 000. This database is operationally available for most areas of Europe. The CORINE Land Cover (CLC) inventory was initiated in 1985 (reference year 1990). Updates have been produced in 2000, 2006, and 2012 (URL1).

In this study, we have chosen Konya Province in Turkey. Konya is located geographically between 36 041 and 39 016 north latitude and 31 014 and 34 026 east longitude. Area is 38 873 km2 (excluding the lakes). This area is the province with the largest surface area. Average altitude is 1016 m. Administrative direction is surrounded by the provinces from the north of Ankara, west of Isparta, Afyon, Eskisehir, south Icel, Karaman, Antalya, from the east, Nigde, Aksaray. Konya Municipality, which was established in 1875, has reached the status of "metropolitan" in accordance with the Law No. 3399 issued in 1987. Since 1989, municipal services have been carried out according to this status. By Law No. 6360 in 2014, the borders of the metropolitan municipality were provincial boundaries (Figure1).

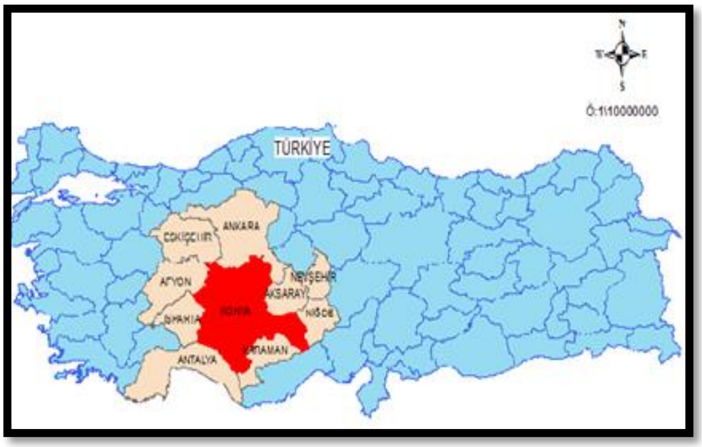


Figure 1. Study Area

Konya has experienced rapid development over the last three decades. Together with economic development, the landscape has changed significantly.

In this study, we used Landsat land use data and Corine land use data in 1990, 2000, 2006, 2012 years and compared. Land use changes in industry, agriculture, settlement and other areas obtained in the Corine and classification process, are calculated as area and evaluated as a percentage. As a result, the values obtained by Corine and classification gave consistent results. In addition, it was observed that urbanization was towards the north of the city and industrialists advanced towards the northeast of the city for the Konya province.

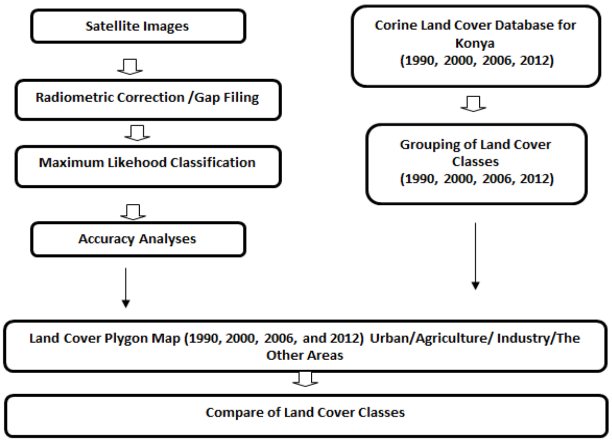
2. METHODOLOGY

Envi 5.0 software was used to process data for 1990, 2000, 2006 and 2010, and ARC-GIS 10.3 program for Geographical Information Systems (GIS) analysis. Obtained satellite images were subjected into image enhancement process and divided into 4 classes (Table 1). After the classification process, accuracy analysis was performed and land use maps for years were created. Classes from the Corine database were divided into 4 groups and land use maps of the same years were obtained. Land use maps obtained from satellite images and from Corine were compared using the GIS program (Table 2).

Table 1. Classes of Land Use in the Study Area

Landuse codes	**Landuse class**
1	settlement areas
2	agricultural areas
3	industrial areas
4	the other areas

Table 2. Study Follow Chart



2.1 Landsat Data Sets and Processing

The image was acquired on 08.06.1990, 13.07.2000, 11.05.2006, 30.07.2012 (Figure 2). Radiometric calibration is used to convert pixel values to reflectance values. After radiometric calibration, gap filing was applied on data Landsat 7 satellite images of 2006 and 2012 using in the ENVI software. Because there are gaps in the Landsat 7 satellite images of 2006 and 2012 used in the study. On 31 May 2003 the Landsat 7 Enhanced Thematic Mapper (ETM) sensor had a failure of the Scan Line Corrector (SLC). Since that time all Landsat ETM images have had wedge-shaped gaps on both sides of each scene, resulting in approximately 22% data loss. These images are available for free download from the USGS GloVis website and are found in the L7 SLC-off collection. Scaramuzza, et al (2004) developed a technique which can be used to fill gaps in one scene with data from another Landsat scene. A linear transform is applied to the “filling” image to adjust it based on the standard deviation and mean values of each band, of each scene.

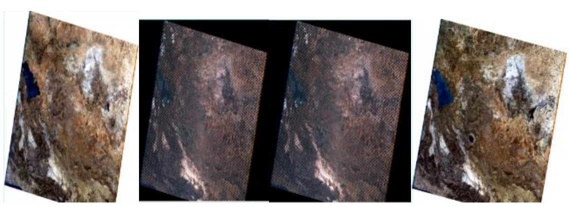


Figure 2. Konya Satellite Images for the Years 1990, 2000, 2006, 2012

The study area is divided into four main classes: Settlement, agriculture, industry and the other areas (Figure 3). Training samples were collected for these defined classes from the imagery with the support of information available in Google Earth. After taking the training samples, the Maximum likelihood (ML) classifier algorithm was applied for land cover classes on each image.

ML classification is a supervised statistical classification approach in which class signatures are assumed to have normal distributions. The ML pixel based method works on the basis of multivariate probability density function of classes (Lillesand et al., 2015). Pixels are assigned to the class which has maximum likelihood, so it is important to select training samples in such a manner that each training class follows a Gaussian distribution (Mishra et al., 2017). After classification, accuracy assessment was also performed. For accuracy assessment of landcover classified image of both datasets, 5 validation sample sets for every landcover class were taken from different locations in the image, with supporting information from Google Earth. The land classes derived in the Landsat were obtained with accuracy of 72%, 80%, 85% and 90% for the years respectively 1990, 2000, 2006 and 2012 (Table 3).

Table 3. Accuracy Rate According To Years

Years	**Accuracy Rate**
1990	%72
2000	%80
2006	%85
2012	%90

The thematic maps formed as a result of the classification are ordered according to the years. As can be understood from the classified images, settlement, industrial and agricultural areas increased, while other areas decreased gradually. Polygon digitization is performed by giving a different code number (1,2,3,4) to each terrain class to obtain the spatial values of satellite images and terrain classes selected for years. The area values of each land class created in the database are calculated in hectare and percent (%). It is thus possible to compare land classes on the Corine database.

2.2 Corine Land Cover Data

Corine land cover (CLC) is a geographic land cover/ land use database for a pan-European region. It is produced by the European Environment Agency and provides consistent information on land cover across Europe using a nomenclature of 44 standard classes which are organized in 4 levels of detail, as shown in Figure. 3,4,5,6. The CLC90 database for Greece in vector format is utilized in this study in an effort to link more effectively land cover and surface emissivity. For this purpose, the original 44 classes of Corine were grouped into only 4 ones: ‘‘urban, ‘agriculture, ‘‘industry areas’’and ‘‘the other areas’’; thus, a new land cover polygon map for each years was produced according the years (Figure. 3, 4, 5, 6). As our interest focuses mainly on settlement areas, the agricultural areas and industry and the other areas of the CLC.

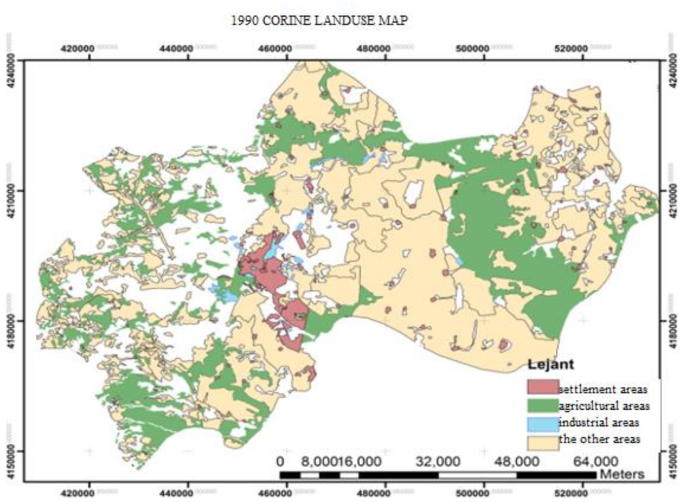


Figure 3. 1990 Corine Landuse Map

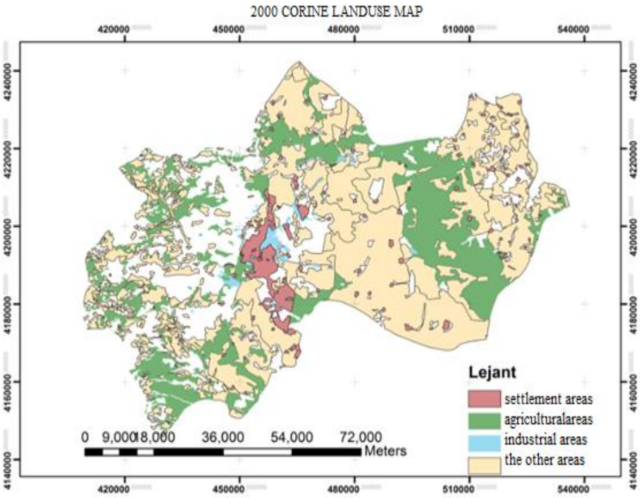


Figure 4. 2000 Corine Landuse Map

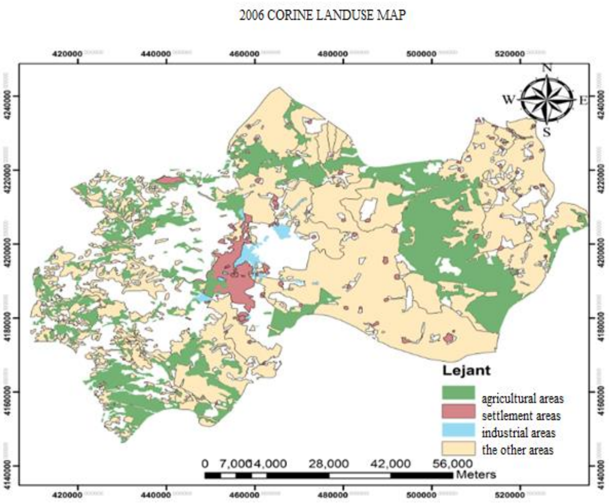


Figure 5. 2006 Corine Landuse Map

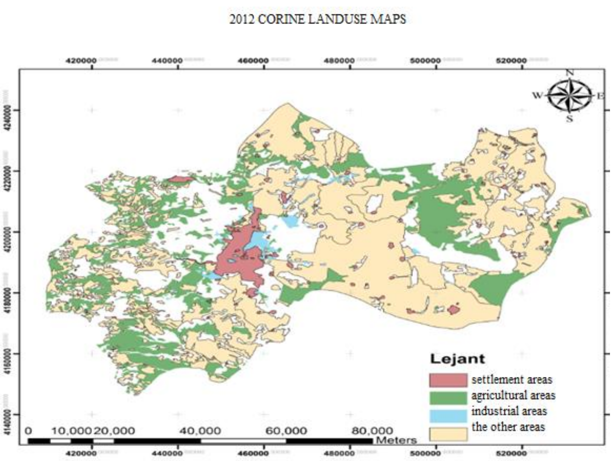


Figure 6. 2012 Corine Landuse Map

The settlement area increased by an area of 20% in 1990, by 21% in 2000, 22% in 2006 and 23% in 2012. Looking at Figure 7, urban sprawl has increased in the north and west of the city in recent years.

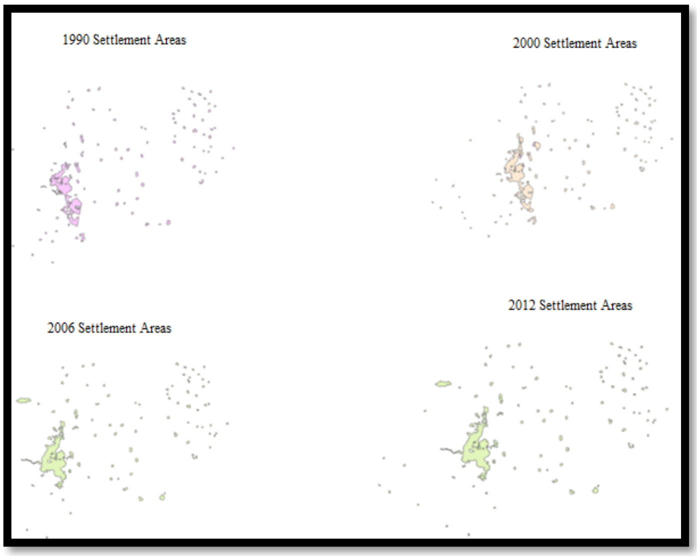


Figure 7. Change of Settlement Areas By Years

The industrialization area increased by an area of 20% in 1990, by 21% in 2000, 22% in 2006 and 23% in 2012.Looking at the increase in industrialization, it seems that an increase in industrialization has appeared in 22 years. With the increase of industrialization, settlement area will increase naturally and other areas will be decreased. As you can see, it is seen that the industrial areas are spreading to the northeast. (Figure 8).

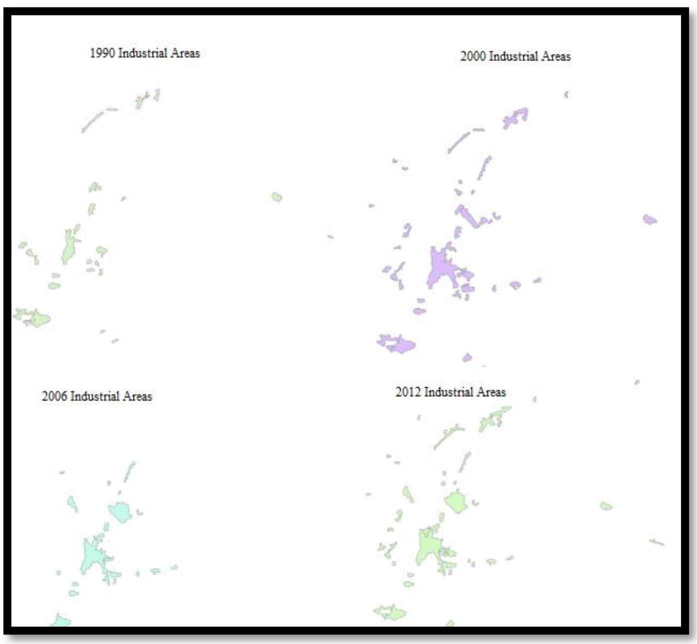


Figure 8. Change of Industrial Areas By Years

The agricultural area increased by an area of 17% in 1990, by 17% in 2000, 16% in 2006 and 18% in 2012.As seen in the above figure, there is a decrease in the northwestern part of the agricultural spread and an increase in the northeast part (Figure 9).

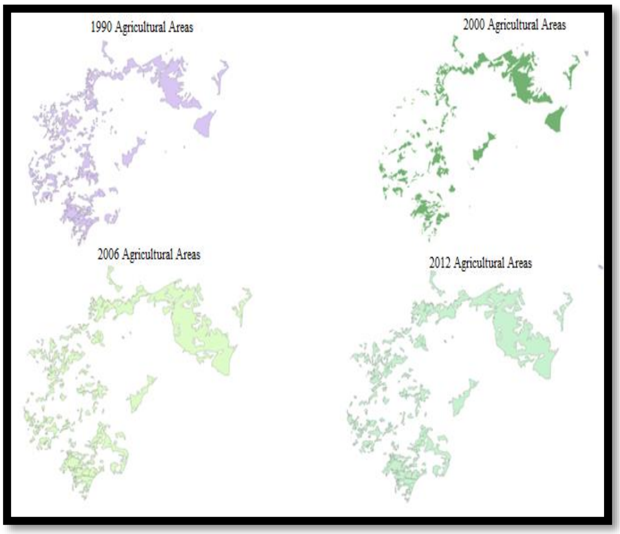


Figure 9. Change of Agricultural Areas By Years

3. RESULTS AND DISCUSSION

Landsat and Corine were compared in terms of percent area and near values were observed (Table 4).

Tablo 4. Landsat and Corine were compared in terms of percent area

		LANDSAT			
		1990	2000	2006	2012
settlement		23.006629	25.153029	25.796236	26.953511
agriculture		15.182117	16.048828	16.269727	17.689420
industrial		18.033751	18.120939	19.121160	19.252333
the other areas		43.777503	40.677205	38.812877	36.104736
all areas		100.000000	100.000000	100.000000	100.000000
		CORİNE			
		1990	2000	2006	2012
settlement		20.69055963	20.70095269	21.94346909	22.64682942
agriculture		17.30757974	17.55687967	17.86522685	18.39974933
industrial		17.38820497	18.4559155	18.86577937	19.0020518
the other areas		44.61365566	43.28625214	41.32552469	39.95136945
all areas		100.000000	100.000000	100.000000	100.000000

The settlement area increased by an area of 20% in Corine and by an area of 23% in Landsat in 1990, by 21% in Corine and 25%in Landsat in 2000, 22%in Corine and %26 in Landsat in 2006 , 23% in Corine and %23 in Landsat 2012.

Looking at the increase in urbanization, it seems that a very rapid urbanization emerged within 22 years. Taking the city into the scope of the Metropolitan Municipality as of 1989 and rapid industrialization in the city have been the biggest factors in the acceleration of urbanization. The fact that the city is built on the plains has affected the rapid construction in a positive way. The fact that the city is located at the South-east gate of the western part of the city is another influence on the rapid urbanization. Established in 1975 but with the establishment of various faculties in 1982, Selçuk University made a major contribution to the city in every way.

The industrialization area increased by an area of 17% in Corine and by an area of 18% in Landsat in 1990, by 17% in Corine and 18%in Landsat in 2000, 17%in Corine and %19 in Landsat in 2006, 18% in Corine and %19 in Landsat 2012.İt seems that industrialization is increased within 22 years.

The agricultural area is by an area of 17% in Corine and by an area of 15% in Landsat in 1990, by 17% in Corine and 16%in Landsat in 2000, 17%in Corine and %16 in Landsat in 2006, 18% in Corine and %17 in Landsat 2012.

4. CONCLUSION

Konya is the one of the cities with fertile agricultural lands with high growth rates. In the last 50 years, the population has experienced a great increase and it has been growing as a settlement area. In the field survey conducted in Konya, it has been seen that the natural areas around the area during this growth process were greatly affected by urbanization.

Today, remote sensing methods have gained importance in many different disciplines, and they have provided great convenience, low cost and speed to research fields of these disciplines. The land use maps obtained from the satellite images give similar results when compared with the data obtained from Corine. Instead of creating terrain classes in satellite imagery for terrestrial applications for the years 1990, 2000, 2006 and 2012, ready-made classes in high-resolution Corine data can be used.

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AN INDOOR POSITIONING STUDY BASED ON THE WI-FI FINGERPRINTING METHOD

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ABSTRACT:

Indoor Positioning is a very popular research area because of its wide range of applications, mainly providing location-based services. Many technologies and methods are suggested for estimating the location of the user in indoor environments where GNSS signals are mostly attenuated or completely lost. Some of these technologies are Bluetooth Low Energy, Wi-Fi, RFID, ZigBee and so on. The methods used for position estimation are various methods such as Angle of Arrival (AoA), Time of Arrival (ToA), Fingerprinting, Dead Reckoning and Map Matching. Among these methods, fingerprinting is promising and mostly preferred method.

Location fingerprinting consists of two phases:'training' and 'positioning'. In the training phase, the indoor space is divided into grid network to form points called reference or calibration points. At these points, Wi-Fi signal strength measurements are made to train the system, that is, to create a fingerprint database. A typical fingerprint database contains local or global coordinate information for a reference point along with information about the BSSID (Basic Service Set Identifier) and received signal strength (RSS) information for the access points at that point. In the positioning phase (Online Phase) the received signal strength information obtained at any location in the indoor area is transmitted to the server or client-side database, where it is presented as input to the vector distance algorithm. The user coordinate is calculated as the closest match result.

Ideal IPS systems offer high location accuracy as well as low cost. For this reason, systems using existing infrastructure are preferred. Therefore, the WLAN infrastructure established in almost every building today is very convenient for this work. It can also be applied easily by fingerprinting method. However, the accuracy to be achieved without making any changes to the WLAN infrastructure will be limited if the distribution or quantity of AP's are not sufficient.

In this study, fingerprinting with Wireless LAN signals was applied in Selcuk University Faculty of Engineering and obtained accuracy was examined. Several factors have been taking into account, such as the location of access points that affect location accuracy, and the number of access points on a floor.

KEY WORDS: Indoor Positioning, WLAN, Fingerprinting, Nearest Neighbour

[1]* Corresponding author. This is useful to know for communication with the appropriate person in cases with more than one author.

1. INTRODUCTION

According to the environment where the positioning is conducted, positioning can be classified into two types: outdoor positioning and indoor positioning. The former is performed outside buildings where the open sky is visible to the receiver in case of GNSS methods. These satellite systems require direct line-of-sight signals for precise location estimation, which is not the case in most indoor environments. Also, the GNSS signals cannot penetrate through the walls and other solid materials hence majority of the signal attenuates and unable to reach to the indoor area. Due to the increased demands for accurate indoor positioning, it has become an active research area in which different solutions have been proposed. Therefore, both the research and commercial products in this area are new, and many people in academia and industry are currently involved in the research and development of these systems.

Considering indoor positioning, the term Signals of Opportunity (SoOP) is an important notion. It refers to the use of any signals for navigation, which are not normally intended for navigation. Such signals include Wi-Fi, radio broadcast signals, cellular network signals, Bluetooth etc. Various studies include: Wi-Fi (Zandbergen 2009, Zheng, Chen et al. 2015, Mathisen, Sorensen et al. 2016, Thuong, Phong et al. 2016), Bluetooth (Liu, Jiang et al. 2014, Zhao, Xiao et al. 2014), FM radio (Chen, Lymberopoulos et al. 2012, Yoon, Lee et al. 2013), radio-frequency identification (RFID) (Ni, Liu et al. 2003, Wang and Katabi 2013, Yang, Chen et al. 2014), ultrasound or sound (Sun, Purohit et al. 2011, Huang, Xiong et al. 2014), light (Kuo, Pannuto et al. 2014, Yang, Wang et al. 2015), magnetic field (Chung, Donahoe et al. 2011, Xie, Gu et al. 2014), etc.

In this study, the accuracy of the WLAN fingerprinting method was investigated. For this purpose, a mobile application for Wi-Fi scanning and a desktop application for analysing the data was developed, and still continuously being updated for more functionality. Measurements have been taken at Block A of the engineering faculty building of Selcuk University and existing WLAN infrastructure was unchanged.

2. WI-FI FINGERPRINTING METHOD

Fingerprint-based positioning methods are based on models related to "Received Signal Strength" (RSS) measurements from the location where the measurements are made from access points (AP) near the mobile device.

The fingerprint positioning method consists of two stages: offline or calibration phase and online or positioning phase. (Location Estimation). During the calibration phase, the received signal strength information (RSSI) from several nearby access points is measured at points placed at specific grid network locations, called calibration points (CP) or reference points (RP). With this process, a specific RSS measure is assigned to a specific point within the measured region where coordinates are determined. In other words, these measures are called fingerprints of the calibration points, which become part of the calibrated signal map. The signal map keeps the received signal strength information of the radio signals collected as a function of the location and covering the area concerned.

The Design of the signal map is an important part of the location fingerprinting process and is influenced by many factors. In each point, the fingerprint database and location information is created by extracting a signal pattern from the data collected in the offline phase.

During the online positioning phase, a set of real-time collected RSS metrics from nearby access points are compared with the signal patterns stored in the database and matching algorithms choose the closest database entry. In other words, the coordinate of the user location is obtained from the database elements having the closest match to the measured signal vector of the collected signal sample.

One of the downsides of the fingerprinting approach is that it is time consuming and cumbersome to collect data that will form a fingerprint database. Another issue to consider is that the collected RSS values are compared with the samples in the database and the applied methods are directly related to the positioning accuracy. Also, location accuracy highly varies according to the physical properties of the indoor environment and the number of access points. In addition, the need to calibrate heterogeneous devices with different Wi-Fi capabilities and the changes that are made in the Wireless Network infrastructure of the system affects the accuracy of positioning negatively.

To determine the location of the Mobile User (MU), K-Nearest neighbour (KNN) method is one of the simplest and common method. The Euclidian distance of Received Signal Strength (RSS) of i'th CP and user's is calculated by

$$D_i = \sqrt{\sum_{j=1}^{n}\left(RSS_{ij} - RSS_j\right)^2} \quad (1)$$

Mobile user's location is then estimated by averaging the coordinates of K nearest fingerprint by

$$\mathbf{x} = \frac{1}{K}\sum_{i=1}^{K} \mathrm{D}_i, \quad (2)$$

3. APPLICATION

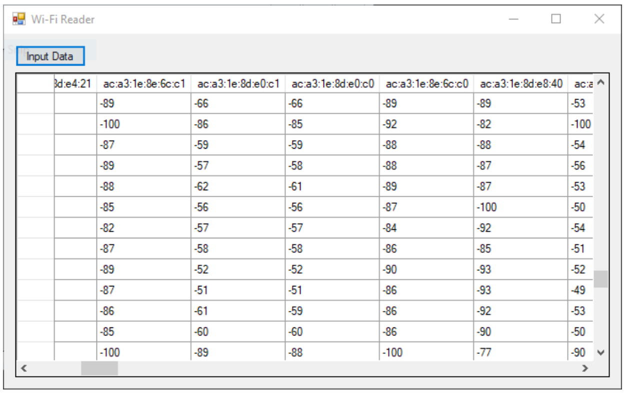
Konya Selcuk University Engineering Faculty Block A building was chosen for the research and experiments (Figure 1). The whole faculty consists of a total of 9 blocks and 3-4 floors above ground. Within the faculty there are WLAN networks with the same equipments in all blocks, Eduroam and SelcukWireless networks are available. The wireless local area network is provided by the Aruba 2xx series of access points (APs), which are available in all corridors.

Figure 1 Engineering Faculty Building

A mobile software was developed and used to perform signal strength measurements at the calibration points for the offline phase (Figure 2).

Figure 2 Wi-Fi Gatherer Mobile Application

With this tool, collection of BSSID (Basic Service Set Identifier), signal strength and other information about the Wi-Fi signal (such as frequency) can be achieved easily. When this information is combined with other parameters (Coordinates, Building ID, Floor) of the calibration point, the raw data required to create a complete database is obtained. This information is referred to as raw data because, for a system ready for positioning, it is necessary to perform some operations on the data. In Figure 3, part of this raw data can be seen.



Wi-Fi Reader

Input Data

	3d:e4:21	ac:a3:1e:8e:6c:c1	ac:a3:1e:8d:e0:c1	ac:a3:1e:8d:e0:c0	ac:a3:1e:8e:6c:c0	ac:a3:1e:8d:e8:40	ac:a
		-89	-66	-66	-89	-89	-53
		-100	-86	-85	-92	-82	-100
		-87	-59	-59	-88	-88	-54
		-89	-57	-58	-88	-87	-56
		-88	-62	-61	-89	-87	-53
		-85	-56	-56	-87	-100	-50
		-82	-57	-57	-84	-92	-54
		-87	-58	-58	-86	-85	-51
		-89	-52	-52	-90	-93	-52
		-87	-51	-51	-86	-93	-49
		-86	-61	-59	-86	-92	-53
		-85	-60	-60	-86	-90	-50
		-100	-89	-88	-100	-77	-90

Figure 3 Wi-Fi Raw Data Reader

When the signal strength information is gathered at the calibration points, signals that are not very healthy and very low power are recorded too. These signals need to be eliminated from the process because they are either too far away or are caught from above or below floor access points. For a consistent positioning, signal time series should be similar to Figure 4 Sample-2.

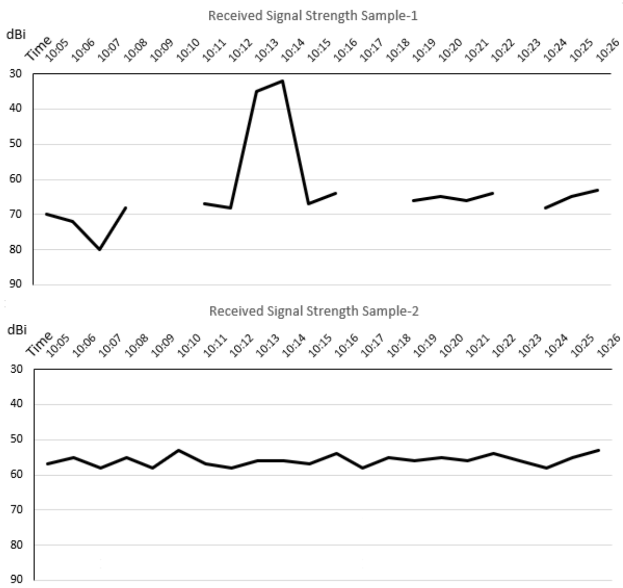


Figure 4 RSS Sample Readings

As can be seen from Figure 5, MSE values increase with K. Also increasing the value of K leads to more data processing in positioning and accordingly more higher error values. However, employing more access points can improve the accuracy and lower the MSE values.

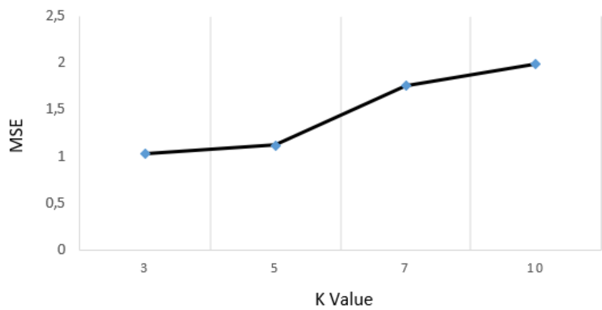


Figure 5 Effect of K-Value on Accuracy

4. RESULTS

At each calibration point, 10 repetitive measurements were taken, and their averages were used. The average positioning error was found to be 1.33 m in Y direction and 0,55 m in X direction. It should be noted that these error values depend on many criteria. The network infrastructure in the building can be arranged for indoor positioning without compromising the wireless connection.

In addition, a few additions to the existing infrastructure can improve positional accuracy while at the same time enabling the positioning system to work in dead spots.

Things to consider for future work:

- Using sophisticated software along with advanced algorithms will positively affect the positional accuracy of indoor positioning system.

- For a system that can work seamlessly in complex structures formed by the merging of multiple buildings, the most suitable fingerprint generation model should be selected in terms of performance and processing power.

- Algorithms must be created to eliminate the need for devices with different Wi-Fi capabilities to be calibrated to determine location.

- Using different technologies (such as Sensor Fusion) that can work together with the fingerprinting method can benefit the system.

5.

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AN ECONOMIC ANALYSIS OF LAND CONSOLIDATION IN THE KONYA-DOKUZ DISTRICT, KONYA

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ABSTRACT:

An economic analysis was carried out in the land consolidation project of Dokuz district in Konya, Turkey. The main target of our research is land consolidation project data of about 112 ha. The aim of work to determine the current state of the enterprises after the land consolidation and contribute to the future policy to be implemented. Therefore, in the land consolidation project implementation area, the return status of the social and economic aspects were examined. Before the consolidation, the ratio of the rectangular shape parcel was 5.93 % and this ratio increased to 58.4 %. Before the consolidation, while the proportion of shapeless parcels was 79.64 % and this ratio decreased to 21.04 %. The average parcel size was increased only about 0.11 % after consolidation. Before the study, in the project area the total parcel border length was 386.86 km and this length was reduced to 251.79 km after the consolidation. So that the economic benefits of the consolidation projects have been expressed with clearer values.

KEY WORDS: Land consolidation, Land reallocation, Economic analysis,

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1. INTRODUCTION

One of the most important problems we face today is that it cannot be increased sufficiently in agricultural production parallel to the growing population. Since it is not possible to increase the agricultural area, it is necessary to optimize the use of existing agricultural areas in order to meet the food needs of the growing population and to ensure food safety. Therefore, the efficiency obtained from the unit area and the income obtained should be increased. With increased productivity, new technology and proper application of agricultural practices; while revenue growth can be achieved by reducing production costs. For this reason, land consolidation is important because it limits the demand for labor, thus reducing production costs, increasing the efficiency of agricultural applications and reducing the investment costs of in-field development services to a great extent (Altıntaş ve Akçay, 2009).

Land consolidation (LC) studies are carried out in many countries in order to improve the production and working conditions in agricultural areas, thereby increasing the yield and ensuring the continuity of product acquisition (Boztoprak ve ark., 2016).

Land consolidation can be definable that economic and social measures to raise the living standards of the farmer's family by bringing together the fragmented, scattered and deformed parcels that will prevent the economical agriculture and make it difficult to take soil protection and irrigation measures (Polat ve Manavbaşı, 2012). There are many benefits of LC projects, especially access to the parcels, effective use of water resources, and combine of the parcels, reduction of the costs of irrigation and drainage projects (Arslan ve Tunca, 2013). Land Consolidation is not only limited to the development of agriculture, but also contributes to the development of natural resources and rural development (Li and ark, 2012).

In our country Land Consolidation studies was begun in 1961. Between 1961 and 2002, 450.000 hectares (ha) of land consolidation studies were carried out. These studies reached 132,000 hectares between in 2003-2007 and 4.5 million hectares between in 2007-2015. At the end of h2015, 5.1 million hectares of land consolidation work was completed. Also at 1.9 million hectares of area land consolidation works have gone on. Priority in Land Consolidation studies in our country; 8.5 million hectares of land to be opened and will be opened for irrigation area are to complete land consolidation work on agricultural land. The Land Consolidation studies in the area of 14 million hectares are planned to be completed by 2023. The target in this issue is to complete the 1st generation land consolidation of our country in 2023 (Anonim, 2017).

In general, Land Consolidation is the reallocation of a large number of fragmented and scattered lands according to modern agricultural management and principles. However, in reality, land consolidation in a broad sense has been associated with economic and social regulation (Ertunç, 2018). According to this approach, Land Consolidation not only combine scattered land but also in order to maximize efficiency and increase labor productivity to make the necessary improvements in all areas of agriculture and take all the social, technical and cultural measures that will increase the welfare level of the farmer.

Land Consolidation projects are so important and the benefits that they provide have made it necessary to conduct economic analyzes of these projects. In this study, an economic analysis of the project was carried out in the district of Dokuz, Selçuklu, Konya province, which was completed in 2017, in order to see to what extent the benefit achieved from a Land Consolidation project has been realized.

2. MATERIAL AND METHODS

The basic material of the research is the consolidation project data made in the district of Dokuz, Selçuklu district of Konya. This project was carried out by the General Directorate of Agricultural Reform in accordance with the provisions of the Agricultural Reform Law on Land Regulation in Irrigation Areas No. 3083.

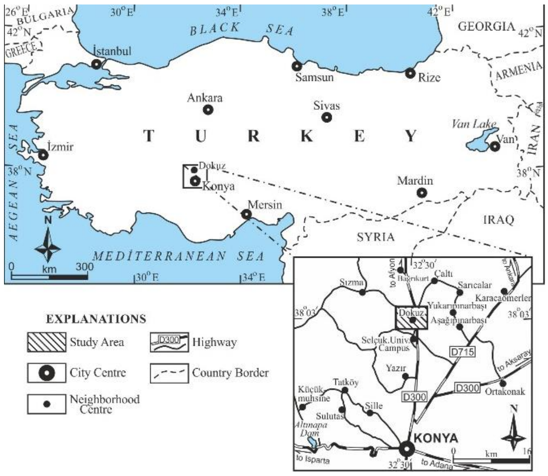

Figure 1. The project area

The project area, Dokuz District belongs to the province of Selçuklu, Konya. The Dokuz districts are 22 km from Konya and 12 km from Selçuklu. 381 people live in the district. The economy of the project is depend on agriculture and animal husbandry.

Figure 2. Cadastral status

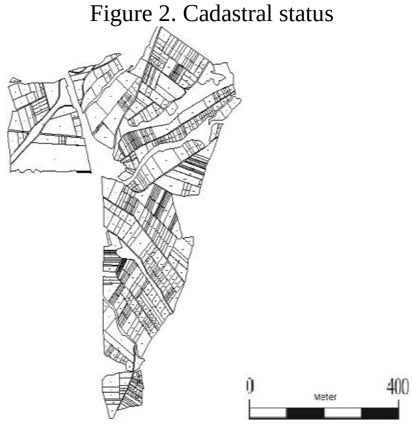

Figure 3. After consolidation status

When the number of parcels is examined in the area where consolidation is made, the old and new conditions of the parcels belonging to the enterprises are as follows: With 388 cadastral parcels in the Dokuz district, the number of parcels decreased to 366 as a result of the consolidation. Numbers of shareholders parcels in cadastral status are 67. After Consolidation shareholders parcel has not occurred. The consolidation ratio is 5%. Before consolidation, the average number of parcel per enterprises is 0.46, but after consolidation this number has decreased to 0.40. Figure 2 shows the cadastral status and Figure 3 shows the status after consolidation.

3. RESULTS AND DISCUSSION

3.1 The Effect of Land Consolidation on the Shape and the Size of Parcels

One of the main purposes of land consolidation is the adjustment of parcel shapes which are triangle, trapezoid or any geometric shape. The parcel border losses increase as the parcel border shapes move away from the proper geometry, therefore unprocessed field loses increase in the work of agricultural machinery. The geometric parcel shape reallocation of the before consolidation and after consolidation in the project area are shown in Table 1.

	Rectangle		Trapezoid		Polygon and shapeless	
	Number	%	Number	%	Number	%
Before	23	5.93	56	14.43	309	79.64
After	214	58.47	75	20.49	77	21.04

Table 1. The geometric parcel shape reallocation of the before and after consolidation

As can be seen in Table 1, the ratio of the rectangular form of the parcel before the consolidation was 5.93%, but this ratio increased to 58.47% after the consolidation. Likewise, the proportion of shapeless parcels before the consolidation was 79.64%, but it decreased to 21.04% after the consolidation.
According to a survey on the effect of the land shapes on work performance; it was found that if a work performance on the rectangle shaped land supposed 100, this yield decreased to 96.7 for the trapezoid and 90.9 for the polygonal shape (Çevik and Tekinel, 1992). According to this study, our employment rate in our application area increased from 91. 07% to 96.05%.

3.2. The effect of land consolidation on averaged parcel size

According to the 2011 data Of Republic of Turkey Ministry Of Agriculture And Forestry "Farmer Registration System" the average parcel size is 6.8 ha in our country. After the consolidation in the project area the average parcel sizes of enterprises increased from 0.6 ha to 0.7 ha and this ratio is well below the average in Turkey. The reason of this, the fact that there are few enterprises with large fields in consolidation area and there are a lot of small shareholders parcels. The average parcel sizes for the project area are shown in Table 2. The average parcel size in the project area has increased by 11%.

Average Parcel Size	Area (ha)	Increase percentage (%)
In the old case	22525.029	-
In the new case	25002.711	% 11

Table 2. Average parcel size of project area

3.3. The effect of land consolidation on parcel borders

In the project area, the parcel border length before the consolidation was 386.86 km, and after the consolidation, the parcel border length was 251.79 km. The land gain based on the consolidation border is 135.07 km. There is no planting in a 0.40 m wide land in the field farming because it cannot approach the parcel border. The amount of unprocessed soil (0.40 * 135.07) is 54. This situation is shown in Table 3.

	Before the consolidation	After the consolidation
Border lengths (m)	386861.37	251794.59
Land gain based on border (m)		135066.78
Land gain based on border (m^2)		54026.712

Table 3. Examination of parcel borders

3.4. Economic Benefit of Border Gain from Land Consolidation

Barley, sugar beet, wheat planting are made in the project area. The yield, the selling price and the product cost data of the products are taken from the Konya Provincial Directorate of Food, Agriculture and Livestock and are shown in Table 4.

Products	Barley	Sugar beet wheat	Wheat
Amount of the soil to be treated (da)	54	54	54
Yield (kg/da)	180	5500	180
Total product yield (ton)	9.72	297	9.72
Selling price (TL/kg)	0.73	0.21	0.93
Product revenue (TL)	7095.6	62370	9039.6
Product cost price (TL/kg)	0.64	0.16	0.70
Product cost (TL)	6220.8	47520	6804
Net income in the amount of soil to be treated (TL)	874.8	14850	2235.6

Table 4. The effect of parcel borders on the products

Net incomes of the enterprises are calculated on the main product. Factors affecting cost price here are planting, fertilization, spraying, harvesting and labor costs.
Irrigation water, road and border disputes among farmers are very efficient in the deterioration of social peace. With the Land Consolidation, border infringements are prevented and the material used to protect the parcels is also saved. The borders are surrounded by wire. A garden wire which has 30 m average length, is 40 TL. The profit from this situation is shown in Table 5.

Enterprise number: 90	Before consolidation	After consolidation
Number of parcels	7	3
Border lengths (m)	5909.07	3083.96
Land gain (m)		2825.11
Wire cost (TL)	7878.76	4111.95
Gain (TL)		3766.81

Table 5. Impact of border length on enterprise

3.5. Economic Analysis of the Land Consolidation and the proximity to the Parcels Owned by the Enterprises

After the consolidation, the distance between the parcels of enterprise number 90 decreased by 4845 m. This allows a significant amount of fuel, time and labor savings to enterprise. There are 249 enterprises in the project area and, if the other enterprises taken into account, the consolidation provides significant economic benefits.

A standard tractor on a straight road consumes 0.2 liters of diesel per kilometer when it is not in any agricultural activity. The diesel savings from the reduction of the distance between the parcels is only 0.97 liters for going. Because agricultural products such as barley and wheat grown in the Central Anatolia region are grown in the project area, fields are being plowed every year in the spring and autumn to increase the productivity of the soil. Farmers must go to and come their fields at least 6 times for the planting, fertilization, harvesting of crops. For the enterprise number 90, it is possible to save at least 5.82 liters of fuel in only transit between fields every year.

3.6 The effect of the Land consolidation on shareholders parcels

In the project area, the number of shareholders parcels is quite high. However, no shareholders parcel was left after the consolidation. Thus, the social problem that arises from being a shareholder has been solved. Table 6 shows the status of the shareholders parcels owned by some enterprises after the consolidation.

Enterprise number	Total number of parcels	Shareholders parcel number before LC	Shareholders parcel number after LC
24	8	7	0
34	9	7	0
38	7	7	0
205	5	5	0

Table 6. Number of shareholders parcels of some selected enterprises before and after consolidation

3.7 Costs of Maintenance of Decreasing Enterprises due to the Parcel Shape Adjusted after the Consolidation

Since the application of Land Consolidation projects and the fragmented and scattered parcels are combined and the number of parcels is decreased and new planned roads are constructed, the way to access the parcels of the farmers is decreasing. Besides, due to the parcel shape, there are areas where the machine is not used, which increases the number of workers and their expenses, increases the cost of maintenance. Table 7 shows the information for the enterprise number 90.

Enterprise number: 90	Before consolidation	After consolidation
Number of parcels	7	3
Amount of land owned by enterprise (m^2)	72378.879	116294.457
Parcel shape	Irregular	Rectangle
The effect of parcel shape on work efficiency	% 90.9	% 100
Border lengths (m)	5909.07 m	3083. 96 m
Land gain (m)	-	2825.11 m
Distance of parcels to enterprise center (m)	3563 m	2158 m

Table 7. Information about before and after consolidation of the selected enterprise

The distance between the parcels of our enterprise, the parcels of which are scattered before the consolidation, is 3563 m. After the consolidation, this distance decreased to 2158 m. The difference is 1405 m. The amount of diesel (0.2 * 7,126 km) consumed by the farmer before the consolidation project is calculated is 1.42 liters. After the consolidation, the farmer consumes 0.86 liters of diesel. 0.56 liters of fuel is saved when the enterprise goes to the parcels only once.

4. RESULTS

In this study, economic analysis of the agricultural enterprises in the areas where land consolidation was done in Dokuz district of Konya province were made. Increasing the number of rectangular shaped parcels in the project area after consolidation increased work efficiency. After consolidation, the area that cannot be planted close to the border has decreased. By collecting the farmers' parcels, gains such as fuel, labor and time were obtained. The removal of the shareholding situation after the consolidation is also a social gain.

It has now been adopted all over the world that the consolidation projects are very important for the development of the rural area and for improving the living standards of the farmer. The results of the economic analysis carried out in the study also show that both the economic development and the agricultural products increase after the consolidation. This is very important for developing countries like our country. Therefore, land consolidation projects must be accelerated and the 1st Generation Land Consolidation must be completed.

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GEOID HEIGHT CALCULATIONS BY DIFFERENT INTERPOLATION METHODS

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ABSTRACT:

GNSS/levelling technique is the most effective engineering method for the determination of heights and height differences. This method is based on the principal of conversion of ellipsoid heights to orthometric heights. The users need the conversion between the ellipsoidal height and orthometric height in many GNSS applications. Levelling measurements conducted with the purpose of determining the orthometric heights on points are quite arduous and time-consuming processes. To be able to use ellipsoid heights in engineering projects, their transformation to orthometric heights defined in the height datum of the region is necessary. For transformation, polynomial surface models are generally used for study region or area. The accuracy of results depends on the location and distribution of selected reference stations with known ellipsoidal and orthometric heights.

In this research, GNSS/levelling data of test area was used in order to examine different interpolation methods. It consists of total 95 points, 36 of which are benchmarks and 59 of which are traverse stations. Orthometric heights (H) of the benchmarks and traverse stations were carried out with geometric levelling method in the datum of Turkey National Vertical Network (TUDKA). The geographic coordinates including ellipsoidal heights (h) were determined in static positioning mode and referred to Turkish National Fundamental GPS Network (TUTGA). The ground control stations of the test area were classified as reference and test for the purpose of this research. Within the scope of application, benchmarks were selected as reference points and traverse stations were selected as test (ground control) points. The geoid heights of test stations were calculated by the different interpolation methods.

KEY WORDS: GNSS/levelling, Polynomials, Geoid undulations, Interpolation

1. INTRODUCTION

In the most general sense, the concept of height can be defined as the distance between a point on the earth and the starting surface. Heights can have physically and geometrically meanings. In general, it is more suitable to use the heights related to the gravity, that is, the physical heights, in engineering projects. The most important reason for this is the physical laws, that is, in the simplest terms, the flow of water is related to the gravitational field. In general, two types of height are more commonly used in our country than others. These are orthometric and ellipsoidal heights. Orthometric heights which have a physical meaning and are defined as the vertical distance along the plumb line between the point on earth and the geoid can be used in engineering projects and mapping applications. On the other hand, the ellipsoidal heights are obtained by GPS and do not have a physical meaning and are based on geometric bases.

Levelling measurements conducted with the purpose of determining the orthometric heights on points are quite arduous and time-consuming processes. To be able to use ellipsoid heights in engineering projects, their transformation to orthometric heights defined in the height datum of the region is necessary. Therefore, in terms of convenience and feasibility GNSS/levelling method is preferred in determining geoid heights. This method is based on the principle of transformation of ellipsoid heights to orthometric heights. In effect, the main purpose of the method can also be regarded as the estimation of geoid undulation values for the study area (Doganalp and Selvi, 2015).

In this paper the accuracy of different interpolation methods are tested and compared. These methods are Kriging, Inverse Distance Weighting, Radial Basis Functions and Polynomials. For this purpose, GNSS/levelling data of test area which is 95 points were used in order to examine these methods.

2. MATERIAL AND METHOD

Different prediction methods such as Polynomials, Triangulation/Linear Interpolation, Kriging, Shepard's Method's, Nearest Neighbor, Minimum Curvature, Least Squares Collocation (LSC), Artificial Neural Networks, Fuzzy Logic and Radial Basis Functions (Multiquadric-MQ, Inverse Multiquadric, Thin Plate Spline-TPS, Natural Cubic Spline-NCS, Multilog, Linear, Gaussian) etc. have been widely used in geoid heights determination. Generally, the methods are separated from each other according to the fields and mathematical structures used. In addition, each technique has advantages and disadvantages relative to each other.

In this study, the geoid surfaces of the test area have been created by Surfer 13® mapping and modelling software. It would be appropriate to briefly explain the basic properties of the methods used in the study. Detailed information is available from references. Kriging method is one of the more flexible and accurate gridding methods and is useful for gridding almost any type of data set. Kriging is effective because it produces a good map for most data sets. It also can compensate for clustered data by giving less weight to the cluster in the overall prediction. One of the disadvantages to Kriging is that it can be slower than other methods. There are two types of Kriging available in Surfer: point Kriging and block Kriging. Point Kriging, the default, is simple and estimates the value of a point from a set of nearby values. Block Kriging estimates the average value of the rectangular blocks centered on the grid nodes. The blocks are the size and shape of a grid cell. The advantage to use Block Kriging is that it often provides better variance estimates and smooth interpolated results. However, Block Kriging is not an exact interpolator because it is not estimating the value at a point. If the neighboring cells share a data point then that point is used to estimate the value of the grid node in each of the blocks (Golden Software, 2018).

Polynomial interpolation methods are widely used especially in determining local geoid heights with the GNSS/levelling method. The main purpose of this method is based on the expression of the studied area with only one function (Doganalp, 2016). To be able to implement the method, reference points in sufficient number and scatter, of which orthometric (H) and ellipsoidal height (h) are known, are needed. With the help of these points, local geoid model is formulated (Doganalp and Selvi, 2015).

Radial basis function (RBF) methods have an important role in field of applications such as numerical analysis, mathematical research and statistics. Also, the RBF methods is one of the most important methods used to solve the problem of interpolation of scattered data in many disciplines. The first application areas of RBF methods appeared in the fields of cartography, geodesy and mapping. Later, the RBF methods have begun to be used in a wide range of areas such as geography, statistics, neural networks and artificial intelligence, signal processing, mathematics and engineering etc. (Doğanalp and Çakır, 2017). The Radial Basis Function gridding method is an exact interpolator which means your data is honored. The real-value function depends on the distance from the origin. This method is similar to Kriging in that it is flexible and it generates an accurate interpretation of most data sets. The method can handle large sets of data and produce a smooth surface. However this is not an ideal method if the data has large changes in surface values within short distances (Golden Software, 2018).

The Inverse Distance to a Power gridding method is a weighted average interpolator, and can be either an exact or a smoothing interpolator. With Inverse Distance to a Power, data are weighted during interpolation such that the influence of one point relative to another declines with distance from the grid node. Weighting is assigned to data through the use of a weighting power that controls how the weighting factors drop off as distance from a grid node increases. The greater the weighting power, the less effect points far from the grid node have during interpolation. As the power increases, the grid node value approaches the value of the nearest point. For a smaller power, the weights are more evenly distributed among the neighboring data points. Inverse Distance to a Power is fast but has the tendency to generate "bull's-eye" patterns of concentric contours around the data points. Inverse Distance to a Power does not extrapolate geoid values beyond the range of data (Golden Software, 2018).

3. APPLICATIONS

The study area consists of total 95 points, 36 of which are benchmarks and 59 of which are traverse stations. Orthometric heights (H) of the benchmarks and traverse stations were carried out with geometric levelling method in the datum of Turkey National Vertical Network (TUDKA). The geographic coordinates including ellipsoidal heights (h) were determined in static positioning mode and referred to Turkish National Fundamental GPS Network (TUTGA). Points in the study area were classified as reference and test (ground control) points. While the orthometric height (H) values of the reference points (36 pts) ranging between 849.20 and 1225.55 m, ellipsoidal height (h) values ranging from 883.89 to 1260.60 m. Similarly, according to the test points (350 pts) heights are ranging between 849.25-1224.80 m and 883.94-1259.80 m for orthometric and ellipsoidal heights, respectively. Geoid heights were first calculated with the above methods and then standard deviations (std), minimum values (min), maximum values (max), mean values (mean) and range values have been presented (Table 1). The values in Table 1 belong to the differences between true and estimated geoid undulations. Similarly, the figures of the obtained results are given for all interpolation methods in order (Figure 1-22). In all figures, the red circles show the test points and the black triangles show the reference points.

Table 1. Performance statistics of Inverse Distance, Kriging, RBF and Polynomial methods (units: meter)

Method		std	min	max	mean	range
Inverse Distance to Power	Power: 1	0.0841	-0.1783	0.1649	0.0238	0.3432
	Power: 2	0.0310	-0.0517	0.0694	0.0174	0.1211
	Power: 3	0.0219	-0.0373	0.0630	0.0164	0.1004
	Power: 4	0.0233	-0.0378	0.0645	0.0166	0.1023
	Power: 5	0.0249	-0.0382	0.0647	0.0169	0.1030
	Power: 10	0.0295	-0.0662	0.0840	0.0174	0.1502
Kriging	Point	0.0196	-0.0339	0.0489	0.0139	0.0827
	Block	0.0193	-0.0418	0.0461	0.0120	0.0879
RBF	Inverse MQ	0.0223	-0.0391	0.0503	0.0122	0.0894
	MQ	0.0205	-0.0362	0.0489	0.0140	0.0851
	NCS	0.0219	-0.0372	0.0555	0.0143	0.0927
	TPS	0.0212	-0.0367	0.0514	0.0144	0.0881
	Multilog	0.0198	-0.0359	0.0534	0.0141	0.0894
Polynomial	Degree: 1	0.0246	-0.0427	0.0661	0.0116	0.1088
	Degree: 2	0.0225	-0.0407	0.0587	0.0117	0.0994
	Degree: 3	0.0216	-0.0389	0.0556	0.0118	0.0945
	Degree: 4	0.0211	-0.0373	0.0534	0.0119	0.0907
	Degree: 5	0.0208	-0.0361	0.0523	0.0120	0.0884
	Degree: 8	0.0206	-0.0346	0.0512	0.0126	0.0858
	Degree: 11	0.0208	-0.0348	0.0509	0.0130	0.0857
	Degree: 15	0.0210	-0.0353	0.0545	0.0135	0.0897
	Degree: 20	0.0218	-0.0356	0.0712	0.0141	0.1068

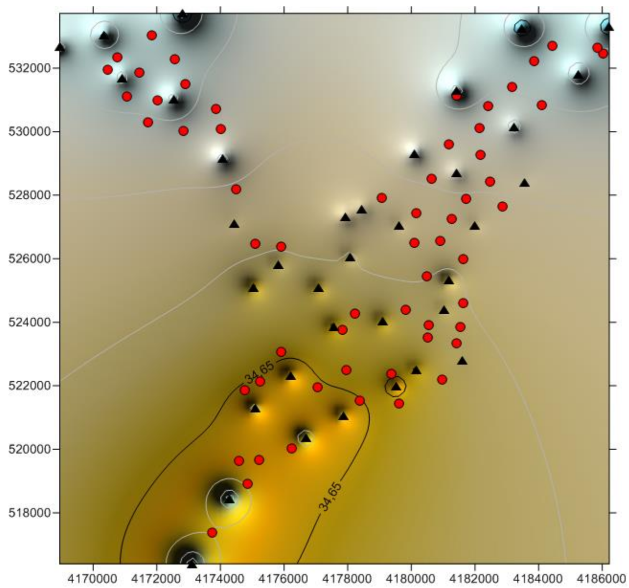

Figure 1. Inverse Distance (power:1)

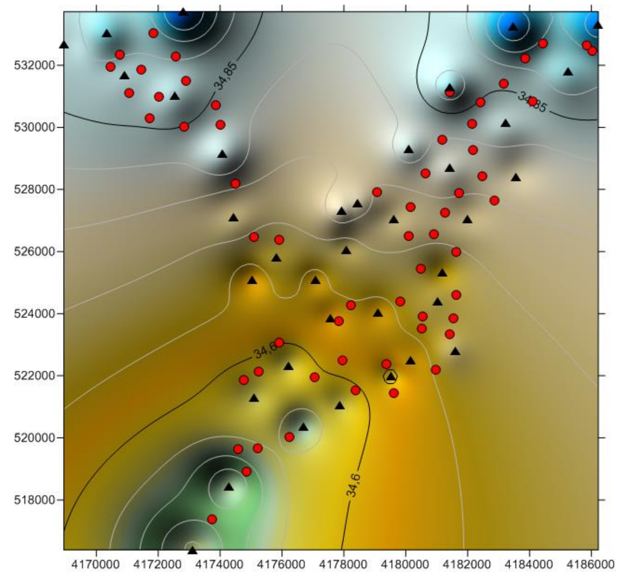

Figure 2. Inverse Distance (power:2)

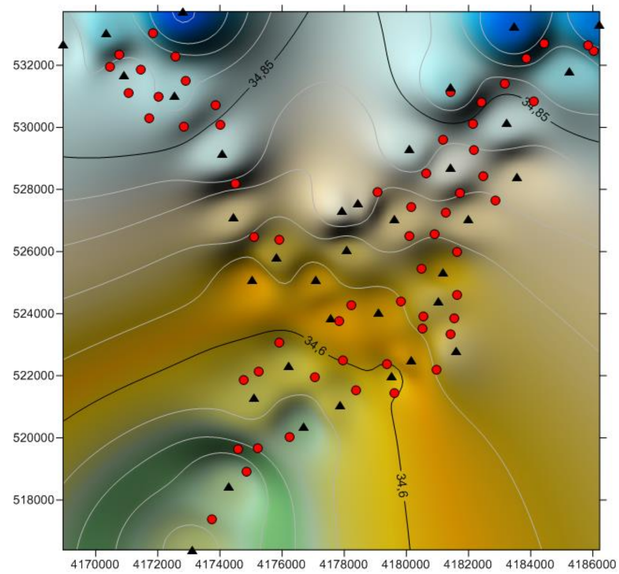

Figure 3. Inverse Distance (power:3)

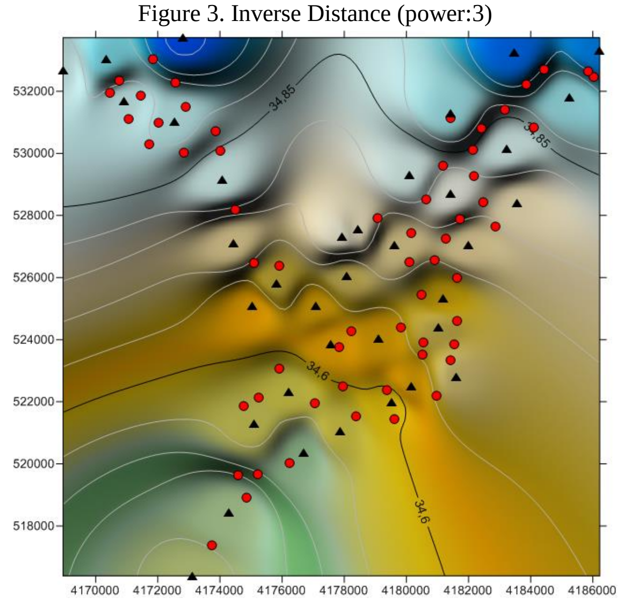

Figure 4. Inverse Distance (power:4)

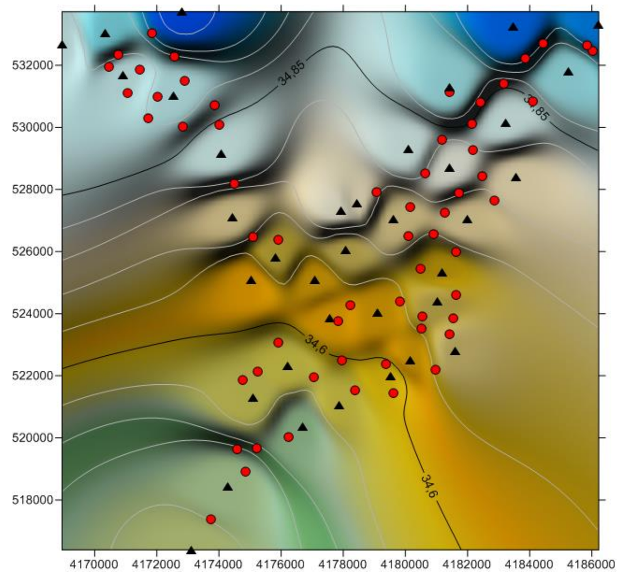

Figure 5. Inverse Distance (power:5)

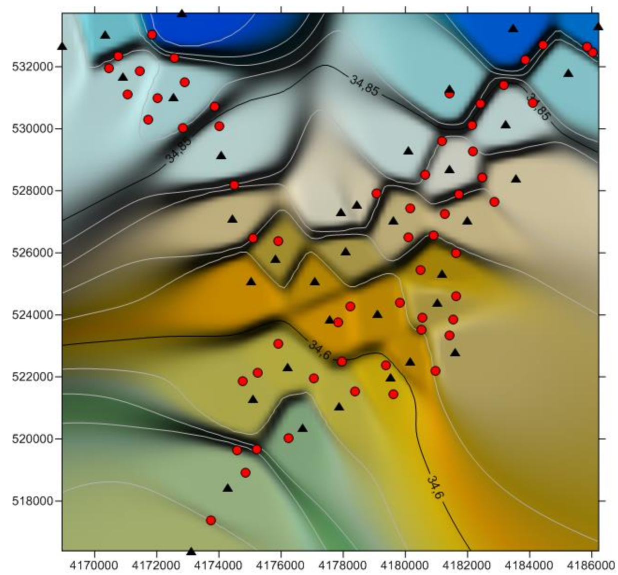

Figure 6. Inverse Distance (power:10)

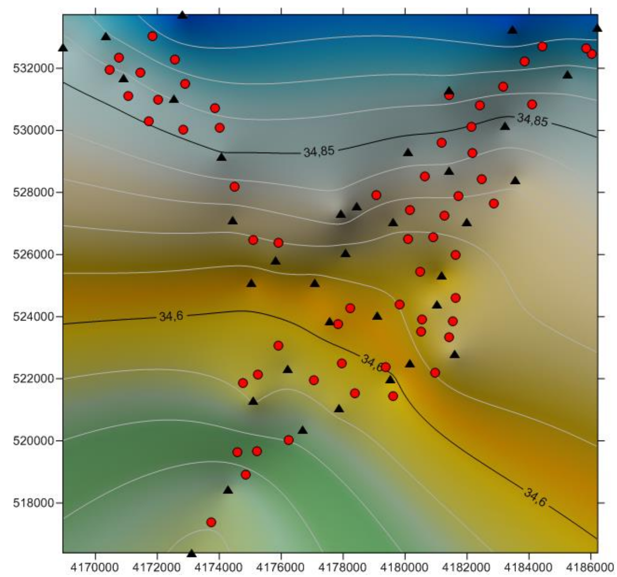

Figure 7. Kriging Point

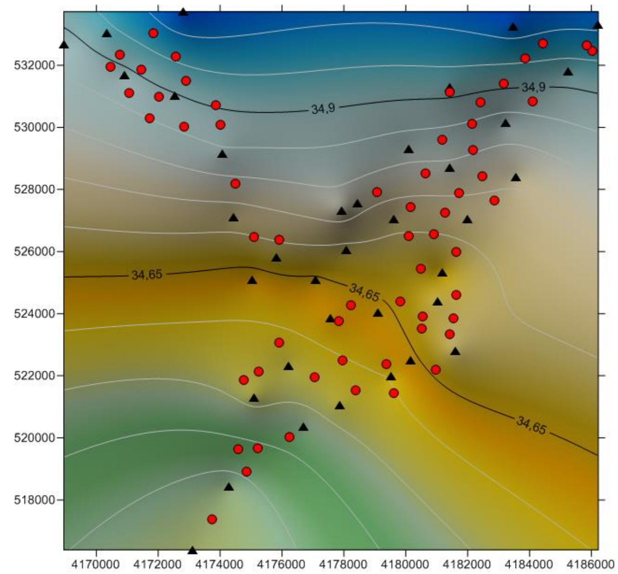

Figure 8. Kriging Block

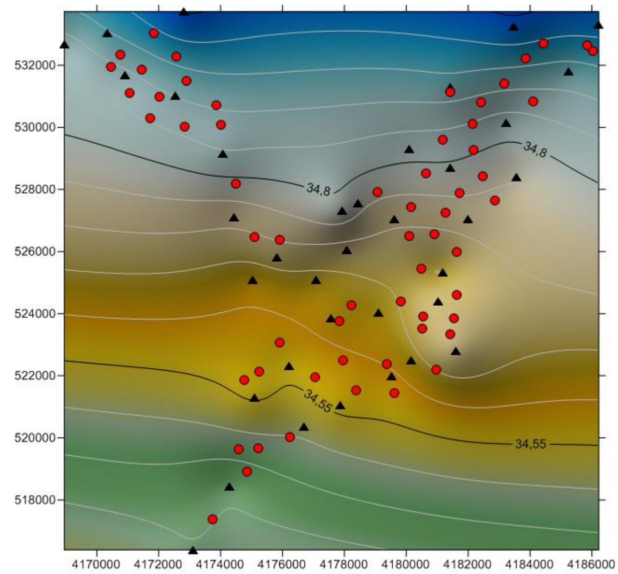

Figure 11. Multilog

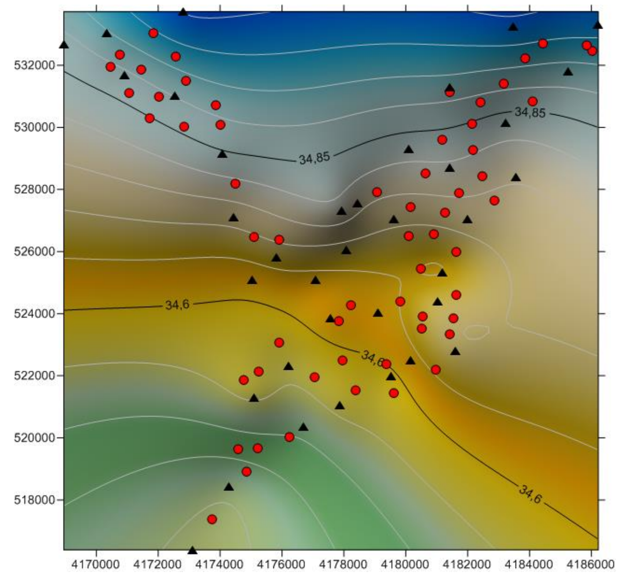

Figure 9. MQ

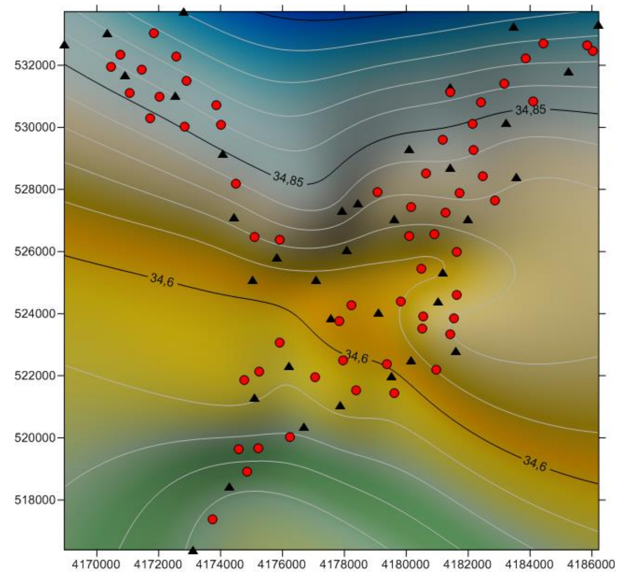

Figure 12. NCS

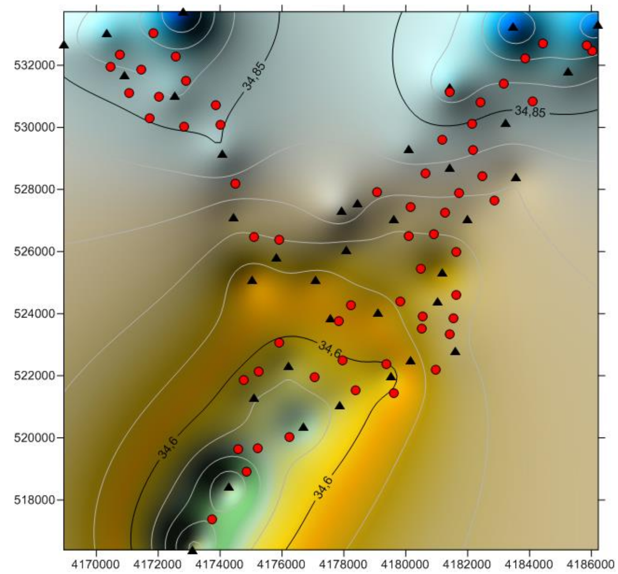

Figure 10. Inverse MQ

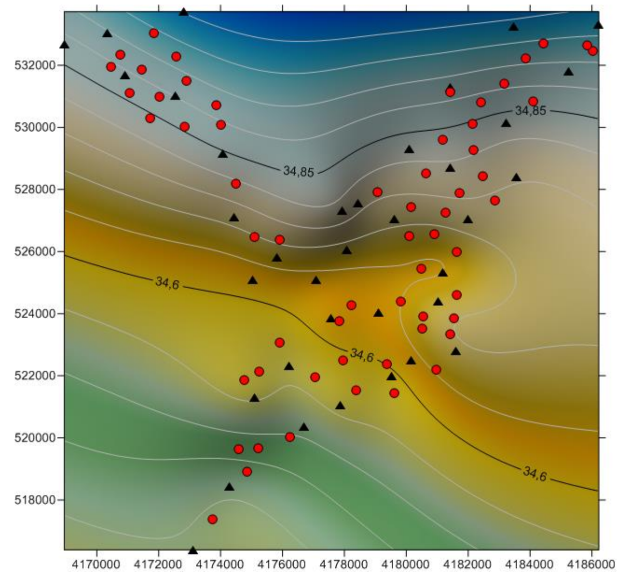

Figure 13.TPS

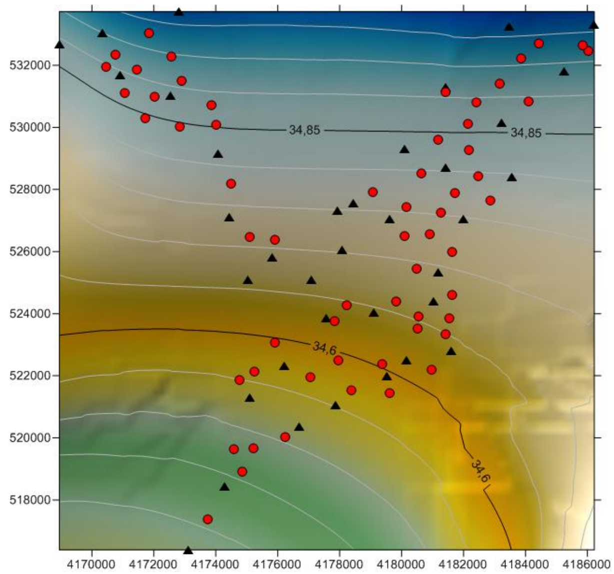

Figure 14 Polynomial (degree: 1)

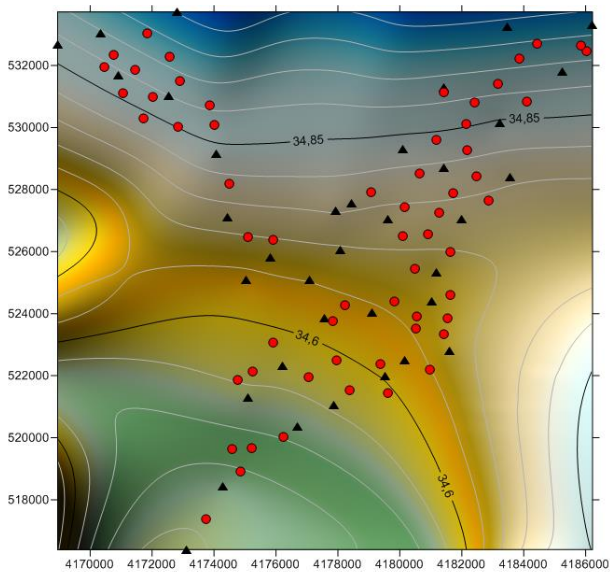

Figure 17 Polynomial (degree: 4)

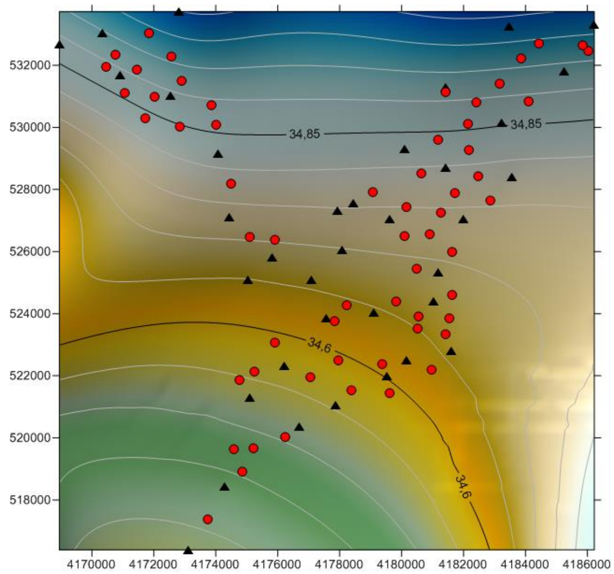

Figure 15 Polynomial (degree: 2)

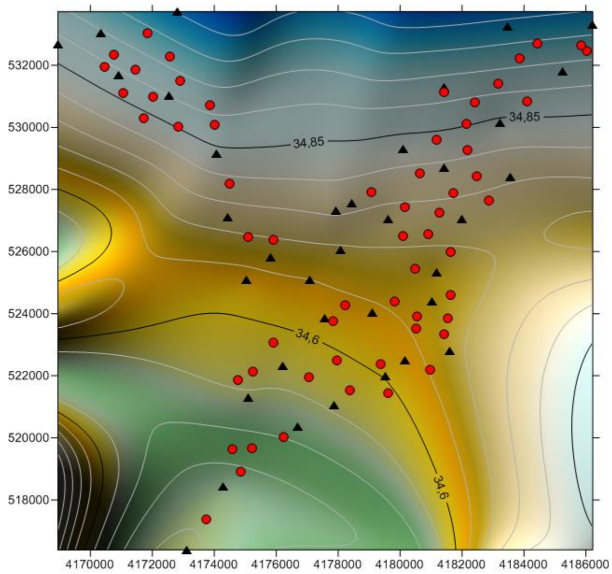

Figure 18 Polynomial (degree: 5)

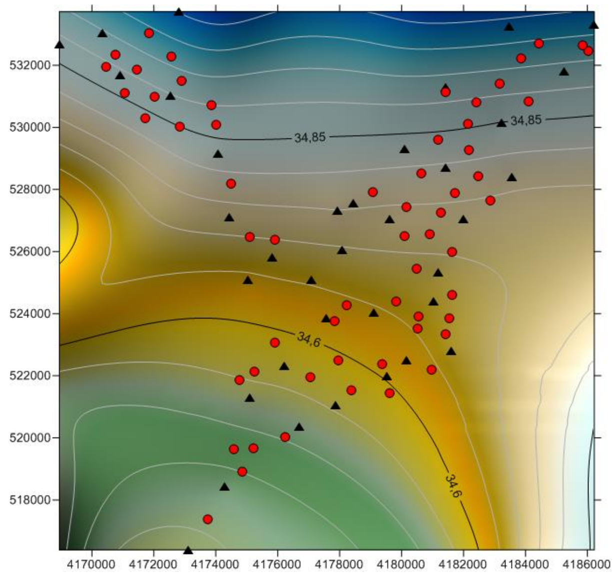

Figure 16 Polynomial (degree: 3)

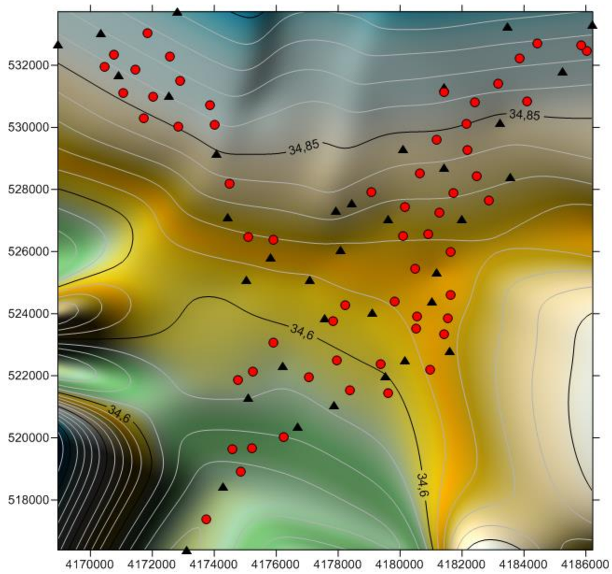

Figure 19 Polynomial (degree: 8)

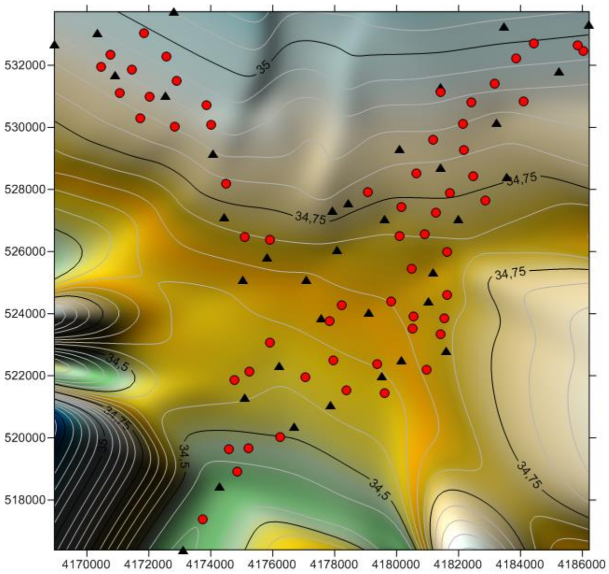

Figure 20 Polynomial (degree: 11)

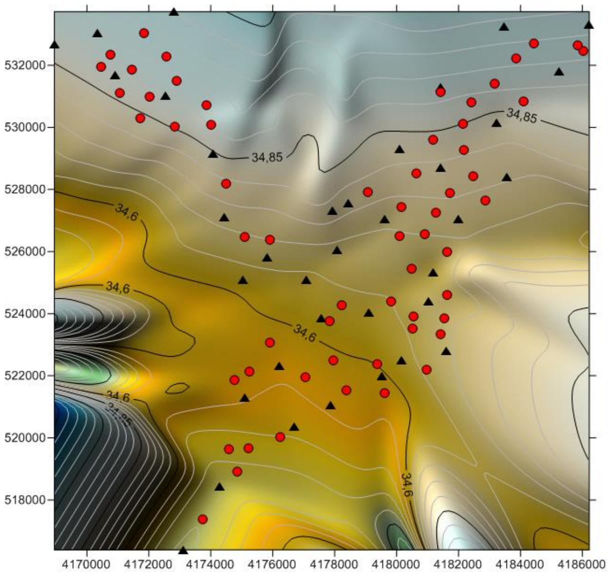

Figure 21 Polynomial (degree: 15)

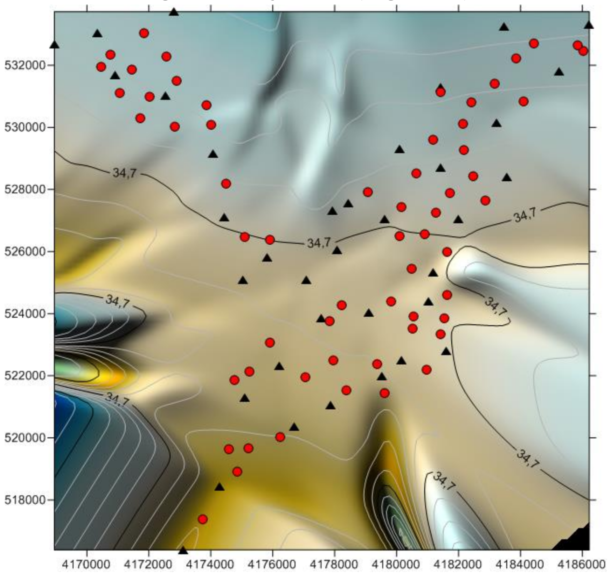

Figure 22 Polynomial (degree: 20)

4. CONCLUSIONS

This research has examined and tested the performance of different interpolation techniques such as Kriging, RBF, Polynomials for geoid heights in a test area. Inverse Distance to Power (different powers), Kriging (point and block), Radial Basis Functions (Multiquadric, Inverse Multiquadric, Natural Cubic Spline, Thin Plate Spline and Multilog) and different degrees polynomial methods were used in the computations. When obtained results and the tables and figures were examined, it was seen that the best results for geoid heights were obtained by Kriging's, RBF's, Polynomials and Inverse Distance Methods, respectively. Especially when the Table 1 were examined, it was seen that the standard deviations in the Inverse Distance and Polynomial methods with lower degree/power showed large picks. It can be said that standard deviation values are improved when the degree/power is increased. However, increasing the degree/power too much can adversely affect interpolation. An example of this is the Inverse Distance method. When the results of the Inverse Distance method are examined, it is seen that after the third power, deterioration on the results begins. In fact, this is also true for the polynomial interpolation. But when polynomial interpolation figures were examined, it was seen that the deterioration occurs on the outside of the test points. Therefore, the test points to be estimated are not affected by this deterioration. On the other hand, when all the results are examined, an accuracy of about 2 cm has been achieved for all methods used in the interpolation on this test area. According to the application results, it may be possible to use 2 cm-geoid height information for various engineering applications. But there is an important point that should not be forgotten. The test area used is small and is located in a region where there are no sudden elevation changes. Therefore, very large differences cannot be achieved in the application results. It is considered that more different results will be obtained if these methods are retested in an area where large, rough and sudden elevation changes occur.

ACKNOWLEDGEMENTS

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DEVELOPMENT OF 3D WEB GIS APPLICATION WITH OPEN SOURCE LIBRARY

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ABSTRACT:

Today, thanks to the internet connection, the borders are disappearing and accessing information is more comfortable. Instead of desktop applications, number of web-based applications which can be seen instant changes by all users are increasing day by day. The diversity of web-based applications that are currently used in presenting spatial information to users is also spreading. Using open source libraries, developers can develop web applications for their own purposes. Three dimensional (3D) visualization on the web is a commonly used approach in geographic information systems (GIS) applications. In this article, it is aimed to develop a 3D web application using open source library. Vector data layers containing attribute data on global, country and city levels are visualized on web application. The raster data layers produced in the most suitable site selection and mapping of land valuation process results are also visualized on the web application in three dimensional. It is pointed that the output products obtained from different studies can be accessed and visualized through the web browser without installing an additional program or add-ons on the users' computers.

KEY WORDS: GIS, geographic information systems, open source library, 3D, webGL, Cesium

1. INTRODUCTION

Although Internet was developed for military purposes, it has globalized and evolved into many other areas like trade, academia, information sharing in public institutions (Yomralıoğlu, 2000). Widespread internet usage has led to sharing data and information easily all over the world. This technological development has made possible to visualize, create, store and share spatial data on web and has emerged Web GIS notion. Web GIS has many advantages when compared to desktop GIS. The applications that have been made for various purposes can be used easily without a GIS software over the internet. The users can access the current database 24 hours a day, 7 days a week at a low cost with a computer connected to the internet and a web browser. Moreover, users on different platforms can use the data concurrently. Spatial queries and analysis like nearest distance, optimum transportation route can be made easily on the web.

Third dimension on maps gives opportunity to have some details, increase the readability of the map and provide reality. We need 3D data to manage cities better. It is significant to create, visualize, store, analyze and share the 3D data for better decision making, planning or solving problems. Lately, the 3D representations of data on the web increasingly gain importance. Since it does not require any additional software or plugin to visualize and analyze the data, 3D Web GIS has been become very popular and integral part of geospatial community. Several industries like real estate, tourism, geo-advertising, smart cities etc. take advantage of 3D web maps.

Javascript is a programming language that supported by many web browsers like Chrome, Firefox, Edge, Opera, Safari and can be operated on the web without using any plug-in. JavaScript APIs widely used for Web GIS applications. A new approach has seen for 3D Web GIS with the development of HTML5 and WebGL (Web Graphics Library). In order to render interactive 2D and 3D graphics within any web browser, WebGL JavaScript API can be used. WebGL allows GPU-accelerated usage of physics and image processing and it is integrated into all the web standards of the browser (Miao, Song & Zhu, 2017).

There are many map libraries for rendering 3D graphics on the web like Cesium JS, WebGL Earth JS API, ArcGIS API for JS, OSM Buildings GL, Vizicities, Tangram, Nasa Java World Wind, wrld3d. In this paper, Cesium JS 3D Map Library is used for creating 3D Web GIS application. Cesium was developed by an open-source community with the Cesium Consortium. Cesium JS uses WebGL for creating 3D globes and 2D maps in a web browser without using a plugin. Since it provides virtual globes with time dynamic 3D visualization of geospatial data, Cesium is functional 3D map library in terms of performance and features when compared with other libraries and frameworks (Chaturvedi, Yao & Kolbe, 2015). With the 3D Web GIS application, it is aimed to visualize different vector and raster data types in Cesium JS 3D globe.

2. MATERIAL AND METHODS

3D web mapping library Cesium is based on WebGL. Hence, it is independent of browsers and platforms. 2D, 3D, and 4D spatiotemporal data can be visualized efficiently by means of WebGL with Three.js framework implementation. WebGL can display many data points since it has direct access to the computing unit of the graphics card. Cameras, shaders, and lights to draw lines, spheres, particles, or a plane and some other tools for the representation of the data is provided for developers and many distinct features such as appearance, field of view for the scene, color, texture or size of objects can be easily managed with Three.js (Resch, Wohlfahrt & Wosniok, 2014).

Cesium supports many open data formats for 3D rendering. To provide interoperability, Cesium visualize geospatial data through OGC standards (Prandi, Devigili, Soave, Di Staso & De Amicis, 2015). Using standard data formats like TopoJSON, GeoJSON and KML, Cesium provide building 3D map applications by supplying expressive tools. Besides, open-source community with support of Cesium Consortium developed data formats which they weren't available for 3D rendering like CZML, 3D Tiles, glTF and quantized-mesh. CZML is a JSON schema that provide temporal 3D scenes, such as of satellites and aircraft. 3D Tiles is a description for visualizing huge 3D geo-datasets like photogrammetry, CAD, and 3D building models. 3D Tiles describe a spatial data structure and a set of tile formats designed for 3D and optimized for streaming and rendering. glTF is an open standard 3D runtime asset format. It can be described as JPEG for 3D. Quantized-mesh provides efficient 3D terrain streaming and rendering. In this paper GeoJSON and glTF data formats used for 3D web map application. Gross Domestic Product (GDP) Per Capita and population statistics of countries

* Corresponding author.

have gathered for 2000, 2010 and 2017 years from World Bank Open Data to visualize on Cesium 3D globe. In figure 1, Turkey's GDP Per Capita in 2016 is shown.

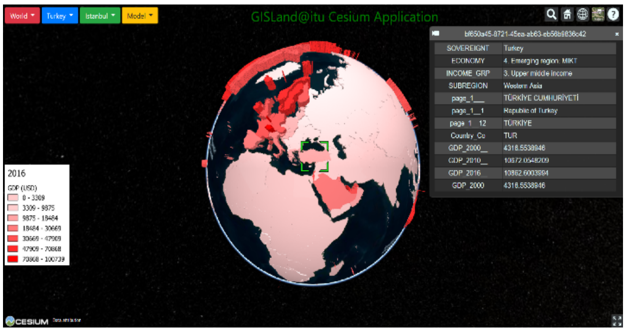

Figure 1. Turkey's Gross Domestic Product (GDP) Per Capita

Besides, population of Turkey provinces and population of Istanbul districts visualized on 3D globe to test the data in different scales. In figure 3, population of Istanbul districts is shown.

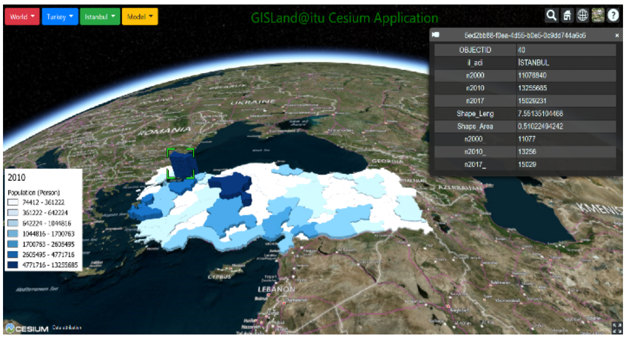

Figure 2. Population of Turkey provinces in 2010

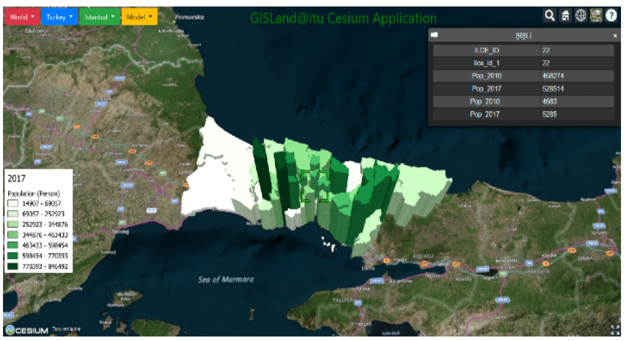

Figure 3. Population of Istanbul province in 2017

GDP Per Capita and Population data can be visualized according to different years using pop-up buttons at the top of the page. It is also possible to create CZML data for 4D temporal data to analyze the change in ten year periods for both statistics. Furthermore, nominal land values of Istanbul province visualized as 3D model in glTF data format on Cesium globe. In figure 3, nominal land values of Istanbul province are shown. In order to convert raster data to glTF format, a three.js library, Qgis2Threejs is used. It is a python plugin which provides capability of exporting terrain data, map canvas images and vector data to the browsers that support WebGL (Evangelidis, Papadopoulos, Papatheodorou, Mastorokostas & Hilas, 2018).

Since Cesium provides data interoperability, the projects which created with other platforms can be integrated easily. 3D Nominal Land Values of Istanbul City Project is visualized with Cesum JS. The model is created as pixel based raster data. In order to viusalize it on 3D Cesium globe, raster data converted to glTF format using a three.js library, Qgis2Threejs. In figure 4, nominal land values of Istanbul districts is shown. The more valuable areas has shown as reddish color.

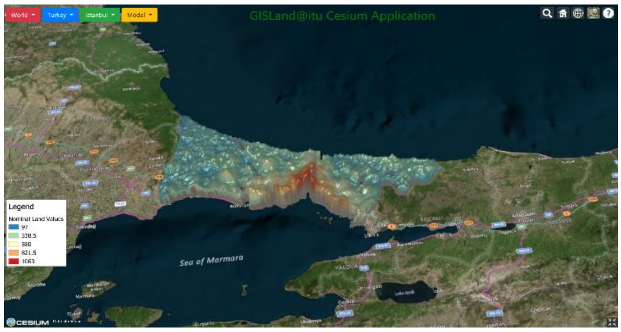

Figure 4. 3D Nominal Land Values of Istanbul province

It is possible to create aircraft and drone tour models, animations with Cesium JS. In order to scout sample geocache locations in New York, 3D city model is visualized in Cesium. The model has 1.1 million OSM buildings. In figure 5, New York 3D City Model tour is shown in drone view.

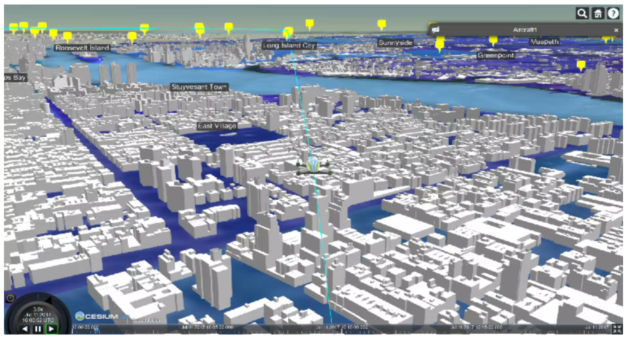

Figure 5. 3D Model of New York City in Drone View

3. RESULTS AND DISCUSSION

Visualization 3D data on the web has become very popular nowadays. There are many libraries and frameworks provide 3D data visualization on the web. Cesium JS is an Open Source JavaScript package supporting webGL which is an extension of HTML5. Cesium provide effective and coherent 3D data visualization without any plugin. It is possible to visualize point clouds, photogrammetry models, CAD/BIM models, KML + COLLADA, CityGML, OpenStreetMap, shapefiles data on Cesium. Cesium is one of the most used 3D web mapping library. It has manual, code examples, help forum and wide user community. Cesium suffer from Javascript limitations and performance issues. Performance of Cesium can vary on different browsers because of different Javascript engines implementation. Therefore, it can fail to render big 3D city models. However, it shows good performance in GeoJSON data visualization. Since it is open source, it does not require additional software or plugin, it has wide community, active help forum and clear manual, Cesium JS is good alternative for 3D data visualization on the web.

4. CONCLUSIONS

Third dimensional data is widely used in many areas such as smart cities, real estate, tourism, planning etc. It is beneficial to visualize it on the web without any additional software or plugin. Thanks to WebGL, 3D geospatial data can be visualized on the web using javascript mapping libraries. Cesium supports many open formats to visualize 2D, 3D and 4D data. In this paper, in order to test GeoJSON and glTF data formats, GDP Per Capita of countries, population and nominal land value model data are used for 3D visualization on Cesium globe. Further, Cesium JS library provide efficient 4D temporal data, creating animations and mobile 3D scenes. To conclude, Cesium is consistent 3d javascript web mapping library. Using WebGL, it makes possible to visualize 3D data on globe on a browser without any plugin.

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EFFECTS OF THE LAND LOCATION AND TOPOGRAPHY IN THE SOLAR POWER PLANT INSTALLATION: THE EAST MEDITERRANEAN EXAMINATION”

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ABSTRACT:
Besides the dependence on foreign energy in Turkey, the Kyoto protocol should have been accelerated in the whole world and our country's greenhouse gas emission reduction efforts. For these reasons, in recent years Turkey has also made serious studies on the evaluation process that began with renewable clean energy resources .. hydro power plants, wind power plants and continues with solar power plants.
While hydroelectric power plants and wind power plants do not contain much land use, solar energy plants are subject to less land planning legislation than solar power plants, while solar power plant facilities require a facility spread over the land and use of large land parts. For this reason, it is a project work that deals with many public institutions. Agriculture, Forestry, National real estate, municipality, many institutions are institutions related to solar energy power plant operation.
Turkey is a country with high potential for solar energy in particular, it is encouraged by the state investments this issue and are given power purchase guarantee. For this reason, the private sector is increasing its investment in this subject.
In this study, the project which is being done in three different regions in the Eastern Mediterranean region of Adana and Osmaniye provinces is examined from the high potential areas of solar energy. solar energy plant plants to be installed; the land slope, the distance to the transformer center and the geometric shape of the distance parcel were compared according to the evaluations and an idea was made about the idea of the location of the solar energy power plant project.

KEY WORDS: Solar Energy Power, The Eastern Mediterranean region, Adana, Osmaniye

1. İNTRODUCTION

The sun is one of the most important energy sources.As it is a clean energy source , it is an alternative for fossil fuels. Solar energy affects physical situaties of the earth and the atmosphere substore and energy flow of erath is possible with solar energy (varınca,2006 :Külekci,2009)
İt is very clear that solar energy market is routh is 25% higher after 2014 in 2015 50 GW – capacity increas was achieved in Turkey , in terms of Global aspect , it was 227 GW concerning regional terms as to the capacity of solar plants built , Europe is the leading continent.Asia and North America follows it . On the other hand, Relating to most photovoltaic system capacity has the list as: China,Germany , Japan, USA and İtaly . As to the photovoltaic system capacity per person , Germany is followed by China, Japan and usa. The latters have performenced highlighth capacity in creas (Kern,2015:Karagöl,2017)
Lately the importance of energy needed in every Available energy sources busines area of information society has increated steadily doesn’t fulfill increasing energy demand. Therefore finding and developing alternative energy trials have numbered much.However , classical energy sources especially fossil fuels production and consumption lead to un recytable norms for nature.
To save livable areas in earth , habitats , requires challenging with hazardous climate change and also with side effects of productions and consumption of energy , which gives responsility to poeple. As a result of paths highlighted above instead of classical fossil fuels and traditional energy productions Technologies , people need to use renewable and sustainable energy sources of which is less hazardous for natüre , Furthermore fort his purpose , countries need to develop new technologies. SEP Technologies gained importance fort he very reason (D.E.K.T.M. committee,2009:Varınca,2005)
The Kyoto protocal signed ,by 39 developed Countries in 1997 , raised the points of the Uniteds Nations Climate Change framework agreement and carbon emission limits every country and industry by nan-fig urative carbon emission quatas.The Kyoto protocol consists of sanctions which target related countries energy industry transition and agriculture fields in terms of less decreasing fossil fuel dependency.The protocal provides to use renewable and ecological energy sources and also to support the trials on point (Durak,2009)
Solar energy the earth is exposed to is almost 10000 times of what people use as fossil fuels and nuclear power.İtis almost 1.2107 watt .0,003percent of sun light reaching the eartj meet the global energy(Seven,2009)
As feasible potential , hygienic, renewable and ecologigal path of views solar energy, compared to other renewable energy sources is apt to wides pread easily. Considering other supplies, SEP needs much more installation costs.Next,less production facotr is another disadvantage. Overcoming same technological and economical difficulties solar energy is tend to be popular in the future. Though Turkey has solar nenergy much available , it hasnt been used widely (Bahnemann ,2004;Winston ,1975)
We have orking areas in East Mediterranean region, which are exposed to 1600-1650 solar radiation. These fields have almost 2950 insolaction hours.
Three different regions of Adana and Osmaniye Provinces are taken into consideration with regard to distance of electiric trafus land scope and sun angles of the lend , fanilly comments on land prefences are held considering SEP

2. MATERİAL METHOD

2.1 Solar energy in Turkey

Need for electiricity in Turkey and World has increased steadily . To meet the need Cool , oil ,natural gas are used.These fossils fuels are apt to finish .Next As industrial plats are inclihed to be built in certain areas of cites they lead to vast amount of enviremental pollution. Fossil fuels used to produce alectricity and other sources causes carbondioxide (CO_2) and nitrogen dioxcide (NO_2) and sulfrdioxide (SO_2), and degree of these gases in atmosphere has reached important levels(ULTANIR,1996)

As a result of the point that the prosent systems used to produce electricity have been hazardous much for environment, renewable energy sources have gained importance. Turkey is significant

İN SEP FOR FİVE REASONS

1- Steady and high demand
2- Tariff gurantee
3- Land feasibility
4- High insolation potential
5- Puplic agreement

İn term of geographical position Turkey has high insolation degreas.The insolation hours of Turky , tough changable within a year, are almost 2738. The averge Daily insolation is 7,5 hours , which is sixty percent above that of Germany.Though these are numerical comperisouns with Germany ,2015 planted power increase of Turkey has risen 0,006 percent of that of Germany, İnvwestors have many feasibilities concerning SEP in Turkey. These are supplemantal goverment incentives inluding value ade tax . customs tax exemption .Licensed or unlicensed Electiricity generation

1-Capacities in Electric
2- Financing solutions
3- Reduction of bureaveratic procedures will lead to domestic and foreign SEP investors to complete much

The Environment and Urban Ministiry 12/2014 strategy planning

SEP targets

2015 300MW
2016 1080MW
2017 3000MW

To provide, supply security, Bydiversifying enrgy sources , To order price increase in electricity market, To decrease import valmes of electricity,To transfer technological innovations and decrease unemplayment valmes.

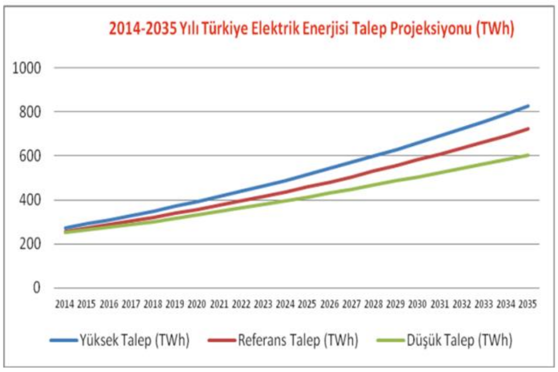


Figure 1: 2014-2035 Turkey Electricity Energy demand Projection

The carbondiooxide(co2)value per person in countries is: Turkey 3.14,USA 20.14, UK 9.8, Germany 9.8,Greece 8.7 tons. The Kyoto Protocol held in 1997, by 190 and EU declared a carbon dioxide market plan, Concerning EU environmenttal compliance laws , related to the greenhouse gas emissions and Emissions trade system, Turkey is to comply with EU environmental legislations.EU Emission Trade System has been in force since 2005 including 25 countries and 13000 establishments.

The system had 362 MtCO2 tranacaction value in 2005 and financial worth of 7.2 billion Euro . İt grew 33 percent in 2010 ,compared to preceeding years concerning global market , with 121 billion Euro financial value

According to Turkey's 2008 greehouse gas emissions sectoral divisions Energy area is number 1 with a percentage of 76%.

Turkey's solar energy generation capacity, concerning valuations is quessed 500000 MW at least Compared to ofher 27 renewable energy sources solar energy has the most capacity in Turkey. Considering Electricity energy total setup power , almost 79000 MW in 2016 values

Transferring solar enery capacity electricity power has gained much importance

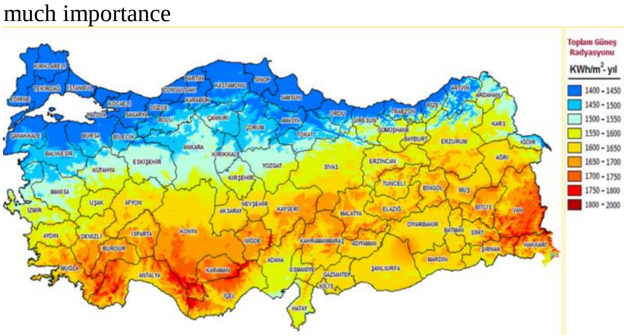


Figure 2: Turkey solar radiation

2.3 Sep Permision and Setup Process

Main Actvity	Sub Actvity	
Reconstruction plan	geophysical etudes	
	-Geological studies	
	-Map etudes	
	-İnstituion views	
	-City planner	
	-City council decesion	
	-City council decesions	
	Supplying equipment	
	Supplying finans	
	İmport costums clearance	
	Domestic equipment Sup.	
	Setup	
	TEDAŞ temporary Ad.	
LAND SUPPLY	MAP WORKS	
	RENTAL / PURCHASE	
DISCUSSION OF AGRICULTURE DIRECTORATE	MARGINAL AGRICULTURE	
INTERVIEW WITH ENVIRONMENTAL DIRECTORATE	ENVIRONMENTAL IMPACT EVALUATION EXEMPTION	
ELECTRICITY DISTRIBUTION COMPANY	PRELIMINARY ASSESSMENT	
	OPINION OF WORKS TURKISH ELECTRICITY CORPORATION	
	CALL FOR CONNECTION	
	PANEL SETTLEMENT PLAN	

PROJECT PLANNING	SINGLE LINE SCHEME	
	ENERGY TRANSPORT LINE PROJECT	
	STATIC PROJECT	
	ENDORSEMENTS	
CONNECTION AGREEMENTS		

Table 1. SEP PERMİSİON AND SETUP PROCESS

2.4. WORKİNG AREAS

2.4.1 Adana Province

Adana is a metropolitan, in east Mediterranean; Surround with KAYSERİ, NİĞDE, İÇEL-HATAY, OSMANİYE and K. MARAŞ nearby Mediterranean , with 14.000 km2 acreage, The average alttude is 23 m. Seyhan, Yüreğir, Çukurova and Sarıçam are the main districts together with Aladağ, Ceyhan, Feke, İmamoğlu, Karaisalı, Karataş, Kozan, Pozantı, Saimbeyli, Tufanbeyli, Yumurtalık. With regard to geographical points, Adana has got plains rugged terrains and mountains concerning plains there is Çukurova set up by by the alluvium rivers carried; and upper plain located in the northern of Çukurova. These two plains are named Adana plain The northwest, North and northeast parts of then province are surrounded by the Middle Toros.

The city has Mediterranean climate, rainy and calm winter dry and hot summers. İn plain part of the city summer are very hot, with high humid, which is very hazardous for people. İn the Toros mountains the climate turns in of terrestrial and Mediterranean in winters it rain in plains, but snows in mountainous areas. Annva rain valve is 650 mm and the average temperature about 32^c Çukurova consists of fertile lands in the Seyhan and Ceyhan rivers irrigation basins.

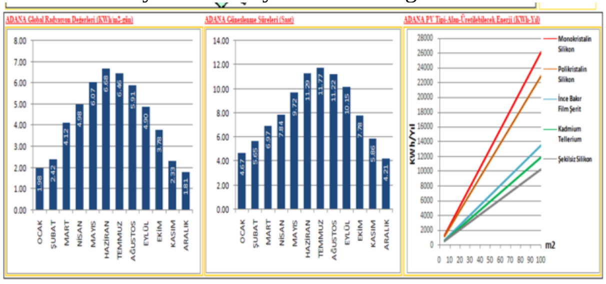
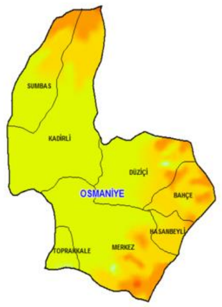


Figure 3: Adana annual sunshine duration

2.4.2 Osmaniye Province

Osmaniye is a city, in the eastern part of Mediterranean, at end of Çukurova, and the most important point is that it transition path in between west and east. Osmaniye is surrounded with the Amanos mountains in the east and South east Gaziantep is located; in South Hatay; İn the West Adana and inb the north K. Maraş As a geographies valve it is located 35-52' -36-42' East meridians and 36-57'- 34-45' north parallels it was 3, 767 km2 acreage percent of the city is forestry 39 percent af it is cultivated land, and 17 percent of it is infertile land and rivalry 2 percent of it is ''other lands''.

The city centre has 113 m altitude. Apart from cultivated lands There are beeches, aks, hornbeams, cedars ponderases, larches in the forest. The climate in Osmaniye drivers converning to plainsand mountains. İt is in fact the Mediterranean climate The are hot and dry; winters are warm and rainy. 2010-TUİK-Value in dicate that there are 7 districts, a towns, 161 villages. The districts are Merkez , Bahçe, Düziçi, Hasanbeyli, Kadirli, Sumbas and Toprakkale There are two domns. They are the Arslantaş down Berke down, which is the highest area in Turkey. They produce electricity and are beneficial for irrigation There web(wind energy plants) Gökçedağ\Bahçe and web Hasanbeyli, produces 500 million kwh electricity.



Fixed system: inclination=35°, orientation=0°				
Month	E_d	E_m	H_d	H_m
Jan	3.16	97.9	3.66	113
Feb	3.79	106	4.46	125
Mar	4.72	146	5.70	177
Apr	4.86	146	5.90	177
May	5.18	160	6.50	201
Jun	5.50	165	7.01	210
Jul	5.52	171	7.04	218
Aug	5.55	172	7.09	220
Sep	5.46	164	6.87	206
Oct	4.79	148	5.92	184
Nov	3.93	118	4.69	141
Dec	3.19	99.0	3.69	114
Yearly average	4.64	141	5.72	174
Total for year	1690		2090	

Figure 4: Osmaniye annual sunshine duration

3. THE PRACTİCE

3.1. The Adana Province Buruk Sep Project

The sep plant to be installed on 1847 parcels of Buruk district in the center of Sarıçam of Adana province shall be done by photovolcanic method and the annual capacity of the plant is 5375.4 MW

Projenin Adı	Buruk GES Projesi
Yatırım Konusu	3468 KWp PV (fotovoltaik) GES
Yatırım Yeri	Adana İli Sarıçam İlçesi Buruk Mah.
Yatırım Öncesi Giderleri	70.000 EURO (KDV hariç)
Yatırım Süresi	6 ay
NACE Kodu	35.11.19 Elektrik Enerjisi Üretimi
Kapasite Kullanım Oranı	%100
Tesis Kapasitesi (yıl)	5375,4 MW
Alım Garantisi Süresi (Devlet)	10 Yıl
Projenin Ekonomik Ömrü	30 yıl ve daha üstü

Figure 5: Information about the project of Buruk

The current map based on the reconstruction plan has been made and approved by the m The poles and line route between the substation center and the 1847 parcel will be measured. The locations of the towers were determined by considering the forests in the region and the elevations of the wire.
unicipality.The proposed master plan (1/5000) and the master plan (1/1000) were approved Sep is planned to be constructed in 1870 parcels, B, C and D in four stages and it is 58607 sqm. The lowest point in the surface-south direction is at 208 m point and the highest point is at 212 m point. The distance between two points is 230 m(at its widest point) and the slope is 1.74 m
in Adana Metropolitan Municipality and Sarıçam Municipality

General information on the project

Conductor Length	9562.86m	Some Number	2
Number of poles	14	Finally, Number of Pillars	2
Cable Length	1380m	Starting Kotu	274.44m

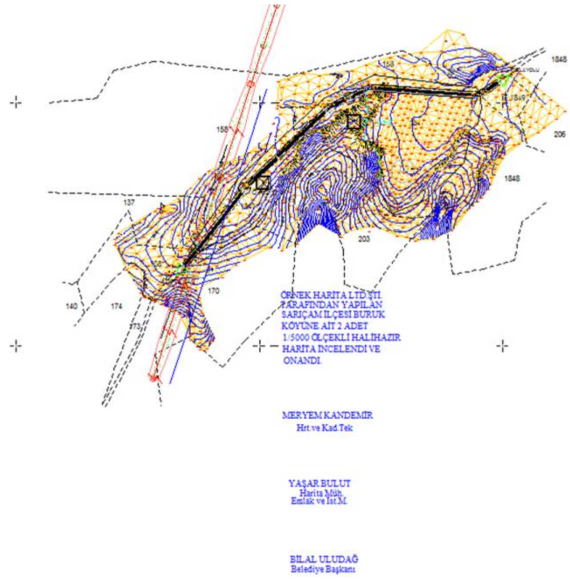


Fig.6 Current map of Buruk 1847 plot

The distance between the cihadiye trafo centre which is the transformer center and the parcel to be installed is reached with 3600 km and 19 poles. The coordinates of the landmarks are below

KOORDİNAT LİSTESİ (ED50 +6 DERECE)

DİREK NO	DİREK TİPİ	Y	X	Z
1	N+3	722820.84	4108905.70	273.29
2	TB+3	722743.93	4108652.22	270.33
3	TB+3	722661.56	4108379.36	267.61
4	NB+4,5	722594.58	4108160.03	263.26
5	NB+3	722518.06	4107857.01	257.45
6	TB+3	722480.85	4107636.56	253.94
7	TB+3	722439.27	4107390.21	251.80
8	TB+4,5	722397.55	4107143.00	249.18
9	TB+4,5	722364.06	4106944.61	227.74
10	TB+3	722322.49	4106698.32	217.38
11	TB+3	722289.93	4106505.42	196.34
12	DB+4,5	722258.25	4106317.73	173.12
13	DA+3	722210.84	4106037.49	193.26
14	N+4,5	722178.91	4105840.05	203.17

Fig.7: pole location coordinates

The poles and line route between the substation center and the 1847 parcel will be measured. The locations of the towers were determined by considering the forests in the region and the elevations of the wire.

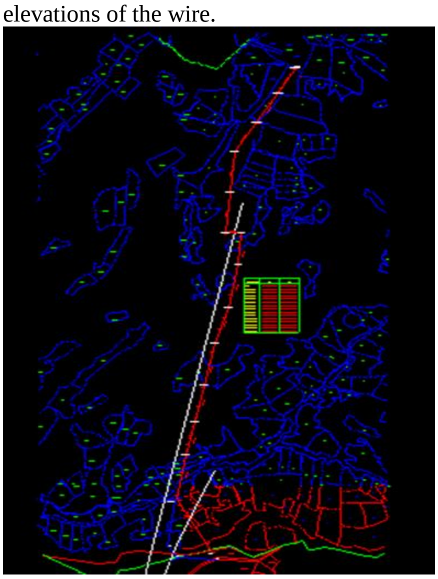


Figure. 8: Buruk 1847 parcel The poles path between the transformer center

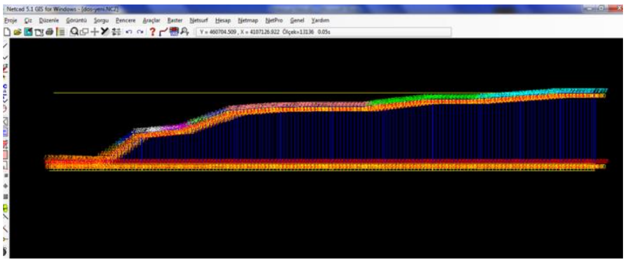


Figure 9: Buruk 1847 parcel The cross section of the pole locations between the transformer center

Sep is planned to be constructed in 1870 parcels, B, C and D in four stages and it is 58607 sqm. The lowest point in the surface-south direction is at 208 point and the highest point is at 212 point. The distance between two points is 230 m(at its widest point) and the slope is 1.74

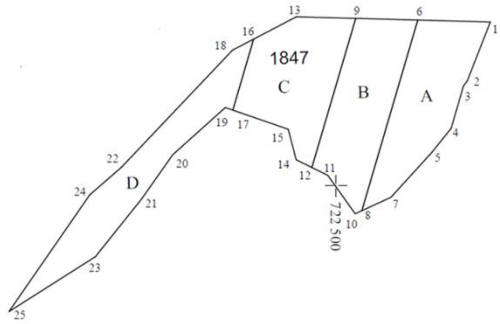


Figure 10 : Buruk 1847 parcels sep Project will be done A, B, C and D sub-parcels

3.2 Osmaniye Province, Sakızgediği village Sep Project
1.1 Preparation in Electronic form

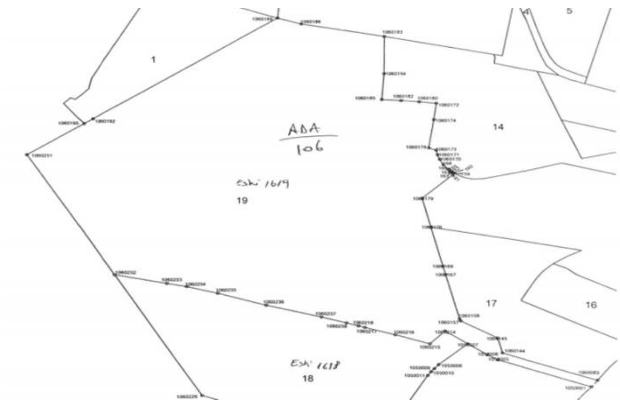


Figure 11: plots sketch of Yaveriye 1619

The facility to be installed on the Yaveriye 1619 parcels in the central district of Osmaniye will be photovoltaic and the annual capacity of the plant is 969 MW

Osmaniye province center yaveriye (sakizgediği village), 1619 project on the part of the sep project is done on the project. Because of the fact that the province of Osmaniye does not have the status of metropolitan city, different from the province of Adana, the master zoning plan, the municipal development plan and procedures are carried out by the special provincial administration.

While the area of 1619 parcels is 775000 m2, 175000 m2 sine Sep plant is established. The main institutional views are taken by Osmaniye province special administration and the 1/5000 scale master plan and 1/1000 scale application plan are approved.

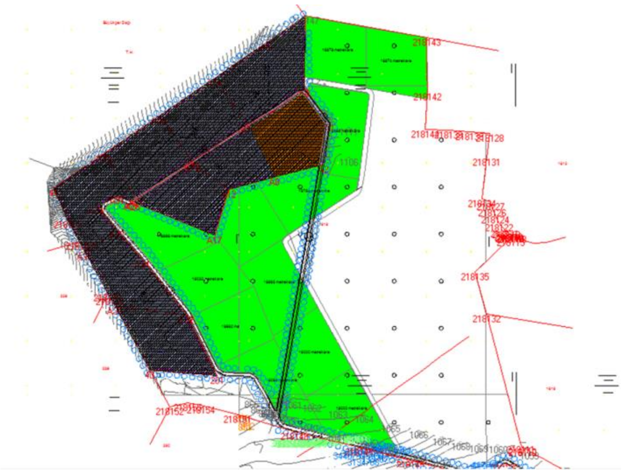


Figure 12: Yaveriye 1619 parcel's zoning plan

Sep will be constructed in project stages by dividing the parcels of 1619 parcels into parcels A, B, C, D, E, F, G, H and I in 175000 m2 area

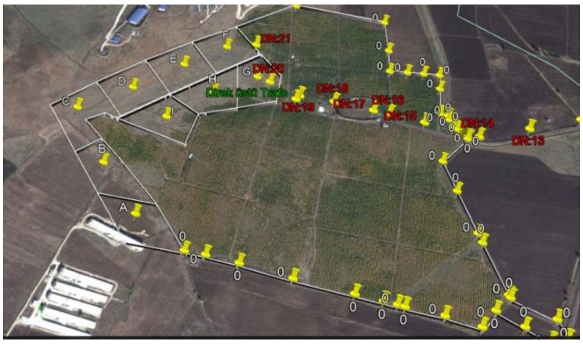


Figure 13: Sub-parcels of Yaveriye 1619 parcels project to be established

The distance of 1619 parcels to the Osmaniye Transformer center is around 2400m and 17 pylons are reached.

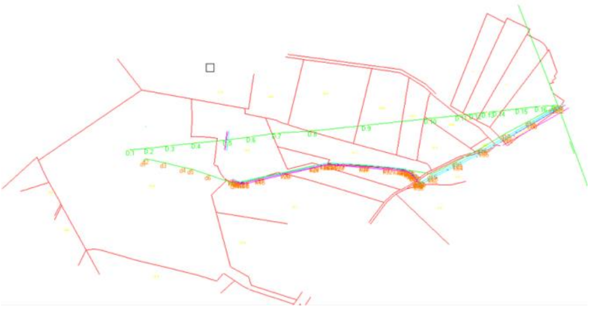


Figure 14: Map of the project to be constructed in 1619 plots

In the area where the Yaveriye 1619 parcels are to be found, the lowest elevation is 99 and the highest elevation is 166 meters, with a distance of 596 m and a slope of 11.2%.

The length section of the mast route was removed and a profile plan was created.

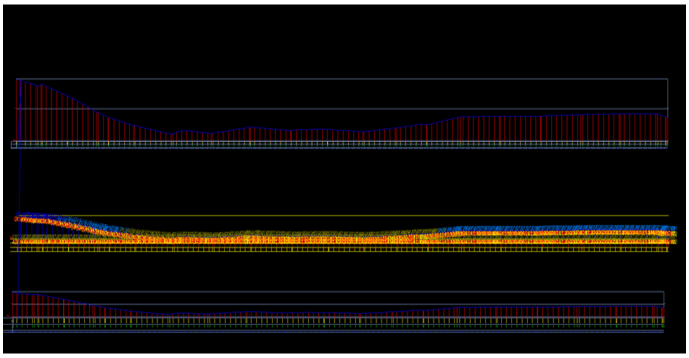


Figure 15: To assist authors in preparing their papers, styleguides for preparing digital versions of papers are provided in Word.

3.3 Osmaniye City, Düziçi Town, Vıllage Pirsultanlı

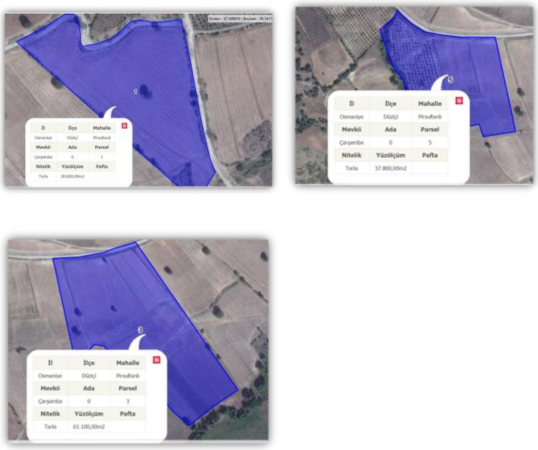


Figure 16: Google earth image of parcels

The displays of parcels 1,3,5 in Pirsulatanlı village as Osmaniye isnt a metropolitan , different from Adana Province, Master Reconstruction plan, practice building plan current map approval procedures are operated by provincial private administration.

The very parcels are 127900 m2 and the land will be used to set up SEP Project , The views of the official institutions about reconstruction and 1/5000 scale master reconstruction plan and 1/1000 scale practice plan are approved.

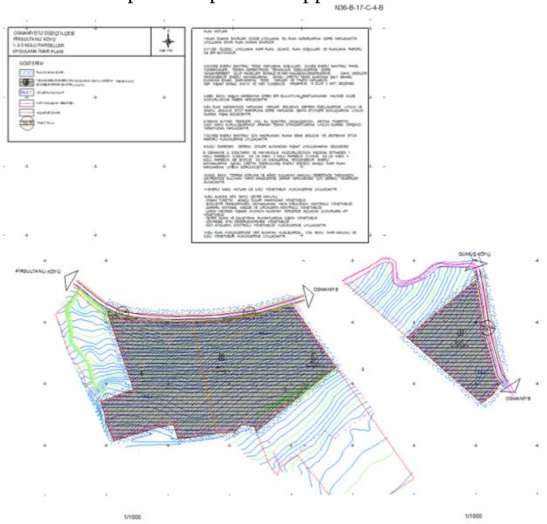


Figure 17: The Master building plan of parcels 1,3,5 in Pirsultanlı village

The Current Maps of parcels 1,3,5 in Pirsultanlı village are approved by the provincial private administration before the master building plan

There is about 5000m distance between electricity centre and SEP Project land . There will be thirty nine electricity poles in the very instance. Six poles will be built in state treasury land ; seven teen poles in the ministry agriculture and forest land and 16 poles in private property land.

The electricity poles in private land have been registered and approved by the very institution, similarly , Those in ministry of agriculture and forest land have been approved and got basement installation.

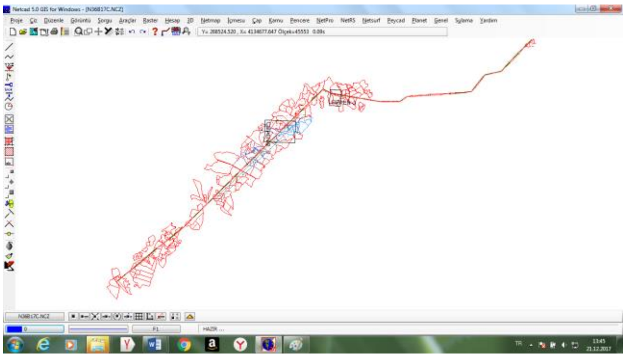
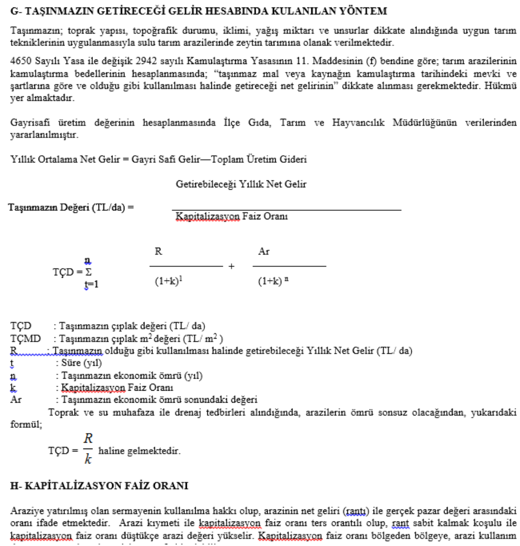


Figure 18:The distance between electricity centre and parcels 1,3,5 in Pirsultanlı village

Figure 19: The distance between electricity centre and parcels 1,3,5 in Pirsultanlı village and pole parcel’s (397) expropriation and easement installation

For the remaining mansions in the private land, easement rights maps are prepared within the expropriation maps and the places passing through the wires.



G- TAŞINMAZIN GETİRECEĞİ GELİR HESABINDA KULANILAN YÖNTEM

Taşınmazın; toprak yapısı, topoğrafik durumu, iklimi, yağış miktarı ve unsurlar dikkate alındığında uygun tarım tekniklerinin uygulanmasıyla sulu tarım arazilerinde zeytin tarımına olanak verilmektedir.

4650 Sayılı Yasa ile değişik 2942 sayılı Kamulaştırma Yasasının 11. Maddesinin (f) bendine göre; tarım arazilerinin kamulaştırma bedellerinin hesaplanmasında; “taşınmaz mal veya kaynağın kamulaştırma tarihindeki mevki ve şartlarına göre ve olduğu gibi kullanılması halinde getireceği net gelirinin” dikkate alınması gerekmektedir. Hükmü yer almaktadır.

Gayrisafi üretim değerinin hesaplanmasında İlçe Gıda, Tarım ve Hayvancılık Müdürlüğünün verilerinden yararlanılmıştır.

Yıllık Ortalama Net Gelir = Gayri Safi Gelir—Toplam Üretim Gideri

$$\text{Taşınmazın Değeri (TL/da)} = \frac{\text{Getirebileceği Yıllık Net Gelir}}{\text{Kapitalizasyon Faiz Oranı}}$$

$$TÇD = \sum_{t=1}^{n} \frac{R}{(1+k)^1} + \frac{Ar}{(1+k)^n}$$

TÇD : Taşınmazın çıplak değeri (TL/ da)
TÇMD : Taşınmazın çıplak m^2 değeri (TL/ m^2)
R : Taşınmazın olduğu gibi kullanılması halinde getirebileceği Yıllık Net Gelir (TL/ da)
t : Süre (yıl)
n : Taşınmazın ekonomik ömrü (yıl)
k : Kapitalizasyon Faiz Oranı
Ar : Taşınmazın ekonomik ömrü sonundaki değeri

Toprak ve su muhafaza ile drenaj tedbirleri alındığında, arazilerin ömrü sonsuz olacağından, yukarıdaki formül;

$TÇD = \frac{R}{k}$ haline gelmektedir.

H- KAPİTALİZASYON FAİZ ORANI

Araziye yatırılmış olan sermayenin kullanılma hakkı olup, arazinin net geliri (rantı) ile gerçek pazar değeri arasındaki oranı ifade etmektedir. Arazi kıymeti ile kapitalizasyon faiz oranı ters orantılı olup, rant sabit kalmak koşulu ile kapitalizasyon faiz oranı düştükçe arazi değeri yükselir. Kapitalizasyon faiz oranı bölgeden bölgeye, arazi kullanım

Figure 20:The valuation document about pricing view of parcels 1,3,5 in Pirsultanlı village

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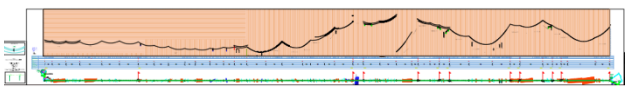

Figure 21: The longitudinal section of pole parcels 1,3,5 in Pirsultanlı village based on expropartion

A profile plan was created as a result of the coordinates and elevation measurements made at the masts.

The Sep project to be done in the villages of Düziçi, , Pilsultanlı village 1,3 and 5, A and B for 1 parcel, A, B, C and D for 3 parcels and parcels with 5 parcels are divided into sub parcels A and B in seven stages.

KOORDİNE ÖZET(ED 50 6)

NoktaNo	Y	X
1	263875.566	4132704.667
2	263926.393	4132705.672
3	263974.280	4132713.053
4	263990.173	4132718.832
5	264037.180	4132731.478
6	264227.831	4132439.780
7	264176.307	4132407.156
8	264131.048	4132373.108
9	264098.621	4132403.487
10	264070.271	4132443.701
11	264040.178	4132482.830
12	264010.535	4132464.399
13	264006.153	4132452.004
14	264001.281	4132458.482
15	263992.930	4132471.641
16	263971.338	4132531.862
17	263951.558	4132535.436
18	263939.015	4132523.309
19	263909.549	4132523.508
19/1	264373.772	4132590.873
20	264367.576	4132607.002
21	264361.456	4132572.106
22	264358.120	4132652.752
23	264348.271	4132561.480
24	264341.633	4132558.310
25	264345.414	4132733.513
26	264335.463	4132786.552
27	264300.101	4132783.676
28	264283.860	4132787.465
29	264271.100	4132786.415
30	264247.172	4132765.722
31	264226.225	4132758.751
32	264207.959	4132756.059
33	264205.514	4132770.681
34	264205.191	4132760.510
35	264204.523	4132785.257
36	264198.354	4132797.089
37	264187.105	4132797.809
38	264165.247	4132785.050
39	264123.134	4132764.207
39/1	263847.034	4132515.547
40	263840.054	4132539.347
41	263811.540	4132534.726
42	263810.175	4132706.744
43	263770.550	4132712.192
44	263742.430	4132516.290
45	263740.392	4132718.910
46	263730.829	4132545.394
47	263728.101	4132563.902
48	263722.382	4132581.030
49	263717.806	4132733.243
50	263698.980	4132609.772
51	263697.630	4132625.288
52	263689.465	4132759.938
53	263678.320	4132744.683
54	263674.807	4132657.993
55	263654.481	4132725.262
56	264158.842	4132545.335
57	264053.218	4132465.874
58	264107.107	4132624.489

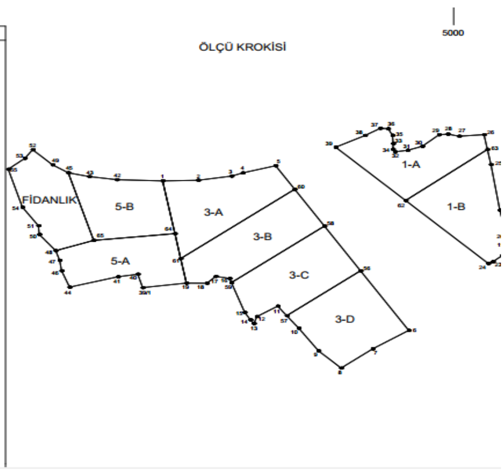

Figure 22: The Sub-parcels of parcels 1,3,5 in Pirsultanlı village based on expropartion

The slope is 14.2% while the lowest level is 258 and the highest elevation 292 is 239 for the flat one and five parcels. The slope is 9.1% for the 3 parcels and the highest elevation 294m is 296m.

4.RESULTS AND SUGGESTİONS

One parcel in Buruk , neighborhood Sarıçam district and Adana Province , another parcel in yaveriye village in Osmaniye city centre and three parcels in pirsulatnlı village of Düziçi have been investigated.
When evaluated in terms of distance to the transformer center; The facility to be installed in Düziçi village Pirsultanlı village is the most costly project with 39 mast and 5 km facility length. Adana / Buruk sep project length is 3600 m and length is 19 m and the least costly is 2400m line length and 14 pylons in the Osmaniye / center / Yaveriye village. However, it is the most costly facility facility due to the fact that its places are hit by private parties. This facility is more easily accessible compared to other facilities a ceremony.
İn regard to land bump, related to energy transmission line (ETL) yaveriye SEP Project land is plain concern flora, yaveriye Project consists of cultivated land plants. The rest two have forestry and their lands current plain rugged. Furthermore, for the latter ones howe much more risk in terms of wire deflection.

With related to parcel shape, Adana, Sarıçam,Buruk parcel no 184715 sub parcels D and C, are bump and shapeless. Likewise, Yaveriye Project parcel no 161915 sub parcel is alsa shapelers.

Relevant to land Adana, Sarıçam,Buruk parcel no 1847, especially its sub parcels A an B. Two land slope in Yaveriye parcel 1619 is 11,2 and that of Düziçi, Pirsultanlı is 14,2 and 9,1 All lands are in southern part of mountains.

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REVIEWING "THE ACT ABOUT TRANSFORMATION OF THE AREAS UNDER DISASTER RISK (LAW NO. 6306)" OF TURKIYE IN TERMS OF ITS CONTENT AND PRACTICE PROBLEMS

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ABSTRACT:

Law No. 6306, which is named as Act about Transformation of the Areas Under Disaster Risk, is the last legislation enacted in order to regulate urban transformation projects in Turkiye. The law became valid after being published in Resmi Gazete (Official Gazette) numbered 28309 on May 31th, 2012. In literature aside from the term 'transformation', there are several others to describe the process that the cities undergone such as renaissance, rejuvenation, renewal, revitalization, regeneration. In all these forms of urban transformation, if the process involves any kind of exclusion or displacement, the practice turns out to be a gentrification which is not a desired result of the transformation projects. Although the Law No. 6306 appears as a regulation towards the areas prone to disasters as highlighted in its title, its extent is beyond that as stated in the first and second articles of the law. In this study, at first some explanations have been given to clarify what is meant by urban transformation. Following that, some papers published on urban transformation projects have been discussed. In the ongoing sections, the issues open to criticism in Law No. 6306 have been argued and solution recommendations have been given. Law No. 6306 have been criticized regarding its content and practice problems, mainly for the provisions about urgent expropriation decisions, owners' rights, authorized bodies to decide on the buildings under risk, and the powers that the Ministry of Environment and Urbanization of Turkish Republic have on urban transformation projects.

KEY WORDS: Urban Transformation, Regeneration, Disaster, Gentrification, Urgent Expropriation, Law No. 6306

1. INTRODUCTION

Huot et al. (2000) provided several definitons for the term "city" as follows:

"*City is a centre of relations and decisions where people meet, exchance goods and disseminate ideas*."

"*City is a system of settlement that has distinctive charateristics and where the complex structure of the society comes through the problems that cannot be solved at individual level.*"

"*City reflects an organized hierarchical political and social structure. City must witness a certain economic and social development, must indicate that a new relation established between the people living in there and the people living around it*."

Many people have been living in cities of hundreds or thousands years old. If it is aimed to sustain the development and prosperity of these cities, radical changes must be made time to time as a consequence of the growth of the cities in an organic and lawless way. However essential changes are difficult to be realized due to the land property type (land in private ownership) in most of the cities in the world. Hence assembling land for the purpose of urban land development has been a necessity worldwide. There are two common land assembling methods in urban land development:

- Voluntary cooperation of the land owners
- Compulsory purchase by a public authority

However, these two approach represent the two edges of the spectrum and the other methods in between are omitted most of the time (Home, 2007). Urban transformation could be considered as one of these in between methods.

The practice of urban transformation has several corresponding expressions in English literature. If the synonymous words are searched in thesaurus dictionary (thesaurus.com), the words such as renaissance, rejuvenation, renewal, revitalization, regeneration will be encountered. Once the adjective 'urban' is added before these words, the created expressions will denote the practice of urban transformation as well. Even these expressions might be used interchangeably, in practice they contain different practice of urban transformation.

Aside from the terms above, there is another form of urban transformation as 'gentrification'. In all forms of urban transformation, if the process involves any kind of exclusion or displacement, the practice turns out to be a gentrification which is not a desired result of the transformation projects. As the value of the land increases, the potential of social exclusion increases as well (Shaw and Porter, 2009).

Law No. 6306, which is named as "The Act about Transformation of the Areas Under Disaster Risk" is the last legislation enacted in order to regulate urban transformation projects in Turkiye. The law became valid after being published in Official Gazette numbered 28309 on May 31th, 2012. In the following section some criticisms have been made with respect to the articles of the law.

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2. COMMENTS ON THE LAW NO. 6306

2.1 Criticism in Terms of the Consistency of the Title of the Law with the Goal of the Law

The title of the Law makes an impression that the Law is about urban transformation activities in the areas under disaster risk. However, various goals have been given in the first article of the Law in addition to the areas under disaster risk. The very first attractive part of a Law or a book is the title of it. The content should be in consistent with the title as well.

2.2 Criticism in Terms of the Uncertainty about the Extent of the Law

The definitions given in the second article of the law such as **reserve building area**, **area under risk**, and **building under risk** are important with respect to describe the areas and buildings wanted to be transformed with the Law. The area under risk which is defined as the area having the risk of causing loss of life and property due to its surface structure or the settlement on it. As it is understood from this definition, the area under risk contain the buildings under risk as well. On the other hand, in the same article of the Law, the term 'building under risk' has not only been given for the buildings inside the area under risk that have the risk of collapse or severe damage, but also for the building that have similar risks outside the area under risk. Thus, it can be said that the boundaries of the definitions for the building under risk and the area under risk are not well defined. Especially with the definition of building under risk, the extent of the Law becomes flexible and it leaves an impression like pursuing a goal to let urban transformation activities even outside of the areas under risk.

2.3 Criticism in Terms of the Determination of the Building Under Risk

In the third article of the Law, the building owners are allowed to have their properties determined as building under risk by the institutions licenced by the Ministry of Urbanization and Environment providing that the costs met by the owners. As the real estate sector is considered as a means of deriving profit both from the point of contractors and owners, serious control mechanism must be created in the event that the buildings with no risk could be defined as under risk.

2.4 Criticism in Terms of the Rights of the Owners of the Buildings Under Risk

In the fifth article of the Law, it has been stated that the owners or the tenants of the buildings, which must be demolished, will be provided with housing benefits or assignments. The amount and the extent of the benefits must be specified so that any owners or tenants will not be behaved unjustly. At this issue, those concerned should be convinced by means of explicit statements.

2.5 Criticism in Terms of the Valuation of the Buildings Demolished

In the first item of the sixth article of the Law, it has been stated that the real property, which became a plot after demolishing the building on it, will be appraised by taking it into consideration with the previous type and be registered in the name of the owners in proportion of their shares at the land register office. If housing or office is meant with the previous type, the property owners could make complaints as the plot value is not considered in the valuation. The building demolished must be appraised together with the plot on which the building had been constructed.

2.6 Criticism in Terms of the Urgent Expropriation Decision

In the second item of the sixth article of the Law, it has been stated that 30 days after the notification the owners of the plot (of the demolished building), urgent expropriation action can be taken by the Ministry, TOKİ (Directorate of Mass Housing Administration), or the Administration if an agreement among owners is not provided with two out of the three majority. However, in case of an urgent expropriation according to the article 27 of the Expropriation Law No. 2942, the reasons for the urgent expropriation must be specified and be well-established (Yazıcıoğlu, 2014: 390).

2.7 Criticism in Terms of the European Charter of Local Self-Government and Power of the Ministry of Environment and Urbanization

The European Charter of Local Self-Government has the feature of to be the first internationally binding agreement and to guarantee the rights of the nations and their elected administrators. There is a condition of the charter that local self-government principle has to be placed into the domestic law or the Constitution in order to guarantee the effectively implementation of the charter. The charter is the first agreement that established the rule of handing over the authorization to the local communities together with the financial resources. The rule which is known as subsidiarity principle gives the opportunity for transferring the power towards self-government (Anonymous, 2010). In the fifth item of the sixth article of the Law. No. 6306, the subsidiarity principle has been overlooked by the permissions given to the Ministry. Since almost all authorization for the urban regeneration has been assigned to the Ministry, the local governments look passivized.

3. DISCUSSION

In developing countries as Turkiye, the unearned incomes generated by projects such as urban transformation should be reclaimed by the public instead of allocating them among the real property owners. Otherwise, the affluent people will add more on their wealth, while the low income citizens will not take any advantage of the projects.

The administrators responsible from the execution of the laws or the candidates for the administrative positions should avoid actions or discourses encouraging illegal activities so that the urban transformation activities or other urbanization actions could be implemented in a planned way, the public resources are not wasted, the goals to have a planned and orderly urbanization could be achieved, social justice feeling of the citizens are kept, and demotivation of the law-abiding citizens are avoided.

4. CONCLUSIONS

Law No. 6306, which is named as Act about Transformation of the Areas Under Disaster Risk, is the last legislation enacted in order to regulate urban transformation projects in Turkiye. In this study, the Law has been criticised with respect to its articles. In general, it is expected to name a law in accordance with its content. If the title of the Law was "Urban Transformation" law, it would be more reasonable compared to the established title. This is because the current title gives an impression like the content of the law is restricted with the buildings under risk. It would have been better to define the goals of the law in a clearer way as follows:

- The areas under disaster risk,
- The buildings that completed their economic lives, obsolete, distressed, neglected, and those can not show resistance against earthquakes and other natural disasters,
- The areas of illegal settlements,
- The areas that has become problematic in various aspects (socially, culturally, economically), threaten safety of life and property, and ruin the image of the city,
- The areas where the infrastructure is insufficient and does not satisfy the needs.

In addition to the targeted areas, another essential issue is to employ the contemporary, opportunities, which are provided by technology, construction techniques, construction materials, during the construction process of urban transformation, and even during the other individual building projects.

In spite of the lack of resources, the municipalities ought to be responsible for the urban transformation activities, should be supervised by the Ministry, and be financially supported if needed. The municipalities should manage the course of urban transformation locally in consideration of subsidiarity principle.

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GEOINFORMATION TECHNOLOGIES FOR THE MANAGEMENT OF WATER REGIME OF AGRICULTURAL CROPS IN IRRIGATED AGRICULTURE

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ABSTRACT:

In the article the algorithm of control of water regime of agricultural crops during irrigation is put, which consists in the fact that. The analysis of well-known and developed by the authors GIS-systems for monitoring and control of water regime of irrigated fields, mainly for acute arid conditions. The analysis of Russian and foreign developments showed that computerized systems based on GIS-technologies for monitoring irrigated agricultural land should receive and record data on humidity, soil temperature and wind speed on the irrigated area in real time. For the operational regulation of the water regime of plants in arid natural conditions requires a preliminary analysis based on adequate mathematical models of heat, salt and moisture exchange. This requires the creation of GIS-systems with blocks of mathematical processing, analysis and decision support, as well as forecasting the development of agrocenoses using the described mathematical models and the structure of the database.

KEY WORDS: Irrigation, Humidity, Temperature, Soil, GIS, Forecasting, Mathematical Models

1. INTRODUCTION.

Modern resource-saving technologies of agricultural production, called "Precision Farming", actively developing all over the world since the end of the last century, are recognized by agrarian science as effective technologies that transfer agribusiness to a higher level. The use of modern IT-technologies allows solving a number of basic tasks that determine success in the conditions of the modern market: availability of up-to-date information, adoption of relevant management decisions and their implementation in practice. The solution of these three interrelated tasks is possible due to the use of specialized technical means and software (software).

Precise farming is the optimal management of crop production per square meter of field in order to maximize profits while saving economic and natural resources (Borodychev et al, 2018; Carvalho et al, 2006). To do this, it is necessary to use IT on the basis of agricultural machines controlled by on-board computers, precision positioning devices, systems for detecting local heterogeneities in soil massifs. In addition, subsystems are required for forecasting and recording yields, applying fertilizers and plant protection products using databases (DB) of remote sensing and automated mapping. All this requires the use of GIS-technologies, including a set of modules of specialized software.

2. MATERIALS AND METHODS.

The maximum efficiency is achieved as a result of building a software package that includes the following subsystems:

1. Means of accurate farming (parallel driving systems, soil analysis, differential fertilizer application systems, crop sensors);
2. Monitoring of agricultural land (site boundaries, agrochemical and moisture availability of fields, mapping of productivity, analysis of agrolandscapes);
3. Monitoring of equipment (automated data collection, based on GPS navigation, visualization of location and movement of equipment, operational accounting of agricultural work, operational management of irrigation equipment);
4. Planning and management (technical and economic planning, operational planning, operational accounting of agricultural products).

The analysis of information technologies and software to support decision-making in the field of land reclamation has revealed the following directions for its improvement.

Improving the quality and scientific validity of the management of the creation and operation of land reclamation systems, preventing the degradation of irrigated soils is impossible without the use of modern software and information tools designed to analyze data on natural and technogenic indicators of the state of reclamation lands and sampling based on this analysis of ecologically and economically sound solutions for cultivation agricultural crops. For efficient and rational use of natural resources, support is needed for making decisions on the distribution of irrigated water to the fields.

Prevention of degradation of meliorative agrolandscapes, ensuring their stable ecological and meliorative state by improving the quality of management decisions in the field of irrigated land use, is possible due to the account of the individual characteristics of each irrigated area. To ensure these approaches, the use of automated fertility management technologies in each field or irrigated area is required to improve the quality of technological and management solutions.

Automated control technologies, including decision support systems (DSS), according to their functional purpose, are divided into information-reference, information-consulting and information-control (Borodychev et al, 2018; Xia et al, 2011; Mikailsoy et al, 2010; Gagarin et al, 2017; Kuznetsov et al, 2014).

Information and reference systems - provide information about the managed process, while the evaluation of the information presented, as well as the acceptance of the managerial decision of the decision maker. Information and advisory systems (ISS) - are characterized by a higher level of control automation. They ensure the receipt and evaluation of information on the management object and generate acceptable alternatives to management decisions that can be taken as the basis for the decision maker (Rogachev, 2009). Information management systems (IMS) provide the next stage of automation of management, implementing the development of executable management decisions (Gagarin et al, 2010). A variety of parameters describing the state of irrigated fields and factors determining the choice of types and parameters of technological operations, the existence of management stages with changing objectives and methods of impact, taking into account various technological, ecological and technical and economic constraints, determine the need to develop automated technologies for crop cultivation using ASC.

Individual automated systems use satellite remote sensing data and GIS technologies (Pronko et al, 2010; Gagarin et al, 2010).

The task of automating the management of the irrigation regime of agricultural crops includes the choice of the irrigation method and calculation of the irrigation regime. The choice of the method of irrigation depends on the following main factors: the need for moistening the soil, its granulometric composition, the need for regulation of plant phytoclimate, the level of groundwater occurrence and the slopes of the field surface.

(Gagarin et al, 2017) proposed an algorithm for controlling the water regime of the soil in irrigation of crops, which allows: to plan the irrigation regime, to formulate and adjust the irrigation demand with an estimate of the likelihood of forecasting, to compile operational-current plans, and to analyze the need for irrigation using the accumulated information.

3. Results and discussion.

The recommended flowchart for selecting the irrigation method is shown in Figure 1.

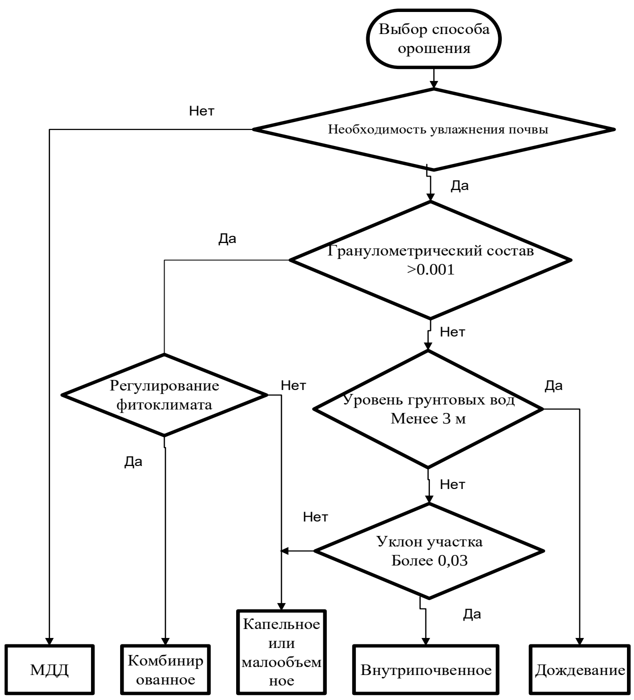

Figure 1.Flowchart for selecting the irrigation method

To implement the DSS in the field of irrigated agricultural production on the basis of GIS technologies, a specialized database was developed, including the following relational tables, which form the following blocks: soil, meteorological, biological, technological, and calculation (Fig. 2).

Various approaches are known to form the irrigation regime in land reclamation (Mikailsoy et al, 2010; Pronko et al, 2010; Rogachev, 2009).

The authors of (Borodychev et al, 2018; Gagarin et al, 2017) consider the use of modern solutions in monitoring the water regime of the soil within the irrigated area and propose a calculation method using agrometeorological information, as well as increasing the accuracy of predictive and retrospective calculations through the use of multiparametric models for determining the total water consumption of agricultural crops.

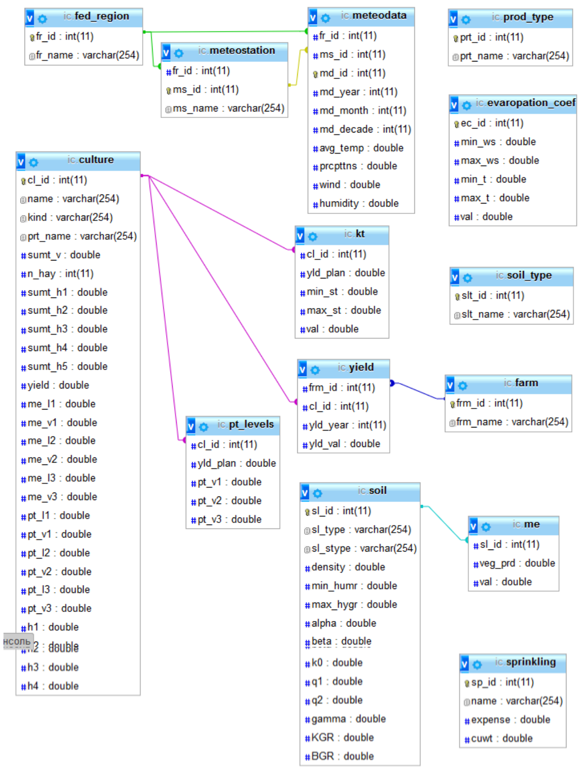

Figure 2. Structure of the relational database of agro-meliorative and technological parameters

The information and advisory system for managing the fertility of irrigated soils (Pronko et al, 2010) can be used both as part of an integrated system for designing technologies for growing crops and for managing them, and independently - for the design and management of operations for the application of organic and mineral fertilizers. In its development, relational databases (DB) were used, which made it possible to unify various directories and sets of procedural rules for assessing the soil-meliorative state of the irrigated area, rules and algorithms for determining species, doses and terms of fertilization. The system is focused on preserving and improving the fertility of irrigated plots and efficient use of resources. This is achieved by optimizing the composition and parameters of the technological process of applying organic and mineral fertilizers. They are able to ensure the receipt of planned crops, to prevent dehumification of the soil.

According to the authors of (Gagarin et al, 2017), for the management of the water regime of agricultural crops, it is necessary to carry out an imitation modeling of the development of plants taking into account the type of crop, the method of irrigation, agroclimatic conditions, including the characteristics of the soil, the phases of plant development associated with the sum of accumulated temperatures and FAR,

The basis of the calculation in the model used is the modified dependence for the total water consumption of the Penman-Monteith formula:

$$ET_0 = \frac{0,408\Delta\left(R_n - G\right) + \gamma\frac{900}{t+273}U_2\left(e_s - e_a\right)}{\Delta + \gamma\left(1+0,34U_2\right)} \qquad (1)$$

where ET_0 is the reference evapotranspiration, mm / day; R_n - net radiation on the plant surface, mJ / m^2 per day; G - heat flux density of soil, mJ / m^2 per day; t - average daily air temperature at a height of 2 m; U_2 - wind speed at a height of 2 m, m / s; e_s - saturation vapor pressure, kPa; e_a - is the actual vapor pressure, kPa; Δ is the slope of the vapor pressure curve, kPa / ^{0} C; γ - psychrometric constant, kPa / ^{0}C.

The solution system includes models for optimizing and searching for an effective option for specified criteria based on information about the need for financing, material and technical resources, etc., necessary for evaluating the options for a repair plan. A distinctive feature of this subsystem should be the implementation of a "measure of comparison" of alternatives based on GIS technologies, in particular, the solution of the stochastic task of technical and economic optimization of parameters of complex technical objects, for example, irrigation systems. Consider the formulation of the general problem of optimizing a design object based on linear programming: Find a plan x such that

$F(x) = cx \rightarrow$ max max under the following conditions:

$Ax \leq b$, $x \geq 0$

Where $\boldsymbol{x} = (xi)$ – is the vector of the unknown variables,

A - matrix of technical and economic coefficients of production costs,

b = (bj) is the vector of free constraint members*;*

c = (cj) is the vector of the coefficients of the objective function.

In stochastic problems, A, b and c can be random. Stochastic programming allows you to choose a plan that would be best, taking into account all possible realizations of the random parameters of the problem and their probabilities. In most cases, as a criterion of optimality is the maximum (minimum) of the mathematical expectation of the objective function M [F (x)] or the minimum of its variance D[F(x)]. In stochastic programming, the described general approach, depending on the nature of the problem being solved, can be realized by applying one of the following optimality criteria:

$$F(x) = M\,(cx) \rightarrow \max \qquad (2)$$

A) The maximum of the mathematical expectation of the effect. In this case, the variance of the effect is not taken into account. This optimality criterion is used in most known applied problems of stochastic programming. It corresponds to the planning and economic tasks for which the criterion of optimality is the maximum of profit or other maximized indicators.

B) The maximum probability of exceeding a certain fixed value of the effect.

$$P[\Phi(x,\xi) \geq \Phi_0\,] \rightarrow \max, \qquad (3)$$

where Φ_0 - is a given threshold sign of the effect, the decrease of which is undesirable. One-stage problems are such stochastic problems in which the optimality criteria are: variance of the effect; probability of exceeding the specified threshold value of the effect; linear combination of the mathematical expectation of the effect and its variance. Two-stage tasks are characterized by the fact that the process of making a planned decision involves two stages: the adoption of a priori solution X and then, after the concrete r-th realization of the random conditions becomes known, the a posteriori solution yr (r = 1,2, ..., n).

Functional capabilities of the field monitoring subsystem: creating custom vector maps in vector format, updating current field maps (Fig. 3) with specification of their boundaries, splitting or merging; input of GPS data with quality control by the number of satellites used in operation and the geometry of their position, affecting the accuracy of positioning; display on the map in real time of data received from GPS; the measurement of distances and areas on a map; definition by simplified technology of a part of the field, processed by agricultural machinery; correction of the accompanying information for each field.

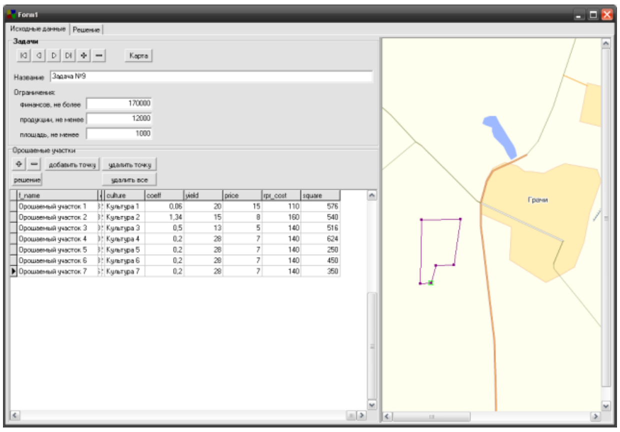

Figure 3. Creating custom vector maps in vector format

For each irrigated area, information on the coordinates, area, cultivated crop rotations (precursors), mechanical and agrochemical composition, soil degradation, terrain features (slopes), etc. are recorded.

Data of agrochemical analysis of soils for each working area of the field can be obtained:

- agrochemical surveys conducted by specialized laboratories;
- own research.

In the first case, the data is provided in the form of an electronic report. Information on the agrochemical state of soils should be conducted at least once every 5 years.

In the second case, it is possible to reveal the local features of each section of the field, according to the distributed data. However, for a number of calculations, it is necessary to operate with uniform indicators of nutrient levels in the soil within the site. The program allows you to calculate a single value by a different method using different methods. The second method of agrochemical monitoring is more promising, since it prepares data for differential fertilization.

The meliorative state of the irrigated area depends on many natural and climatic conditions (moisture availability of the year, air temperature, soil during the growing season of crops, wind speed, terrain, etc.). To conduct timely irrigation, it is necessary to monitor, preferably daily, these indicators promptly. For this, appropriate sensors and measuring and recording equipment are required.

Currently, there are many programs using GIS-technologies: QGIS, GEOGRAF, MapINFO, Map 2005, etc., allowing to implement and computer monitoring, which is an effective method for determining and visualizing changes in humidity and productivity on the fields of the economy. Taking into account the data on which area of the field will bring a greater yield, proceeding from optimization of costs and extraction of maximum profit, a decision is taken on differentiated field processing. It is possible to set the opposite task - to reduce costs in accordance with the potential of the harvest on poor lands. If desired, at any time, the system of computer yield monitoring can easily be turned into a yield mapping system.

Based on topographic data on the location of the working areas of fields and field passports, the system makes it possible to determine the following indicators:

- slopes of terrain (averaged, longitudinal and transverse);
- exposure (direction) of the slopes (to the north, to the south, to the east, to the west);
- the degree of erosion;
- mechanical composition of soils.

By combining these data with agrochemical data, yield maps, precipitation levels, surface runoff, etc., it is possible to determine local areas characterized by some assessment: leaching or fertilizer application and NWP, swamping or lack of moisture, up to yield forecasting.

Data analysis technology is provided by means of spatial analysis of GIS Map 2005. The user is presented with a wide range of powerful functions of spatial modeling and analysis. The analysis is based on the functions of constructing and transforming vector data into matrix (raster) and vice versa. Spatial analysis includes:

- Conversion of vector data into matrix data.
- Creating buffer zones by the distance and proximity of objects.
- Creation of density maps of objects.
- Creation of continuous surfaces by points.
- Construction of isolines (interpolation), calculation of tilt angles, exposure of slopes, washing of relief.
- Analysis of the matrix map.
- Performing algebraic operations and logical queries to a series of maps and matrices.
- Execution of overlay operations (entry, intersection, proximity).

CONCLUSIONS

Thus, the conducted analysis of Russian and foreign developments showed that the software for monitoring irrigated agricultural land based on GIS technologies should take into account data on soil moisture, temperature and wind speed in the irrigated area, for the operative regulation of the water regime of plants in arid conditions. For this, it is necessary to create GIS-systems with blocks for mathematical processing, analysis and decision support, as well as forecasting the development of agrocenoses using the described mathematical models and the structure of the database.

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COMPARISON OF TOPSIS AND VIKOR MULTI CRITERIA DECISION ANALYSIS TECHNIQUES

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ABSTRACT:

Nowadays, beside Geographical Information Systems (GIS) analysis capabilities, Multi Criteria Decision Analysis (MCDA) techniques have been applied to a large amount of spatial decision problems. MCDA techniques are widely used in different kind of site suitability analysis in the field of environmental, engineering, topographical, social and economic perpectives. When planners are giving decision to related problems, there are limitations, expectations and requirements are involved in this stage. Right decision giving require to characterize the complex criteria structure and select appropriate data.

The most used MCDA techniques in GIS are Analytical Hierarchy Process (AHP), The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR). In this study, TOPSIS and VIKOR techniques are compared to each other according to the models and capabilities.

KEY WORDS: Geographical Information Systems, Multi Criteria Decision Techniques, AHP, TOPSIS, VIKOR

1. INTORDUCTION

Decision makers have to work in very complex conditions - fast-changing, overloaded with information and comprehensive decision making. Multi-Criteria Decision Analysis (MCDA) refers to making decision in the presence of multiple criteria.
Problems in daily life require to consider complex structure of criteria which have effect on solutions and results (Baizyldayeva et al., 2013).

MCDA methods provide a platform to evaluate the criteria and have some characteristics;

Criteria, can be an attribute or spatial data

Conflicting criteria, the conflicts and similarities of each criterion against each other.

Units, each criterion can be in a different measure unit.

Flexible design, the structure of weight calculation is completely flexible.

MCDA concept involves different kind of methods to give decision with multiple and conflicting criteria. Analytical Hierarchy Process (AHP) is the most mentioned methods in MCDA and is a general term that refers to the applications used to determine the most suitable solution to the real problems by providing a selection from different data clusters compared to others such as The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) due to the high applicability rate of AHP to a wide range of disciplines for spatial and non-spatial data (Hwang and Yoon, 1981; Arentze and Timmermans, 2000). TOPSIS is based on determining the best alternative which has the shortest distance to positive ideal solution and longest distance from negative ideal solution (Hwang and Yoon, 1981). The positive ideal solution represents the maximized benefit criteria and minimized cost criteria. In other words, the negative ideal solution represents the maximized cost criteria and minimized benefit criteria (Wang and Elhag, 2006; Ho et al, 2010; Sakthivel et al, 2015). Finally, the VIKOR method is a MCDA method to determine the compromise ranking and compromise solution via given criteria weights. The VIKOR focuses on ranking and selecting from a set of alternatives by multi-criteria ranking index based on a measuring the distances to the ideal solution. The compromise ranking list can be determined by calculating the closeness of alternatives to the ideal solution (Opricovic, 1998). In an outranking method PROMETHEE it is possible to define different preference functions for criteria (Brans et al. 1984, 1986; Brans and Vincle 1985). It is well adapted to the problems where a finite set of alternatives are to be ranked according to several, sometimes conflicting criteria (Albadvi et al. 2007). One of the main advantages of PROMETHEE is the simplicity of its methodology in comparison to the other outranking techniques (like TOPSIS, VIKOR and ELECTRE) and the Preference functions support which provides more realistic definition for real problems (Senvar et al. 2014).

In this study, VIKOR and TOPSIS methods are compared considering the structure of evaluation techniques.

2. MATERIALS AND METHODS

Analytical Hierarchy Process (AHP)

The procedure outlined by (Saaty, 1977; 1980) scales the importance of each criterion, from 1 to 9 relatively (1=Equal, 3=Moderately, 5=Strongly, 7=Very, 9=Extremely). The pairwise comparison matrix includes the scales (ann) and determines the importance of criteria.

A	*Criteria 1*	*Criteria 2*	*Criteria 3*	*…*	*Criteria n*
Criteria 1	a_{11}	a_{12}	a_{13}	…	a_{1n}
Criteria 2	a_{21}	a_{22}	a_{23}	…	a_{2n}
…	…	…	…	…	…
Criteria n	a_{n1}	a_{n2}	a_{n3}	…	a_{nn}

Each element of the comparison matrix is divided by the sum of its own column sum to generate a normalized matrix with Formula 2.

$$a_{ij}^{1} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}$$

The average of the sum represents the weights of each criterion in pairwise comparison matrix (Formula 3).

$$\mathrm{w_i} = \left(\frac{1}{\mathrm{n}}\right) \sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{a}_{\mathrm{ij}}^{'}\ , \ (\mathrm{i,j} = 1,2,3, \dots, \mathrm{n})$$

The consistency of the pairwise comparison matrix must be calculated to decide the criteria, comparisons are consistent or not. Consistency Index (CI) is one of the methods to define the consistency coefficient of the pairwise comparison matrix. CI is calculated with Formula 4 (Saaty, 1994).

$$CI = \frac{\lambda_{max} - n}{n-1}$$

Calculating consistency index depends on the λmax (eigen value) value with Formula 5 and Random Index (RI) value according to the matrix order.

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} \left[\frac{\sum_{j=1}^{n} a_{ij} w_j}{w_i}\right]$$

After calculating the CI and RI, consistency ratio (CR) can be calculated with Formula 6. If CR exceeds 0.1, based on expert knowledge and experience (Saaty and Vargas, 1991), recommends a revision of the pairwise comparison matrix with different values (Saaty, 1980).

$$CR = \frac{CI}{RI}$$

TOPSIS

TOPSIS method was introduced by Hwang and Yoon (1981), considering that alternatives have shortest distance to positive ideal solution and longest distance to negative ideal solution. The ranking which made by TOPSIS is a result of evaluating the distances of alternatives to the ideal solution within each criteria (Eleren and Karagül, 2008; Kalkan et al., 2017).

The best ranked solution, which is determined as positive ideal solution, is a solution that maximizes the benefit and minimizes the cost criterion. Similarly, the negative ideal solution is a solution that maximizes the cost and minimizes the benefit (Wang and Elhag, 2006). In TOPSIS method, results can be determined by ranking the values which represent the relative distances. (Cheng, Chan and Huang, 2002).

In evaluation matrix Ai, $\mathrm{A} = (1,2, \dots, \mathrm{n})$ represents the alternatives and Ci, $\mathrm{C} = (1,2, \dots, \mathrm{m})$ a set of criteria; where Xi (X11 to Xnm) defines the ratings

	C₁	***C₂***	***C₃***		***Cₘ***
A₁	X_{11}	X_{12}	X_{13}	…	X_{1m}
A₂	X_{21}	X_{22}	X_{23}	…	X_{2m}
…	…	…	…	…	…
Aₙ	X_{n1}	X_{n2}	X_{n3}	…	X_{nm}

R and V matrices represent normalized weighted decision matrices considering the ratings (Hwang and Yoon, 1981).

$$r_{ij}(x) = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^{2}}}, \quad i = 1, .., n \ , \ j = 1, .., m$$

$$v_{ij}(x) = w_i x r_{ij}(x), \ i = 1, .., n \ , \ j = 1, .., m$$

While positive ideal solution consists of the largest element of weighted normalized decision matrix V, negative ideal solution consists of the smallest element.

$$\mathrm{A}^{+} = \{\mathrm{V}_1^{+}(\mathrm{x}), \mathrm{V}_2^{+}(\mathrm{x}), ., \mathrm{V}_{\mathrm{m}}^{+}(\mathrm{x})\} = \left\{\left(\max_i v_{ij}(x) \ | \ j \in j_1\right) \min_i v_{ij}(x) \ | j \in j_2 | i = 1, n\right\}$$

$$\mathrm{A}^{-} = \{\mathrm{V}_1^{-}(\mathrm{x}), \mathrm{V}_2^{-}(\mathrm{x}), ., \mathrm{V}_{\mathrm{m}}^{-}(\mathrm{x})\} = \left\{\left(\min_i v_{ij}(x) \ | \ j \in j_1\right) \max_i v_{ij}(x) \ | j \in j_2 | i = 1, n\right\}$$

Di* and Di⁻ calculations refer to the separation of the alternatives from the positive and negative ideal solutions via Euclidean distance calculation. The number of Di*and Di -will be equal to the number of alternatives (Peters and Zelewski, 2007; Triantaphyllou, 2000).

$$D_i^{*} = \sqrt{\sum_{j=1}^{m} \left[V_{ij}(X) - V_j^{+}(X)\right]^2}, \ D_i^{-} = \sqrt{\sum_{j=1}^{m} \left[V_{ij}(X) - V_j^{-}(X)\right]^2}, i = 1, .., n$$

As a result, relative closeness to the ideal solution Ci* (1 > Ci* > 0) decides better solution with closeness to 1.

$$C_i^{*} = \frac{D_k^{-}}{D_k^{*} + D_k^{-}}, \qquad C_i^{*} \in [0,1], \forall i = 1, \dots, n$$

VIKOR

VIKOR method has been proposed by Opricovic and Tzeng (2004) to solve multi criteria decision making problems (Opricovic & Tzeng, 2004). On the assumption that each alternative is evaluated for each criterion, with the weights determined in the VIKOR method, the compromised ranking is obtained by comparing their ideal proximity values for ideal alternative (Opricovic & Tzeng, 2007).

Development of the VIKOR method started with the following form of Lp-metric;

$$\mathrm{Lp}_{,\mathrm{j}} = \left\{\sum_{i=1}^{n} \left[\frac{w_i\left(f_i^{*} - f_{ij}\right)}{f_i^{*} - f_i^{-}}\right]^{P}\right\}^{1/P} \quad 1 \leq P \leq \infty, \qquad j = 1,2, \dots . J$$

Within the VIKOR method L1,j=Sj and L∞j= Rj are used to formulate the ranking measure. The minimum Sj solution represents the maximum group utility and the minimum solution Rj represents the individual regret of the opponent (Yu, 1973; Zeleny, 1982; Opricovic, 1998).

Best f_i^* and the worst f_i^- values of all criterion functions (i = 1,2,..,n),

$f_i^* = \max_j f_{ij}$, $f_i^- = \min_j f_{ij}$, represents a benefit

$f_i^* = \min_j f_{ij}$, $f_i^- = \max_j f_{ij}$ represents a cost

will be used to compute the values Sj and Rj with Formula 15,

$$S_j = \frac{\sum_{i=1}^{n} w_i(f_i^* - f_{ij})}{(f_i^* - f_{ij})}, R_j = max_i \left[\frac{W_i(f_i^* - f_{ij})}{(f_i^* - f_{ij})}\right], \ \text{j} = 1, 2, \dots, \text{J},$$

where wi are the weights of criteria, expressing their relative importance.

Compute the values Qj; j = 1,2,...,m, by the Formula 16

$$Q_j = \frac{v(S_j - S^*)}{(S^- - S^*)} + \frac{(1-v)(R_j - R^*)}{(R^- - R^*)} \quad \text{where} \quad S^* = min_j\, S_j,\ S^- = max_j S_j,\ R^* = min_j\, R_j,\ R^- = max_j R_j$$

The best ranked Q (minimum) measure is proposed as a compromise solution.

Comparison of Techniques

Comparison of ranking results obtained by TOPSIS and VIKOR methods, using the same criteria as times higher education world university ranking

Both methods assume a scale factor for each criterion. This scale requires to eliminate the different units of all criteria values. For ranking the values that calculated by methods are defined with an aggregating function. Addition to TOPSIS, VIKOR method provide a compromise solution with an advantage rate.

The normalization procedures are different in each method. While the VIKOR method uses linear normalization, TOPSIS method uses vector normalization. IN linear normalization, the normalized value does not depend to the unit of the criteria. In TOPSIS method, normalized value could be different for different evaluation unit of a particular criterion (Opricovic & Tzeng, 2004).

The main difference between two methods appears in the aggregation approaches. The VIKOR method provides an aggregating function representing the distances from ideal solution.

The TOPSIS method introduces the ranking index including the distances from the ideal point and from the negative-ideal (nadir) point. These distances in TOPSIS are simply summed without considering their relative importance (Opricovic & Tzeng, 2004).

The TOPSIS method uses n-dimensional Euclidean distance that by itself could represent some balance between total and individual satisfaction, but uses it in a different way than VIKOR, where weight v is introduced. Solution. Both methods provide a ranking list. The highest ranked alternative by VIKOR is the closest to the ideal solution. However, the highest ranked alternative by TOPSIS is the best in terms of the ranking index, which does not mean that it is always the closest to the ideal solution. In addition to ranking, the VIKOR method proposes a compromise solution with an advantage rate (Opricovic & Tzeng, 2004).

Discussion

Both methods VIKOR and TOPSIS are mostly used MCDA methods in decision making projects. Ability to adapt methods to Geographical Information Systems increase the applicability in the field of environmental, meteorological and engineering problems. Different solutions enhance the decision process and increase the preference of decision makers. Thus, right decision giving can be possible with two probabilities.

These two MCDM methods use different kinds of normalization to eliminate the units of criterion functions, whereas the VIKOR method uses linear normalisation, the TOPSIS method uses vector normalization. The normalized value in the VIKOR method does not depend on the evaluation unit of a criterion function, whereas the normalized values by vector normalization in the TOPSIS method may depend on the evaluation unit.

A comparative analysis shows that these two methods use different normalizations and that they introduce different aggregating functions for ranking.

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USING EXPLORATORY FACTOR ANALYSIS METHOD IN THE CALIBRATION STEP OF SLEUTH URBAN GROWTH MODEL: A CASE STUDY OF ISTANBUL SANCAKTEPE DISTRICT

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ABSTRACT:

Land cover changes effected by urbanization is one the main problem for urban decision makers. They want to keep urban growth under control to protect natural and environmental sources located in urban fringes. Cellular automata-based simulation models have been frequently used for this purpose. Therefore, a small number of models have been generated for many years, and the most well-known model is SLEUTH Urban Growth Model among them. The name of SLEUTH was derived from required input data such as slope, land cover, excluded areas, urban areas, transportation networks and hillshade. In SLEUTH software, urban growth simulation model is generated in three steps; test, calibration, and prediction. The calibration is an important stage because it affects model accuracy, directly. For this reason, different methods have been created to calibrate simulation model. In this study, exploratory factor analysis method, which is a new approach, was used in calibration stage and promising results were obtained from Istanbul Sancaktepe District which has rapidly grown in recent years.

KEY WORDS: GIS, Land Cover Change, Cellular Automata, Urban Growth, Exploratory Factor Analysis

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1. INTRODUCTION

It is very important to understand the growth and change in rapidly growing cities due to population growth, industrialization and migration etc. In such cities, it is necessary to control the urban growth in a way which makes more efficient use of resources and increases the quality of life. This requires not only how the land cover will change, but also how the urbanization will be predicted.

Urban growth is one of the most important topics in recent years. The fact that the urban growth phenomenon is a constantly changing structure, and is oriented towards the future, which makes it necessary to carry out these researches. This study aims to produce predictive models for the future by explaining the actual cause and effect relations of changes in cities. In this regard, predictions that may be needed in the future can be obtained in advance and potential deficiencies can be avoided.

Despite planning studies, urban and environmental problems continue to increase. The researchers purpose for generating new alternative urban approaches on the grounds that the proposed studies do not provide solutions for urban and environmental problems (Günbeyaz and Turan, 2009).

It is aimed to control urban growth in the direction of sustainability target, to decrease or stop the urban sprawl (Wheeler, 2004). The urban growth models (UGMs) play an important role in reducing the damage to nature and the environment by controlling the urban growth (Ayazli et al, 2015). Cellular automata (CA) based simulation methods are frequently used to model land use/cover changes (Clarke et al., 1997; Engelen, et al., 1997; Silva & Clarke, 2002; Cheng, 2003; Batty, 2007; Başlık, 2008; Ayazli et al, 2017).

One of the most well-known model SLEUTH allows for predicting potential land use/cover change using temporal data. It is aimed to calculate the best fit growth coefficient values into the model in the calibration phase, which is completed in three phases; coarse, fine, and final. The model has 13 metrics, each of which include Pearson's product-moment correlation coefficient r^2 score (Dietzel and Clarke, 2007). Each of the metrics have separate impacts on the modelling of urban growth. However, there is not yet a consensus on which r^2 score/scores to create model. Lee-Sallee and Optimal SLEUTH Metric (OSM) techniques are generally used to select the growth coefficients (URL 1). The main purpose of this article is to investigate the modelling achievements of the explaratory factor analysis (EFA) method in the calibration step.

The EFA reduces the number of variables by combining correlated variables into factors (Büyüköztürk, 2002). For the EFA method to be used, the sample size must be greater than 50 (Büyüköztürk, 2002). In this study, there were over 3000 for coarse and fine calibration steps and 215 for final. According to results 12 of 13 metrics can be used in the final calibration step to model urban growth by the EFA method in Istanbul Sancaktepe district, which has rapidly grown in recent years.

2. STUDY AREA

Sancaktepe, located in east side of Istanbul, is one of the districts where urbanization is rapidly experienced after the 1980s (Figure 1). Population growth in the study area is around 55% between the years 2008 and 2015 (TSI, 2016).

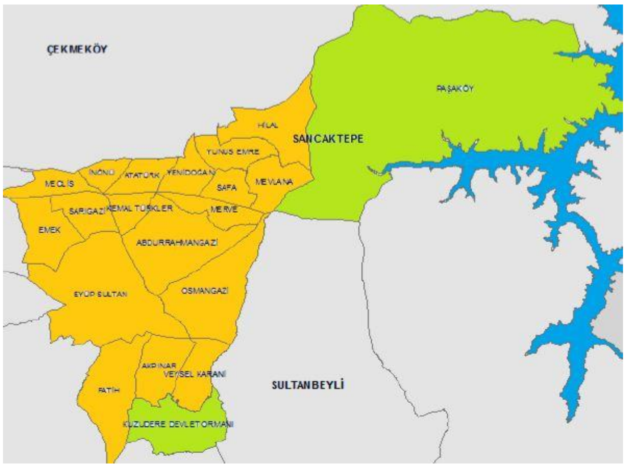

Figure 1. Administrative boundaries of study area (Ayazli and Baslik, 2016)

3. METHODOLOGY

3.1 Model Background

The data, which were used in the creation of the model, are stored in an urban growth database management system so that the storage, editing, analysis, and presentation of the data can be done easily. Land cover data, transportation maps, digital elevation models and master plans are frequently utilized in order to produce urban growth simulation model (UGSM).

Land cover data are usually generated from satellite images. However, the necessary data for creating UGSM were obtained from cadastral maps in this study. The cadastral maps obtained from Umraniye Cadastre Directorate and the master plans taken from Sancaktepe Municipality have been transferred to a geographical database in order to prepare settlements, building site, land cover, and accessibility data.

CA based SLEUTH UGM was used in the study to create UGSM for Sancaktepe. The name of software was derived from required input data such as Slope, Land Cover, Exclusion, Urbanization, Transportation and Hillshade (URL 1). As software input; slope, two period land cover, excluded areas, at least four periods of urban area, at least two periods of transportation and hillshade are used.

The software uses four growth rules and five growth coefficients associated with these rules while creating the UGSM at the test, calibration, and estimation stages (Table 1).

Growth rules	Growth coefficients
Spontaneous Growth	Dispersion, Slope
New Spreading Centre	Breed, Slope
Edge Growth	Spread, Slope
Road Influenced Growth	Breed, Road Gravity, Slope, Spread

Table 1. Rules and coefficients of SLEUTH (Ayazli et al, 2010)

The first stage is the test phase when the simulation model is created with SLEUTH software. Testing of the input data generated during the test phase and the regulations made in the scenario file are tested for compliance with the standards required by the software. After the test phase, the calibration phase starts. This phase is the most important step in order to create UGSM (Silva ve Clarke, 2002). During the calibration phase, the best fit growth coefficient values for the model are calculated. Finally, simulation model for the future is generated in the prediction phase. A general flow chart is presented in figure 2.

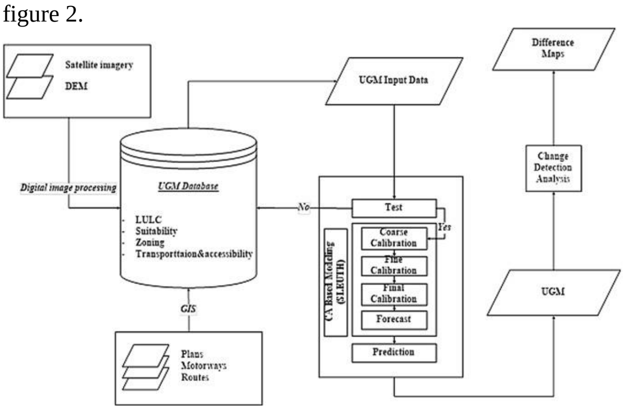

Figure 2. The flow chart for generating UGSM (Ayazli et al, 2015)

3.2 EFA

The SLEUTH UGM, which is an open source and free software, uses Monte Carlo Iteration for simulation. 13 metrics of the model have separate impacts on calculation of urban growth during the calibration processes. The main goal of this study is to calculate urban growth accurately for detecting the effects of urbanization in Sancaktepe. For this purpose, EFA method was used to obtain unique variables.

The EFA attempts to define intercorrelated variables together and it was used to obtain unique variable (Ayazli & Bilen). When using this technique, calculating the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity values are very important. The KMO value should be greater than 0.45 (Balanza et al, 2007) and Bartlett's test of sphericity should be less than 0.05 (Tabachnick and Fidell, 2013), in order to check adequateness of sample size for EFA. Calculating the Total Variance Explained (TVE) based on the eigenvalues for each factor is the second step (Balanza et al, 2007; URL 2). At the final step Rotated Component Matrix (RCM) should be generated.

4. RESULTS AND CONCLUSIONS

Calculated scores for the KMO, the Bartlett's test of sphericity and the TVE are presented in Table 2.

Calibration step	Coarse	Fine	Final
KMO	0.500	0.801	0.732
Bartlett's test of sphericity	0.000	0.000	0.000
TVE (%)	76.23	84.77	86.13

Table 2. KMO, Barlett's test and TVE scores

The sample size is adequate for using EFA in the study because the KMO scores of each calibration step are greater than 0.45 and the Barlett's test values are lesser than 0.05.

The TVE identified eight factors that explain 76.23 % of the total variance in the coarse calibration, three factors that explain 84.77 % of the variance in the fine calibration and two factors that explain 86.13 % of the variance in the final calibration.

According to results, three metrics were used for the fine calibration step, six metrics for the final and eleven metrics for the forecast.

In the EFA technique, all SLEUTH metrics can be handled at the same time. The inter-correlated metrics are calculated, and coefficient intervals can be narrowed using highly correlated variables.

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SIMULATING LAND COVER CHANGE BY PROTECTIVE AND NON-PROTECTIVE SCENARIOS

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ABSTRACT:

Land cover changes caused by population growth and rapid urbanization and determination of land cover changes impact is compulsory for sustainable urban management policies. Therefore, simulation models have been densely used in planning studies. Cellular automata-based simulation models present significant contribution for monitoring land cover change analysis and determining the urbanization effects on natural areas in the rapid growing cities. The main goal of this study is to predict urban growth and to determine the probable land cover changes according to protected and non-protected scenarios in Istanbul Sancaktepe district which has experienced an enormous population growth in last years. The required historical land cover data for the model were generated from cadastral maps which have been generated since 1950s. For this purpose, change detection analysis was first made between 1961-2014 and weight coefficients were calculated to create simulation model by protected scenarios for 2030. In order to detect the damages of uncontrolled urbanization, the second simulation model was created by non-protected scenario. According to first scenario, approximately 10 % of forest area will be probably transformed into settlement and agricultural area by 2030. However, if the necessary precautions are not taken, namely uncontrolled urban growth occurs, this rate will be dramatically high.

KEY WORDS: GIS, Change Detection, Land Cover Change, Cellular Automata, Urban Growth

1. INTRODUCTION

Uncontrolled urban growth is one of the most prevalent problems in the modern urban planning. Contemporary planning issues such as sustainable development, smart growth, and compact city are against scattered and extreme urban growth. In the urban growth studies, the damage caused by the urban growth is analysed through prediction models, by doing so the protection areas are determined.

From urban modelling techniques, cellular automata (CA) is suitable for modelling complex and dynamic natural phenomena such as urban areas. It is a convenient method for simulating urban systems because it is dynamic and directly compatible with the raster GIS. Cellular automata consist of basic elements such as grid, lattice, cell, interaction, neighbourhood, cell states, transformation rules, and starting position (Benenson and Torrens, 2004). CA is a system that divides a plane into cells and determines the state of each cell in the next generation relative to its neighbours. The state of the cells in the grid network indicates land cover. In this regard, geospatial information can be spread or changed on the grid network (Benenson and Torrens, 2004).

Our study area, Sancaktepe district with 19 neighbours is located on the Anatolian side of Istanbul. In the study, model input data were prepared by more than 70.000 parcel data from the establishment cadastre to 2014 were arranged in GIS environment. Two periods of land cover, three periods of transportation data, and four periods of settlement data were produced from these data. In addition, administrative borders, two period transportation, and one period building stock produced by Istanbul Metropolitan Municipality (IMM) and digital elevation model (DEM) data by Map General Command were used in the study. In this paper, until 2030, two different models of urban growth simulation have been generated and the results to be produced according to the scenarios of protection and non-protection of forest areas have been revealed.

2. STUDY AREA AND METHODOLOGY

2.1 Study Area

According to the Turkey Statistical Institute, the population of the county in 2015 was determined to be 354,882 (URL 1). The region (Figure 1), which is a highly sensitive residential area due to its basin character, is increasing its importance due to the transportation facilities provided by the TEM motorway (URL 2).

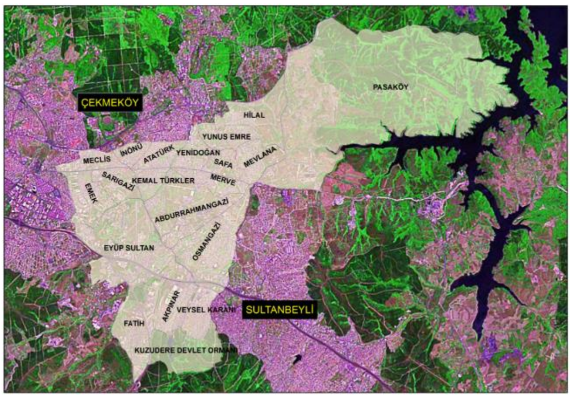

Figure 1. Study area

2.2 Methodology

Considering the density of cadastral map production and zoning activities, four different time periods are emerging such as 1961, 1992, 2001 and 2014. The data generated from the digitized maps were kept in the geographic database and the attribute information was entered through the title deed. CA based SLEUTH software has been used to generate urban growth simulations. The software has been used in a number of projects around the world (Akın et al., 2014; Ayazli et al., 2014; Heinsch et al., 2012; Jantz and Goetz, 2005; Rafiee et al., 2009; Silva and Clarke, 2002; Wu et al., 2009; Dietzel et al., 2005).

The study was started with archive work. Suitability, zoning, accessibility, land cover, and socio-economic data needed by the simulation model stored in the geospatial database have been produced. Four land cover classes were used in the study such as settlement areas, agricultural areas, forests, and open spaces.

3. RESULTS AND CONCLUSIONS

Rapid population growth and migration led to land use changes in the county since the past years which brought with it squattering, illegal settlement and uncontrolled urbanization.

According to the simulation results, 10 % of forest areas are expected to be transformed into built-up areas, agricultural areas and open spaces by protective scenario (Figure 2) and this rate will be 25 % if necessary precautions are not taken (Figure 3).

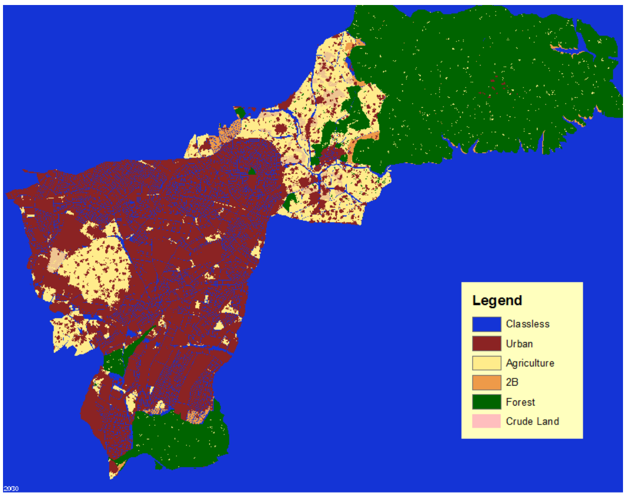

Figure 2. Urban growth simulation model by protective scenario

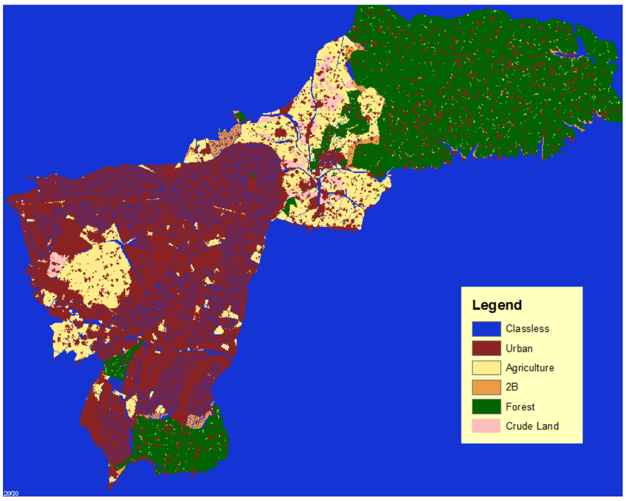

Figure 3. Urban growth simulation model by non-protective scenario

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NECESSITY AND CONTENTS OF GEOGRAPHIC INFORMATION SYSTEMS PROGRAMS IN VOCATIONAL COLLEGES

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ABSTRACT:

To make every decision taken in terms of public administration (investment, education, strategy, ...) is accurate and sustainable, time and space-related data must be collected and processed. Developed countries have applied this method as GIS (Geographical Information System) since 1950. Such practices were implemented also in our country, in 1995 in some municipalities in the Marmara region in a simple way. Over time, an institutional structure was needed to make sure that decisions that would be taken nationwide would be successful. GIS General Directorate was established in 2011 for this purpose. The main purpose of the institution is to contribute to sustainable and planned development by providing reliable data to all relevant investor institutions and organizations. To achieve success, a trained technical worker for this purpose is required. To fulfil the need, programs have opened under the name of Geographic Information Systems Technology in the associate degree sections of universities. In this paper, a study about the courses and contents that should be taught in these programs will be presented.

KEY WORDS: Associate Degree, Geographic Information System, Spatial Query, GIS Course Content

1. INTRODUCTION

Human beings have always lived with the fact of learning, and when they fulfilled this fact, firstly they needed knowledge and used knowledge as a means of development. Knowledge has directly influenced the development of not only individuals but also societies. Because, in parallel with the rapidly increasing population in the living world, in order to

1. Answer the quality service request,
2. have a high living desire,
3. Increased demand for diversified information,
4. Catch the level of civilization and contemporary civilization,
5. Be an information society

the need for knowledge and efficient use of information in all service sectors has emerged.

Today, besides the data / information produced on the earth, the amount of data / information obtained with the satellites increases day by day. In short, there is intense information traffic. Since the size and intensity of information volume information leads to a complex structure, information requires to be managed in an organized manner. This requirement has brought the concept of information systems together with developments in information technology. As a result of this, the concept of Geographic Information Systems (GIS) has emerged (Yomralıoğlu 2003).

Although GIS is defined as an information system that collects, stores, processes, and presents information based on location in particular, it has become an indispensable information fact that developed communities can use in every field in today's arena. Therefore, in order to utilize information technologies with full capacity in national development, as GIS has been considered as an important component of national information policies, national information infrastructure in a country need to be established and all kinds of information services need to be organized.

2. WHAT IS GIS?

Geographical information systems are a collection of geographic databases, software, hardware, personnel, standards and methods that come together for the functions of gathering, storing, querying, analyzing, submitting and exchanging the information needed for research, planning and decision-making bodies according to geographical bases. GIS has application areas in many sectors such as urban and regional planning, agriculture, forestry, landscape planning, geology, defence, security, tourism, archaeology, local governments, population, education, environment and medicine.

Geographical Information Systems have a wide perspective and are named according to their usage areas because users who are interested in spatial information are from different disciplines and they are used for different applications and purposes. GIS is "a concept that analyzes geographical information that includes the whole of spatial information systems" by some experts; some are "a computer-based tool that translates spatial information into a digital structure"; some administrators are described as "a data base management system that helps the organization". GIS is an important tool that helps you to make the most optimal of all and make decisions.

GIS is linked to information systems such as computer-aided design (CAD), computer-aided cartography, database management systems, and remote sensing. However, unlike these systems, GIS also has the ability to "perform geographical analysis" and "generate new knowledge" (Bengsghir 2004).

GIS, which is a powerful tool for analyzing the relationship between spatial and non-spatial data, provides important input in the determination of public policies either at the local or central level. In fact, despite the fact that GIS as a political tool is not new, the fact that all the actors (policy makers, citizens, experts, etc.) have access to GIS through the development of internet and web technologies in recent years makes it necessary to integrate this tool from a more institutional perspective. As it has been widely used in the field of environment and natural resource management for many years, it now provides new initiatives for the formulation and implementation of public policies. With this feature, technical and legal obstacles have been overcome not only in developing countries such as our country but in US and European country applications where these technologies are mainly used, and it has encouraged public institutions and organizations to use CBS more effectively and to develop them in a wider spectrum (Greene 2001).

3. IMPORTANCE OF MAPS IN GIS

Maps; is a generalized model of the real world using indirect or direct various mathematical transformations with information such as spatial relations, hierarchy, neighbourhood, continuity, structure, shape, density, size, height, position, direction and distance. The map can be defined as a summarized form of earth reality, a basic language of geography, and marked presentation of geographical reality according to selected objects, object relationships, and object characteristics.

The maps used in GIS are pre-made maps for various purposes. Cadastral and service maps are usually in large scale. Small scale maps are usually used in geospatial analysis,. When working with spatial data in the GIS environment, three basic types of interrogation are encountered: "What?, Where ?, When?". Analysis is obtained from locative, thematic and temporal comparisons. The environment where the relations in these kinds of queries are best presented is the ones that respond to the questions in the best way (Uluğtekin 2005).

Before GIS became widespread, paper maps and statistics were the most effective tools for researchers working with spatial data. Analytical techniques and mapping techniques have been developed to work with these paper maps. These techniques are also among the commands of the GIS packages used today. Today, with the development of information technologies the same researchers are benefiting from the highly powerful databases, spreadsheet software and graphical tools. These facilities not only reduce load and time of the process, but also allow the user to access the map data. This allows the map to be viewed from a different angle, and puts the maps to the centre of spatial research. We can give the following examples to the disciplines that produce and use GIS and maps: geography, remote sensing, cartography, geodesy, photogrammetry, measurement, earth sciences, mathematics, statistics, meteorology, coastal geography and management, civil engineering, regional planning, anthropology, service management, forestry, management and so on. Business areas like Epidemiology, archaeology, law and education were identified as new GIS areas (Uluğtekin 2005).

Science emphasized by global phenomena like Global desertification, ozone hole, global circulation, world economy has brought the maps to the agenda that global phenomenon is needed. The flow, circulation and understanding of distribution

of information have increased mainly by means of thematic maps and the perception of spatial processes becomes easier.
As a result of the effective use of this scientific approach (Clarke, 2002):

1. The boundaries between the disciplines have been removed and the distinction between science and social sciences has also been disappeared,
2. Geography-based relations, mapping of phenomena and visualization has become obligatory,
3. The advantage and effectiveness of the use of the map as a means of communication has exceeded the limits of science.

Maps make the spatial representation of the earth aiming communication for users by means of GIS. Cartographic visualization and increased user interaction will produce useful information about the spatial distribution, which the purpose is the production and sharing of useful information. Interactive, animated and cyber maps will take the place of analogue and electronic maps that are used extensively until today. In addition to these issues, cartography will continue to develop basic guidelines for effective data display rules and misunderstanding of maps, will continue the studies on making user interfaces to help solve spatial queries, and will answer the question how to make optional displays required by specific applications.

The maps used in the GIS environment can be collected under the following main headings (Uluğtekin 2000):

1. Cadastral-purpose maps,
2. Service maps (gas, water, waste water, electricity, telephone, cable, etc.),
3. Socio-economic maps (maps derived from relevant statistics on population, infrastructure, settlement, distribution of labour, education, agriculture etc.)
4. Maps for environmental purposes (plant cover, soil, hydrology, geology, forest, etc.)
5. Other maps (maps related to the use or particularly misuse of resources such as water pollution, air pollution and soil pollution).

4. ASSOCIATE DEGREE GIS EDUCATION

4.1 Student Resource

The purpose of opening the associate degree GIS programs is to is to educate the staff to public and private institutions;who are equipped with analytical thinking, problem solving and decision making abilities about geographical information technologies which are effective in decision making process and basic principles of spatial data management, strategies and techniques. The program covers all the theoretical and practical teachings of the study area and equips its students with the ability to specialize in the fields of Remote Sensing and Geographical Information Systems and gain students the ability of doing research in this area.

However, the graduates have been aimed to have preferred to be employed by the business world, have an innovative, sustainable understanding of education, be productive, researchers, self-reliant, sensitive to ethical values, have sophisticated socio-cultural background in society, and to be qualified individuals who follow technological developments.

Nine universities in our country have this program (Table 1). When we examine the tabled data, we can reach the following judgments;

1. When Open Faculties are excluded (520/154), a total of 154 people prefer this program. The overall rate of quota is 30%
2. The place of preference in the general order is decreasing every year (603 000 to 1 300 000),
3. The program lost its charm which it has in the first years.

Table 1: Universities with GIS program in associate degree and additional information (Url 1)

Üniversity	Vocational College	Quota	Settled	The Lowest Score Puanı	The place of the last settled 2018 2017 2016
Akdeniz	TBMYO Daytime	60	61	188.48	1300000 843000 635000
	TBMYO Evening	60	21	184.72	1265000 1000000 954000
Anadolu	Open University	1400	1435	166.71	1300000 - -
Burdur MAE	Bucak Daytime	50	10	165.26	1295000 765000 635000
	Bucak Evening	50	12	170.05	- - -
Çukurova	OSB	40	24	177.48	1284000 1000000 678000
İstanbul	Open University	150	154	169.56	1300000 924000 603000
Manisa CB	Demirci Daytime	45	10	173.18	1290000 1230000 -
	Demirci Evening	40	2	169.47	- - -
Selçuk	Çumra	55	8	180.01	1275000 1214000 872000
Sinop	Boyabat	50	4	191.21	- - -
Süleyman Demirel	Uluborlu	70	2	201.56	- - -
Toplam		**2070**	**1741**		

4.2 Course Curriculum

The course curriculum of the program is nearly the same in all universities with minor differences. Here, the course curriculum of Çumra Vocational School of Selçuk University which is one of the first founded programs in the field and Open Education Faculty of Anadolu University will be given.

Table 2: The course curriculum of SÜ Çumra Vocational School GIS Technology Program (url 2)

1st Semester Courses	ECTS
Principles of Atatürk and History of T.R- 1	2
Tuıkısh Language-1	2
Foreign Language-1	2
Mathemetics-1	3
Surveying-1	4
Coordinate Sytems in GIS	3
Introduction to GIS-1	5
Basic Information Technologies	3
Basaic of Programming	3
General Communication	3
2nd Semester Courses	
Principles of Atatürk and History of T.R- 2	2
Tuıkısh Language-2	2
Foreign Language-2	2
Occupational Health and Saffety	3
System and Database Design in GIS	4
Cadastre and Zoning Information	3
Institutional Comminication Comminication and Corporate Working	3
Mathemetics -2	3
Introduction to GIS - 2	4
Location Techniquesd	3
Internship-1 30 Days	4
Public Reations	3
3rd Semester Courses	
Remote Sensing	4
GIS Project-1	5
Computer Aided Design-1	5
Presentation techniques in GIS and Cartoprachic Design	4
Photogrametry	3
Statistics	3
Spatial Data Standarts	3
Land Management and GIS	3
Urban Development	3
Laser Scaning Techniques	3
4th Semester Courses	
WEB Based GIS	4
Computer Aided Design -2	4
GIS Project -1	5
Spatial Analysis	4
Internship-2 30 Days	4
Vocational Foreign Language	3
Enviromental Projection	3
Busines Management	3
Management Systems and Standarts	3
Disater Management	3
Special Issues in GIS	3
Open Source Coded Solutions	3
Cmputer Networks	3
Financial Literacy	3

Table 3: The course curriculum of AÜ Open Faculty CBS Technology

1st Semester Courses	AKTS
Basic Information Technologies I	3
Introduction to GIS	3
Basic Statistics for GIS	3
Computer Aided Basic Design	3
Computer Aided Map Drawing I	3
Spatial Database I	3
Basic Mathematics for GIS	3
Foreign Language I*	0
2nd Semester Courses	
Basic Information Technologies II	3
Geographical Information Systems	3
Computer Aided Map Drawing II	3
GIS Applications I	3
Basic Geometry for GIS	3
Spatial Database II	3
GIS Standards and Basic Legislation	3
Foreign Language II**	0
3rd Semester Courses	
Remote Sensing	2
Photogrammetry	3
Project Design and Management in GIS I	3
Open Source Coded GIS Software Applications	2
Office Applications for GIS I	3
Remote Sensing Applications I	3
Principles Of Atatürk And History Of T.R I	3
Turkish Language I	3
4th Semester Courses	
Project Design and Management in GIS II	3
GIS Applications in Local Governments	3
Office Applications for GIS II	3
Uzaktan Algılama Uygulamaları II	3
Remote Sensing Applications II	3
Digital Picture Processing	3
Principles Of Atatürk And History Of T.R II	3
Turkish Language II	3

The program is map based naturally. It is connected with computer for technological inquiry. For this reason, map and computer courses are predominant in this program.

5. CONCLUSION AND RECOMMENDATIONS

In Central European countries there are about 250 companies operating in the field of GIS. The spatial information industry in Germany is not regarded as large, with 7,000 people working, with a cash flow of half a billion dollar. But the market share of

10% is not considered to be negligible. We shouldn't forget that there is a growth of 16% per year in the GIS field in Germany and in the world market (Köktürk 2003).

The governors of the country understood the importance of this issue and the GIS General Directorate was established for this purpose (Url 4). The main aim of the institution is to establish a network of GIS information across the country and to increase the appropriate investment by giving right decisions of the users. GIS General Directorate has also been organized in big cities. Since students do not choose GIS-based programs (as they were chosen by lower-profile students), they provide qualified human resources primarily from other engineers, including Map and Computer engineers. The institution should increase the number of applications and provide the nationwide efficiency. For this, the administrative structures of the old institutions should be revised.
The courses of the program should also include Immovable Valuation and Land Management.

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AzerWIS
A web based geographic water information system for Azerbaijan

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ABSTRACT:

The floods along the Kura-Araz river system in 2010 emphasized the necessity for an information system enabling a quick response to the dynamics of the water system. Next to this disaster the growing demand for fresh water for cities like Baku and the (re) development of the agricultural sector raised the necessity for a good overview of the status of the water system for Azerbaijan. Therefore an extensive data collection program for water and water related data was conducted late 2014 covering all domains of importance for Azerbaijan, i.e. ground water, surface water and irrigation, both quality and quantity aspects. The survey was part of a project called Water Resources Inventory of the Republic of Azerbaijan.

AzerWIS is a complete geographical data management system based on open source and modular components. AzerWIS has a 3Tier architecture and can be easily extended with other module, such as a hydrological times series data management system (Delft-FEWS). This management system makes it possible to operate models in an operational mode to carry out Forecasts that are part of Early warning systems. AzerWIS is a geographical web based interface, a geodatabase and several services to enable data flows via OGC services which are used to either visualise geographic data as well as extract data from the database for the numerous locations where time series data is available for to present these via time series plots.

KEY WORDS: AzerWIS, OGC services, Historical data, Google Earth Engine, Flood, Forecast Early Warning System, Water inventory

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1. INTRODUCTION

1.1 Context

The floods along the Kura-Araz river system in 2010 emphasized the necessity for an information system enabling a quick response to the dynamics of the water system.

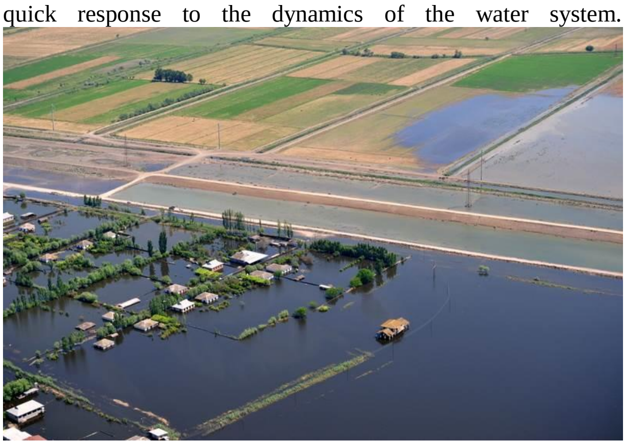

Figure 1 Flooded canals in Azerbaijan

Next to this disaster the growing demand for fresh water for cities like Baku and the (re) development of the agricultural sector raised the necessity for a good overview of the status of the water system for Azerbaijan. Due to the difficult times in the past detailed information on the natural system is highly scattered and in some cases outdated. Therefore an extensive data collection program for water and water related data was conducted late 2014 covering all domains of importance for Azerbaijan, i.e. ground water, surface water and irrigation, both quality and quantity aspects. The survey was part of a project called Water Resources Inventory of the Republic of Azerbaijan.

The aim of the project is to prepare an inventory of water resources and water demand and to present an analysis of the development of resources and demand under different scenarios and management strategies. The current, first stage of the project focuses on data collection and storage in an information system, field work, preparation of monitoring plans, hydrological modelling of surface water, demand analysis and an initial water resources analysis focusing on surface water. A second stage was foreseen, including drilling of exploration boreholes, groundwater modelling coupled with surface water modelling and a water resources analysis including both groundwater and surface water resources and use. However this second stage has not been conducted upon this day.

1.2 Phase 1

Phase 1 of this project mainly focussed on making archives accessible (in a modern GIS based data platform) to gain better understanding of the historical data for the domain surface water as well as gaining knowledge about that status of the irrigation system and groundwater reserves of Azerbaijan. Several extensive field campaigns were organised to acquire new as well as historical data. Hydrological yearbooks from 1971 – 2015 where converted into a more robust data structure in order to be used in hydrological analysis. These data where georeferenced and made available via a web portal called AzerWIS Azerbaijan Water Information System). Ground water quality and ground water suitability maps from geological surveys were compiled and made accessible via the AzerWIS. The data was completed by data from the surveys carried out to gain insight in the status of the irrigation works. This 'classic' approach was enriched by analysis from satellite imagery via Google Earth Engine, GeoEye, Landsat series. The Google Earth Engine platform allows analysis on all publically available data from NASA and ESA satellites (and more). For 2 lakes (Mingachevir reservoir and Shamkir) data is extracted from Landsat 8 imagery over the period 2000-2016. The algorithm used yields the maximum bank full situation per year for the lakes under investigation. The corresponding outlines have been stored in a geodatabase which is exposed as OGC-WMS (OpenGeospatial Consortium Web Mapping Service) service to the AzerWIS visualising the trend (animated bank full situation) of these lakes to end users.

1.3 Phase 2

Phase 2 of the project would further focus on the (re)construction of an operational monitoring system for water quantity and quality, including groundwater, surface water and drainage systems. This data should then be available via telemetry and being available in near real time mode for operational use in dashboards for operators and as time series via a web portal. With an extended comprehensive AzerWIS system which links the interdependencies between groundwater, surface water and climate this platform would be an essential tool in the future strategic development of agriculture plans as well as assess the future potable water demand and flood safety for all governmental bodies in Azerbaijan. The modular setup of AzerWIS and the use of OGC services (OGC, Open Goespatial Consortium, Anonymus 2018-1) throughout the complete architecture makes the AzerWIS a useful source for geographic and time series information on the status of the hydrological system of the Republic of Azerbaijan.

2. MATERIAL AND METHODS

2.1 Data collection

The most important task in the establishment of AzerWIS is the collection of data. "Without data, no AzerWIS". The main aim of phase 1 of the project was to get an update of the hydrological knowledge and centralise this for the Republic of Azerbaijan. The updated knowledge is the basis to get a clear view with respect to the amount of water available for the various water demands by functions like drinking water, agriculture and nature.
In intense collaboration with hydrologists of the Ministery of Emergency Situations various data sources have been identified and digitized and made available via the AzerWIS. The following paragraphs elaborate further on the data collection

2.2 Base data collection

First stage in hydrological modelling is describing the study area using global data sources such as a global digital elevation model, land use and soil maps. In later stages often these data can be updated (partially or not) by more accurate data. During the initial set up the following set of data were collected:

- DEM (SRTM)
- Administrative boundaries (MES)
- Landuse
- Soilmap

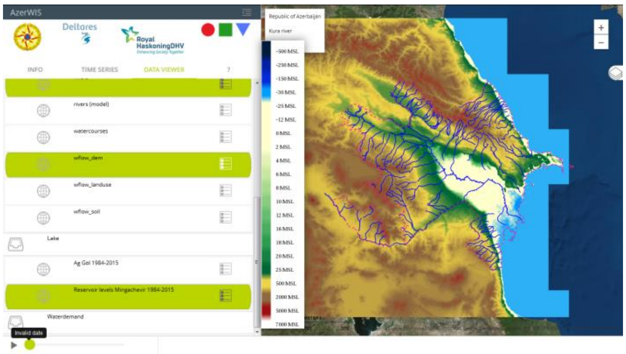

Figure 2 Digital Elevation model based on SRTM data and used in hydrological modelling software.

2.3 Hydrological yearbooks

Special attention has been granted to the Hydrological Yearbooks. Azerbaijan has a rich history in collecting and maintaining collections of data in yearbooks. But … the data from those yearbooks are in analogue or in digital document formats available. The use of this kind of formats is not possible in hydrological modelling, therefore conversion to a more 'model friendly' format had to be carried out. This was done by converting the *.doc formats to the more modern and more easyer to parse *.docx formats. From there the tabular information for each station and parameter was parsed to csv file formats that could be connected to lists of locations of stations via the Delft-FEWS import routines. The direct connection between Delft-FEWS and the core database of AzerWIS made all data available for any type of user (and model).

2.4 Other HydroMet data sources

Hydrological and meteorological data are important data sources for understanding the hydrological system. Especially long time series help in calibrating and validating hydrological models. AzerWIS is initially populated by extracting data from hydrological yearbooks (water level and water discharges) and from global sources which are:
Within the project, the following sources for precipitation data were collected.

- Station data from the Global Historical Climatology Network (GHCN)-daily (Menne et al., 2012) from the National Oceanic and Atmospheric Administration NOAA).
- Station data from MES, both daily and monthly time steps.
- Station data from the ECA project.
- Station data (mean monthly values) from WMO dataset.
- Gridded precipitation from EUWATCH dataset.
- Gridded precipitation from WFDEI dataset (Weedon et al., 2014).
- Gridded precipitation from MSWEP dataset.

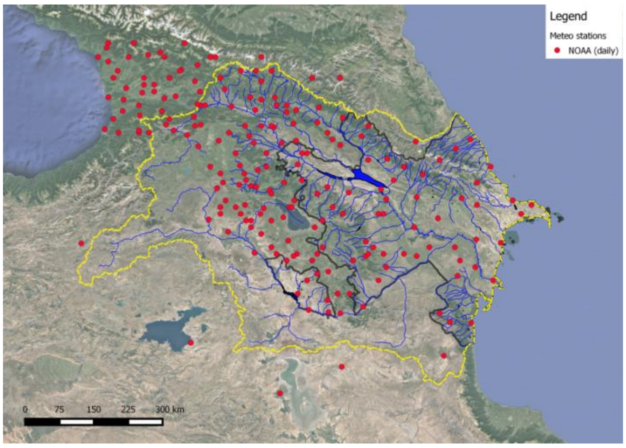

Figure 3 Meteorological stations with daily precipitation data from the NOAA dataset, including the major rivers and in yellow the boundary of the model, in black the boundary of the Republik of Azerbaijan.

2.5 Geological surveys

Detailed information about aquifers and the current status of ground water quality and quantity was only available from analogue maps and or deprecated records from yearbooks. During several field surveys ground water quality was tested with the Merckoquant test strips (Nitrate test strips) and EC meters. Interpretation of the data resulted in identifying promising groundwater basins and expected potentials for large scale abstractions. The final overview is presented in next figure.

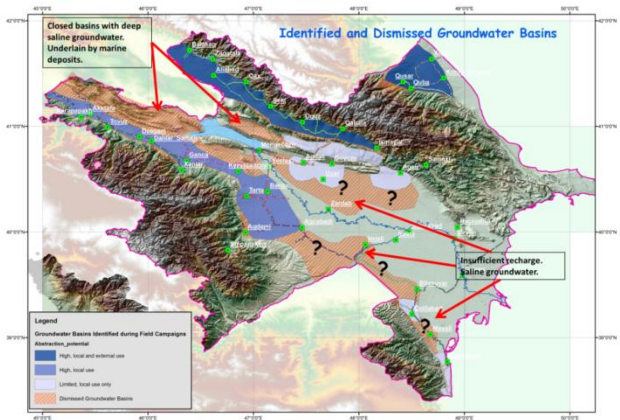

Figure 4 Promising groundwater basins as identified during the "quick scan" field campaign and expected potentials for large scale abstractions. Also shown are the areas which can be dismissed as promising groundwater basins.

2.6 Google Earth Engine

Google Earth Engine gives the ability to explore large scale as well as regional scale phenomena using Googles calculation and storage capacity. Google Earth Engine enables researchers to use all publically available satellite data such as MODIS, LANDSAT and from 2014 onwards also ESA Sentinel imagery. The ability to write algorithms and apply them on the imagery available is used to extract bank full situations for various basins in Azerbaijan during the period of 1984 to 2016. Image below is a snapshot of the data available within AzerWIS of the bank full delineation of Lake Mingachevir.

Figure 5 Bank full delineation of lake Mingachevir in 2014

2.7 Water demand data

The objective of the water demand assessment is to quantify the current and future water demand within the Azerbaijan. The results of the analysis will be used in the water resources analysis where supply and demand will be jointly analysed and potential shortages, measures and trade-offs will be identified
Large upstream parts of the Kura-Aras Basin are located in neighbouring countries. These countries have their own water management systems, affecting the quantity and quality of the water which crosses the border with Azerbaijan. Trans-boundary developments in the upstream part of the Kura-Aras River Basin affecting the water availability in Azerbaijan therefore need to be identified to be able to estimate how much water crosses the border.

- The following key indicators of the quality and efficiency of local water supply operations have been estimated:
- Per capita consumption;
- Value of Non-Revenue Water (NRW);
- Actual water use in m3 per day for domestic and non-domestic users in 2015;
- No. of staff per 1000 connections, and
- Meters of distribution network per connection;

One of the water demand functions is water for industrial purposes. Next figure gives the intake points for current urban and industrial water use.

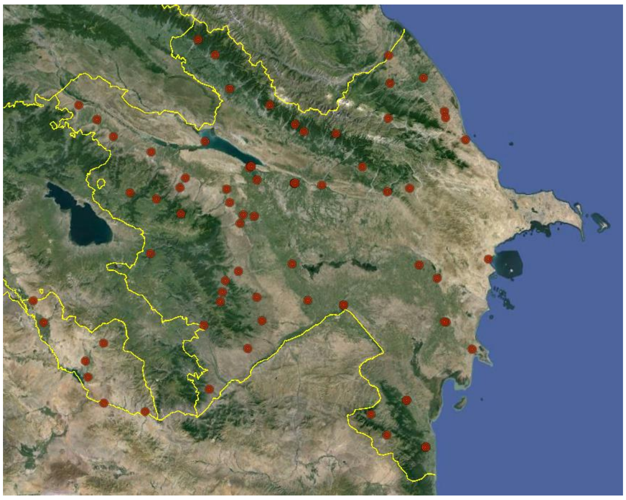

Figure 6 Intake points current urban and industrial water demand in Azerbaijan

2.8 OpenEarth

OpenEarth (www.openearth.eu) was developed as a free and open source alternative to the current often ad-hoc approaches to deal with data, models and tools.
OpenEarth as a whole (philosophy, user community, infrastructure and workflow) is a comprehensive approach to handling data, models and tools that actually works in practice at a truly significant scale. For data, models and tools that are truly strategic and really cannot be shared, OpenEarth stimulates the setup of internal OpenEarth clones. This way the OpenEarth workflow can still be adopted, promoting collaboration within the organization, while taking care of security considerations at the same time (Koningsveld, 2010).

OpenEarth does not prescribe components to be used, but only some conditions that has to be met, such as open source and open standards. In the years after the first OpenEarth data intensive projects a couple of open source solutions appeared to be working within the concept. These components all have a huge track record in scientific research, but the use is certainly not limited to scientific research. This chapter will focus on the solutions that form the basis for data management in the AzerWIS, the main components are:

- PostgreSQL/PostGIS
- Geoserver
- OGC-WPS
- THREDDS

2.9 AzerWIS vs OpenEarth

AzerWIS is based on several components which are widely used throughout the world. A good example of the use of PostgreSQL/PostGIS in combination with geoserver is a product called Geonode (Anonymus 2018). The AzerWIS is built upon the same components, but, not via the Geonode approach. The AzerWIS is a system that build-up of the components in such a way that via OGC services

2.10 Components

2.10.1 Introduction

The architecture of AzerWIS follows the three tier architecture concept which for the AzerWIS situation is visualised in next picture.

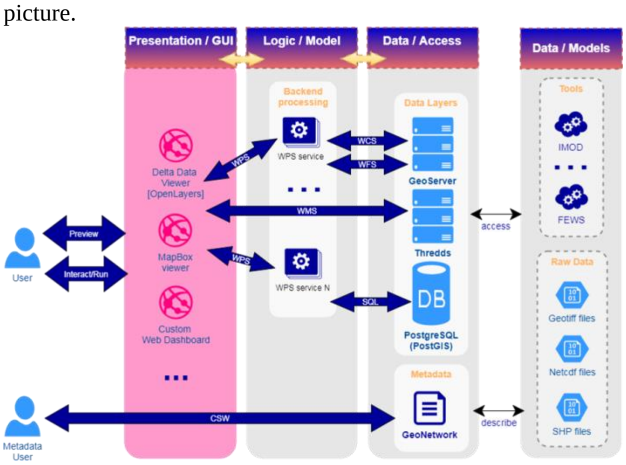

Figure 7 Three Tier architecture as basis of AzerWIS

This architecture consists of a data part, a logical model layer and presentation layer. The open structure of the architecture and the underlying components allow extension of several modules such as models, workflow managers and sources of raw data. From these options DELFT-FEWS will be considered as an important part of the AzerWIS since it is a very useful tool in setting up and running hydrological models.

2.10.2 PostgreSQL/PostGIS

PostgreSQL is a powerful, open source object-relational database system with over more than 15 years of active development. PostgreSQL is Operating Software independent and therefore a very popular database system used in several fields of research. As addition to PostgreSQL the add on PostGIS is also very popular in the field of georelated research. PostGIS adds extra datatypes to the PostgreSQL database and a lot of GIS functions which de fact mean that the combination PostgreSQL/PostGIS is geodatabase with complete GIS functionality.
This combination of GIS functionality and optimized performance for large datasets makes it very useful in multidisciplinary earth science research with large volumes of data.
In AzerWIS the PostgreSQL/PostGIS database is used in the storage layer as storage of thematic layers and time series data. These time series data is validated data derived from various sources and stored in the FEWS schema of the database.

2.10.3 THREDDS

The goal of Unidata's Thematic Real-time Environmental Distributed Data Services (THREDDS) is to provide users with coherent access to a large collection of real-time and archived datasets from a variety of environmental data sources at a number of distributed server sites. The THREDDS Data Server (TDS) is a web server that provides metadata and data access for scientific datasets, using a variety of remote data access protocols.
The THREDDS Data Server (TDS) is 100% Java, open source, and runs as a Tomcat web server application. TDS data serving capabilities are built on top of Unidata's netCDF-Java / CDM library. The CDM data model combines the NetCDF-3, DAP2, and HDF5 data models, into what is called the Common Data Model (CDM).

In AzerWIS THREDDS is supposed to deal with high volume data outputs of hydrological models in phase 2 of the Inventory of water system of Azerbaijan.

2.10.4 Geoserver

GeoServer is a Java-based software server that allows users to view and edit geospatial data. Using open standards set forth by the Open Geospatial Consortium (OGC), GeoServer allows for great flexibility in map creation and data sharing.
GeoServer allows you to display your spatial information to the world. Implementing the Web Map Service (WMS) standard, GeoServer can create maps in a variety of output formats.
OpenLayers, a free mapping library, is integrated into GeoServer, making map generation quick and easy. GeoServer is built on Geotools, an open source Java GIS toolkit.
There is much more to GeoServer than nicely styled maps, though. GeoServer also conforms to the Web Feature Service (WFS) and Web Coverage Services (WCS) standards, which permits the actual sharing and editing of the data that is used to generate the maps. Others can incorporate your data into their websites and applications, freeing your data and permitting greater transparency.
GeoServer enables desktop GIS software (like ESRI ArcGIS and QGIS) to access online data sources.
In AzerWIS GeoServer serves data from the storage layer to web portal in a styled way.
GeoServer couples xml formatted style files (so called styled layer descriptor or SLD) and data into styled services. Layers disseminated via GeoServer can be completed with abstract and links to metadata information. These objects are all used in the Web portal.

Besides static maps GeoServer is also able to serve dynamic content through date time information in the data source

2.10.5 Geonetwork

GeoNetwork is a catalogue application to manage spatially referenced resources. It provides powerful metadata editing and search functions as well as an interactive web map viewer. It is currently used in numerous Spatial Data Infrastructure initiatives across the world.
GeoNetwork provides an easy to use web interface to search geospatial data across multiple catalogues. The search provides full-text search as well as faceted search on keywords, resource types, organizations, scale, ... Users can easily refine the search and quickly gets to the records of interests.
GeoSpatial layers, but also services, maps or even non geographic datasets can be described in the catalogue. Easily navigate across records and find sources or services publishing a dataset.
GeoNetwork in AzerWIS is used to store meta data of the layers available in the AzerWIS. The web portal serves the link to detailed metadata via the link stored in the properties of each layer (in GeoServer).

2.10.6 WPS

PyWPS (version 3.2.1) is an implementation of OGC Web Processing Service standard. It should make life easier for those, who want to interface custom geospatial calculation to the Internet (or intranet), using now days standards.
The OGC WPS provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay. The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to those processes. The data required by the WPS can be delivered across a network or they can be available at the server.
PyWPS is part of the communication layer between storage and information layer (i.e. the web portal). WPS enables dynamic gathering of data, allows transformations and GIS procedures to be carried out in the back end of the AzerWIS. WPS can return a wide variety of objects such as simple numbers, time series arrays, imagery or complete documents. In AzerWIS WPS as interface between user interface and storage component and is implemented using PyWPS3.2.1.
Three functions have been implemented, *get parameters*, *get locations* and *get time series*. The *get parameters* process is executed on start-up of the AzerWIS, it gets the parameters stored in the FEWS data model of the Storage layer i.e. the PostgreSQL/PostGIS database.
A users action to choose a parameter executes the *get locations* process which returns a geojson that is plotted on the interface as an extra layer of geographical information.
A click on the map triggers the *get time series* process passing the location of the click in Web Mercator projection (EPSG:3857) to the process. Using the pyproj4 library coordinates are transformed to WGS84 (EPSG:4326) and used

in a query to get time series data for the location (closest location to the given coordinates) and the time span chosen. The result is json formatted time series that is visualised in the front end.

2.10.7 FEWS

Delft-FEWS is an open data handling platform initially developed as a hydrological forecasting and warning system. Essentially it is a sophisticated collection of modules designed for building a hydrological forecasting system customised to the specific requirements of an individual organisation. Because of its unique characteristics concerning data importing and processing and model connections, Delft-FEWS has also been applied in a wide range of different operational situations. Examples are water quality forecasting, reservoir management, operational sewer management optimization, and even peat fire prediction.
DELFT-FEWS works in 2 modes, each of them having specific requirements. Standalone just runs on every laptop or pc, regardless the Operating System. The operational mode requires a specific infrastructure and specific software such as an Operator Client, Achive Server and Computation Node. This is a scalable system. The main architecture is given in **Figure 8**.

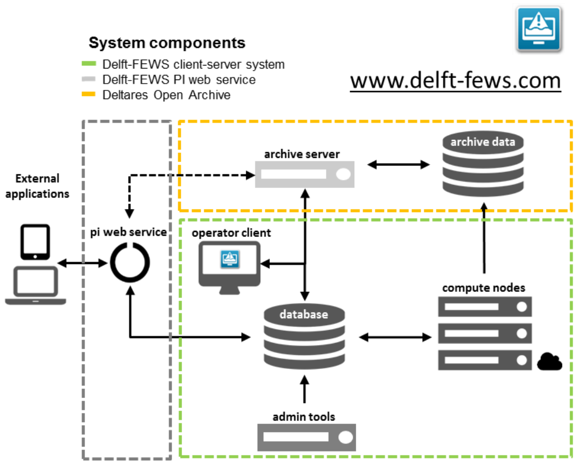

Figure 8 DELFT-FEWS architecture

DELFT-FEWS comes with an API called PIWEBservice, this is the link between DELFT-FEWS and other environments such as AzerWIS. PIWebService can only give information about time series. But because of the open architecture of FEWS also information from rasterdata can be used in AzerWIS, in this particular case via OGC services.

2.10.8 Presentation layer

The presentation layer has openlayers2 as basis and has the expected classical components as zoom and pan and the ability to toggle layers on/of, but also some extra functionality, such as:

- Dynamic build up the layertree from GetCapabilities from geoserver
- Retrieve layer information from geoserver
- Dynamic build up of form extracted from GetCapabilities from WPS

The first 2 extra functions make it possible that back end and front end are dynamically coupled and that changes in Geoserver are automatically picked up by the front end, so no intereference is necessary by front end developers. The layer information capability extracted from geoserver is used when a layer is toggled on. Extra layer information is loaded in memory and made available as an abstract of the data and lets a link to metadata appear in the lower area of the interface.

The WPS support is enable via the VUE framework. At startup the GetCapabilities of the WPS service is requested and a list of processes is extracted. This list of processes exist of a title and a description. In case an end user selects a process the frameword checks if the process really exists by executing the DescribeProcess. The return of the DescribeProcess gives the description of required inputs. These inputs are converted into objects which result in the composition of a user form. By default WPS does not prescribe which type of objects are possible. Therefore a specific list of objects are supported, these are:

- Integer (i.e. give layer number)
- Double (i.e. give factor)
- Datetime
- Dropdown (i.e. a list will be presented as dropdown choice box)
- Point (i.e. this enables a button on the form and enables users to click on the map canvas where the location is converted into a json point object)
- Line (like previous, but then a point collection as json object is returned to the process)
- Execute button

The final object on the form is the execute button. It is not specifically necessary to have WPS as service layer, but the fact that it is an OGC standard and that it seperates front end from back end enables easy and fast scripting without input from front end developers.

The composition is such that the WPS always returns a html which is used as an overlay over the map. This html is in most cases some kind of statistical plot (bar, line) of for instance a time series or a profile of a raster. WPS enables any kind of process to be run on the backend. More about WPS processes can be found at http://openearth.eu.

2.11 Modelling suite

An integrated approach to the water system and its surroundings is the basis for long-term, sustainable management of environment. Multi sector planning to allocate scarce resources at the river basin level is increasingly needed in the water sector, as water users and governmental agencies become more aware of the trade-offs occurring between quantity, quality, costs and reliability.

2.12 WFLOW

To assess the surface water hydrology, the Wflow model is used, this is a hydrological rainfall-runoff model. The Wflow model is a distributed, gridded, rainfall-runoff model that calculates the runoff at any given point in the model at a given time step, based on physical parameters and meteorological input data. For a more technical description of the model, see Schellekens (2014).

2.13 Ribasim

RIBASIM (River Basin Simulation Model) is a generic model package for analyzing the behaviour of river basins under various hydrological conditions. The model package is a comprehensive and flexible tool which links the hydrological water inputs at various locations with the specific water-users in the basin.

RIBASIM enables the user to evaluate a variety of measures related to infrastructure, operational and demand management and the results in terms of water quantity and water quality. RIBASIM generates water distribution patterns and provides a basis for detailed water quality and sedimentation analyses in river reaches and reservoirs. It provides a source analysis, giving insight in the water's origin at any location of the basin. RIBASIM follows a structured approach to river basin planning and management.

RIBASIM is a modelling instrument for river basin planning and management. It has a set of outstanding features which make it a state of the art river basin simulation package. The model has been applied for more than 30 years in a large number of countries and in a wide variety of projects. Water management organizations world-wide use it to support their management and planning activities. Large and complex river basins have been modelled and simulated with RIBASIM. Separately modelled sub-basins can be combined into one main-basin.

RIBASIM has a link with the rainfall-runoff model WFlow, the groundwater flow model SEAWAT and the detailed water quality process model DELWAQ. Further, RIBASIM is used in an operational water demand and allocation environment using the Delft-FEWS software Anonymus 2018-2.

3. RESULTS AND DISCUSSION

From 2014-2016 data collection is gradually build up and taken up in the central data storage system of AzerWIS. The AzerWIS has been evaluated during that time to enable analysis on data from the collected times.

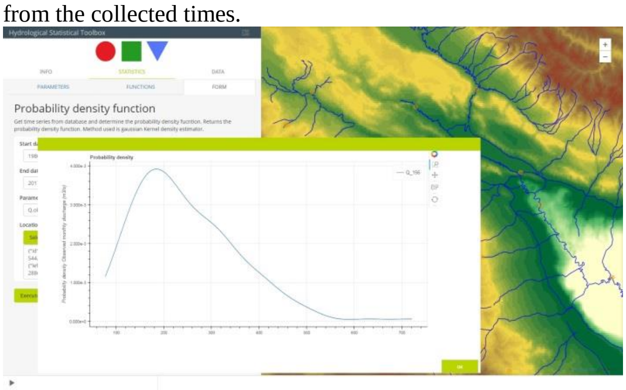

Figure 9 Probability density function for a location in Azerbaijan using time series data collected from several sources.

The modelling framework has been setup with the collected data and the first calibration runs have been carried out. The conclusion from the calibration runs was that the model obtained can be used for a first assessment of a water resources study, as yearly and monthly regimes are captured accurately enough by the model for the assessed rivers.
However, uncertainties in the model parameters and forcing, discharge data, operational rules of reservoirs and irrigation abstractions remain and should be reduced.

As foreseen, progress on water resources modelling has been limited compared to the other parts of the project, since this depends on their results of the hydrological modelling. The approach and data for the initial water resources analysis have been described in detail the modelling approach, the required data and the foreseen application of the model. This provides the basis for the implementation of the water resources model.

4. CONCLUSIONS

This article is a report of the establishment of a water information system for Azerbaijan and the collection of data. Both support the project Water inventory Inventory for the Republic of Azerbaijan conducted in the period 2014-2016. Therefore the main conclusions are that the setup of the complete system has resulted in a first good overview of the situation of the water system in a wide variety of water domains where data is stored in an open source geo database and made available via internationally agreed upon standards for data exchange using state of the art techniques and software like DELFT-FEWS.

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SPECIAL MAP BASE OF MILITARY GEOINFORMATION SYSTEM

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ABSTRACT:

Since its inception, the Geographic Information System (GIS) has been widely used in many areas of the civilian sector. However, this system with its remarkable technical capabilities is still insufficiently implemented in the military sphere. Therefore, the article points out the necessity and expediency of creating a GIS for military purposes.

When creating a GIS for military purposes, it should enrich its main block, that is, a topographic database (TDB) with additional materials such as special maps, aerospace photo documents that are universally used in the troops.Based on these considerations, the article proposes to create in the military GIS an additional functional unit called the "Special Map Base". This article describes in detail the structure, content and function of the proposed block.

KEY WORDS: Military geoinformation system, geospatial database, topographic database, special maps, photo documents.

INTRODUCTION

Before proceeding to the content of a special map base of military GIS (MGIS), we will briefly review the features of a standard GIS.

Depending on the area of implementation, the content of GIS is determined in different ways. In some definitions, it appears as a tool for creating maps, storaging, using and displaying of geographic data, and in others as a computer geographic database to support decision making:

Geographic Information System - this is a computer system of cartographic software, created by individuals, scientific organizations and industrial enterprises for the collection, analysis, storing and dissemination of information from the Earth's surface;

Geographic information system - this is a computer system for the collection, storage, processing, analysis and presentation of geographic data by specific organizations;

Geographic information system is a set of powerful tools for collecting, storing, processing, transforming and demonstrating geographic data;

A geographic information system is a decision support system using geospatial data.

Summarizing these definitions, we can say that in general, GIS is a system for collecting, analyzing, systemizing, processing, storing, presenting and managing all geographic and geospatial data on the Earth using computer technology.

Geographical information system was first used by the Canadian government in the 60s of the last century for the purpose of inventorying state land plots. Since that time, GIS has been widely used by state institutions and private companies in other countries as a "Tool" for planning the production process, making decisions and managing them.

Thanks to the technical capabilities of GIS, military organizations also have showed interest in creating GIS for military purposes. Military organizations are well aware and appreciate that GIS in its format is a large geographic database that provides detailed information about the terrain in the form of digital raster and vector topographic maps, or on separate layers of maps and map products. Such a database is very important for the proper planning and conduct of operational-tactical acts in military affairs. If the GIS base is additionally equipped with military information, this system will be called the Military Geographic Information System (MGIS) or the Defense Geographic Information System (DGIS).

Depending on the purpose of creating and assigning tasks, technical equipment, software, level and scope of application, the MGIS may have different structures. However, for all types ofGIS, the four main functional blocks - 1. Topographic database block; 2. Technologyblock; 3. Hardware block and 4. Software block are characteristic.

TOPOGRAPHIC DATABASE OF THE GEOGRAPHIC INFORMATION SYSTEM

The variants for creating GIS are determined by their purpose, tasks and responsibilities, resulting from these tasks. TDBisthemainfunctionalblockofGIS.This block contains all the geographic information of the system, as indicated above.In recent years, special computer programs allow to collect geographic data from maps and aerospace images directly into the TDB.

The main advantage of TDB in comparison with a topographic map is, that here the presented geographic data makes possible to conduct a complex analysis of the terrain in the current time (real-time).TDB is also an effective tool for creating and updating digital topographic and thematic maps.If the analogue (paper) topographic maps represent the geographic content of the terrain (relief, vegetation, hydrography, settlements, socio-cultural objects, road network, boundaries, etc.) with cartographic simbols, but the TDB on the basis of the spreadsheet of attributes allowsand provide more detailed information about each object of the map.Due to the preservation of data in a vector format, using TDBs, you can quickly update maps and map products.

Because the database objects are in the form of simbols, their places can be changed, erased, updated, enlarged as images or displayed as a 3D model.The TDB has the ability to present the previous state of objects and events, as well as the future (predictive).

For the functioning of GIS, as well as MGIS, including the collection and presentation of information in TDB, it is advisable to use cartographic software Oracle, ArcCIS and Global Mapper.The Oracle software is a powerful computer program and is recommended for use in the implementation of the MGIS server.Database management capacity in the Oracle software is 100 ÷ 1000 GB (gigabytes).The program allows thousands of users at the same time to access the TDB of the MGIS.At the present time Oracle7, Oracle 10 and Oracle 11 are used in production.ArcCIS software is used to collect map data in TDB, as well as to create map layers.A Global Mapper as a GIS software package is used to represent digital cartographic products.

1. DISTINCTION BETWEEN GEOSPATIAL AND GEOINFORMATION SYSTEMS

The twentieth century marks the era of the scientific and technological revolution, aviation, space and nuclear technologies.The 21st century is called the age of information.In everyday life we everywhere meet with information.

Information - this is a data about a particular object or reality. It should be noted that 80-85% of the information available everywhere is geo-information. Geospatial information is a combination of different types of information about space, territory, events and processes.The terms "geospatial", "geospatial data", "geospatial database" are included in the technical literature in the late 80s of the last century and are now widely used in scientific literature.

Despite the differences in essence and designation in most cases, the term "Geospatial Data Base" (GDB) is used in place of the term "Geographic Information System".This is a completely wrong approach.

GDB - is designed to store, process and represent objects in a geometric space.The basis for GDB is the geospatial information network, which is called a Geospatial dataset (GDS). In GDB geospatial data are stored in the form of coordinates, addresses, city names and codes.

Unlike GDB, the GIS is based on a topographic database, which consists of geographic information, topographic maps, topographic plans, aerospace images and other materials.

A comparative analysis between GDB and GIS shows that it is more expedient to use GIS for military purposes.Because, at present time, military operations are mainly planned and conducted using digital topographic maps and map productswhich are stored in the TDB of MGIS.

2. SPECIAL MAP BASE OF MILITARY GEOINFORMATION SYSTEM

When creating a GIS, depending on the content and purpose, you can include additional elements in its structure. As we know, when planning and carrying out military operations, alongside topographic maps, there are widely used special maps and aerospace images in the troops (note: further in the text"Special maps").

The main purpose of creating special maps is to provide troops with additional terrain data not available on topographic maps.Depending on the tasks, if special maps are created, it is necessary to digitize and collect them into a separate database in order not to confuse them with other maps (Fugure 1). Thus, with the use of modern cartographic computer software such as ArcGIS, it is possible to create a new special map base for military GIS.

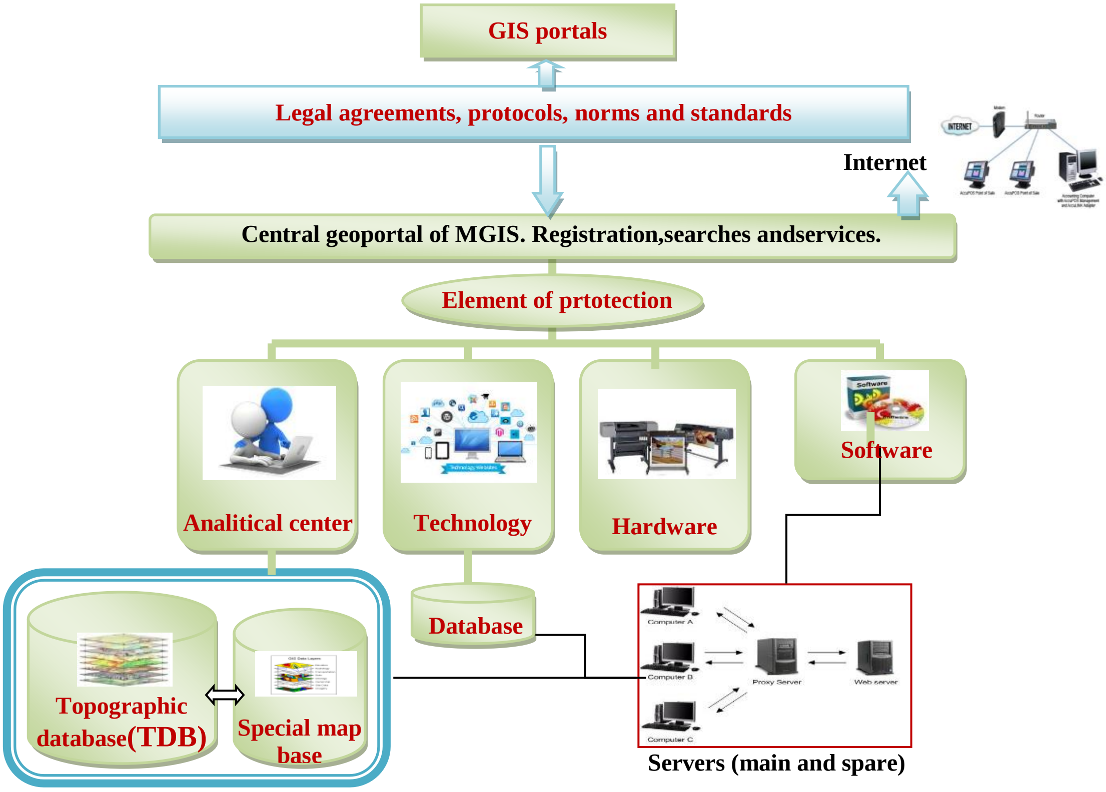

Figure 1. MGIS functional blocks (variant)

After determining the content of special maps, we will review their types and appointments, as well as aerospace images located in a special military GIS database.

3.1. SPECIAL MAPS

Special maps -are maps that describe in detail the specific part of the terrain depending on the task and the requirements of higher combat headquarters. They are created in advance by units and units of the topographic service of the Army in the preparation and conduct of military operations.

When creating special maps, in detail analyze the data of territorial intelligence obtained from various cartographic sources. After that, all these data are displayed in a vector format as a separate "Shape" file, if necessary, the created shapefile or vector layer is combined with a raster topographic map and printed.

Special maps include: maps of terrain changes (Figure 2); maps of contour points (maps of geodetic data); maps of river sections; cross-country maps; maps of mountain passages; maps of landing areas; maps of aboveground and underground water sources; maps of drainage systems;maps of plant cover;nautical charts;relief maps; maps of railways; road maps; aerodrome maps; maps of seaports; maps of accommodation centers; maps of energy centers; oil storage maps; geological maps; hypsometric maps, etc.

Of the above-mentioned special maps, the first four are most often used in the troops.

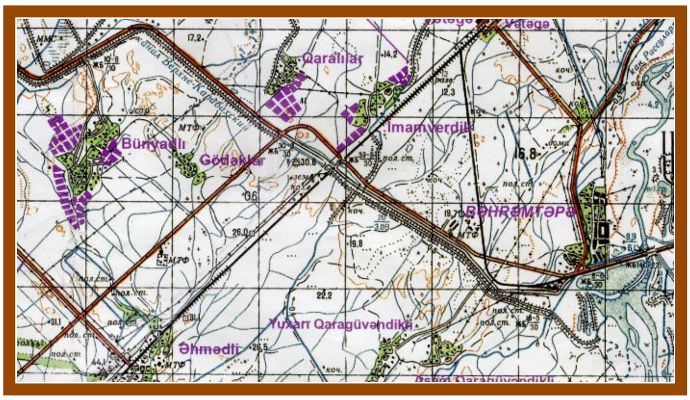

Figure 2. Map of terrain changes (fragment)

Operative correction of topographic maps produsing faster than updating them. When conducting military operations, a great need is shown for them, they are more effective and are used by troops everywhere.

3.2. AEROSPACE PHOTO DOCUMENTS

Aerospace photo documents are intended to bring the information about the terrain to the headquarters and troops in addition to the information available on topographic maps. Like special maps, they are also created on the most important areas of battlefilds. These documents usually show decrypted data about the enemy.

In headquarters, photo documents are usually used together with topographic maps. Photo documents include:

aerospace images;
photo schemes;
photo plans (orthophoto);
photo maps, etc.

Special maps and photo documents must satisfy the requirements of the troops for the completeness, reliability, accuracy and visibility of the images of elements and objects of the terrain on them, as well as the timing of the creation and visualization of these documents.

CONCLUSIONS AND RECOMMENDATIONS

In order to improve the troops daily activities, increase the efficiency and effectiveness of planning and conducting military operations, military GIS as an information base is an indispensable tool in military affairs.

Topographic database is one of the main block of the standard GIS and differs significantly from other types of geographic data base. Therefore, its creation requires a special approach.

The experience of past warriors, military operations conducted in modern conditions and military trainings shows that for making informed decisions it is necessary to have additional sources of data that are not available on topographic maps.

In this regard, it is required to provide troops with special maps and photo documents. We suggest that MGIS of the Army which will be created, be supplemented with a new block which called "Special map base“. The newly created database of special maps, enabling the enrichment of TDB with special geographic information, and will also enhance the military significance of GIS.

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3D OBJECT RECOGNITION WITH KEYPOINT BASED ALGORITHMS

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ABSTRACT:

Object recognition is important in many practical applications of computer vision. Traditional 2D methods are negatively affected by illumination, shadowing and viewpoint. 3D methods have the potential to solve these problems, because 3D models include geometric properties of the objects. In this paper, 3D local feature based algorithms were used for 3D object recognition. The local feature was keypoint. This study aimed to research facilities of keypoints for 3D object recognition. Keypoint is feature of object that is detected by detector algorithms according to certain mathematical base. A recognition system was designed. For this purpose, a database that includes 3D model of objects was created. The algorithms were improved in MATLAB. The keypoints on the 3D models were detected using keypoint detectors. These keypoints were described by keypoints descriptors. The descriptor algorithms detect geometrical relation between each point of point cloud and create a histogram. In the third step, the keypoints in different point clouds are matched using the feature histograms obtained. Statistical methods are used to compare generated histograms. Thus, the two closest similar points between the different point clouds are matched. It is expected that the models with the most corresponding points belong to the same object. Euclidean distance between corresponding keypoints in the two point cloud is calculated. It has been accepted that the points are shorter than 10 mm. The positional accuracy of the matched points has been examined. Iterative Closest Point (ICP) was applied to the matching point clouds for this purpose. As a result, the graphics were generated that showed correct matching ratio and root mean square error. As a result, there are different approaches about 3D object recognition in literature. This study aimed to compare different keypoint detector and descriptor algorithms. Intrinsic Shape Signature (ISS) is keypoint detector algorithms. Point Feature Histograms (PFH) and Fast Point Feature Histograms (FPFH) are keypoint descriptor algorithms. The results of this study will provide guidance for future studies.

KEY WORDS: 3D model, Recognition, Local Feature, Object

1. INTRODUCTION

Object recognition is a fundamental research area in computer vision. Detecting the identities and poses of the 3D objects is main task of a 3D object recognition system. 3D object recognition is used in many application such as robotics, biometrics, navigation, remote sensing, entertainment etc. (Guo et. al., 2015). The goal of 3D object recognition is to correctly identify objects in a point cloud and estimate their 3D pose (Lu et. al., 2014). There are two categories of existing 3D object recognition algorithms: global feature-based and local feature-based. Global feature-based algorithms extract feature from entire input object. These algorithms are affected by occlusion and clutter. Local feature-based algorithms are main focus of research of 3D object recognition, because local feature-based algorithms are robust to occlusion and clutter. Local feature-based algorithms extract local features from object stored in a library and input object. Then, the algorithms try to detect corresponding features from two objects (Guo et. al., 2015).
In this study, a 3D object recognition system was developed by using local feature-based algorithms. Keypoint was used as local feature in the system. The system has three steps. In first step, the keypoints were detected by using 3D keypoint detector algorithm. In second step, the keypoints were described by using 3D keypoint descriptor algorithms. In final step, the corresponding points were detected by using histogram matching algorithm. The keypoint detector algorithm is Intrinsic Shape Signature (ISS). The keypoint descriptor algorithms are Point Feature Histograms (PFH) and Fast Point Feature Histograms (FPFH). Kullbeck-Leibler Divergence method was used to match local features. In next section, the mathematical models of the methods were explained. For accuracy analysis, Iterative Closest Point (ICP) method was applied. The aim of the study is to compare 3D local feature-based algorithms for object recognition.

2. METHOD AND MATERIALS

2.1 Intrinsic Shape Signatures (ISS)

In the ISS method, the support area of a point is determined by using a sphere that has certain radius. The points that are inside of the sphere are neighbour points of the central point. Firstly, the points are weighted.

$$\omega_i = \frac{1}{\|\{p_j : |p_j - p_i| < r\}\|} \quad (1)$$

Then, scatter matrix is computed. It is need to compute saliency value. Saliency is parameter that is used for selection of keypoints.

$$\Sigma(p) = \frac{1}{N}\sum_{q\in N(p)}(q - \mu_p)\,(q - \mu_p)^T \quad (2)$$

μ(p) is the average coordinate value of neighbour points of point p. Than the eigenvalue vector of the scatter matrix is computed. Calculated eigenvalues (λ1, λ2, λ3) are sorted from largest to smallest. When the ratios of the eigenvalues to each other are less than the specified threshold values, the point is selected as candidate for the keypoint. The points that has smallest λ3 in the its neighbourhood is selected as keypoint (Tombari et. al., 2013).

2.2 Point Feature Histograms (PFH)

Point Feature Histograms (PFH) are multidimensional histograms created using the different properties of each pair of points within the neighbourhood of a keypoint (Guo et. al., 2016).

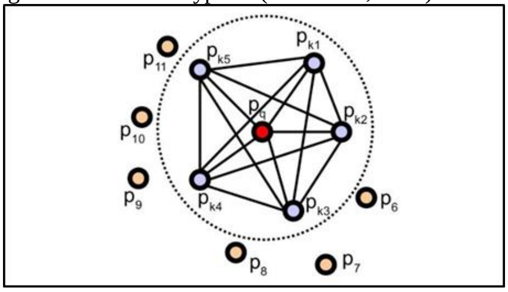

Figure 1. Point Feature Histograms (PFH) diagram

Local Reference System (LRF) of a keypoint is determined by using Darboux frame. Darboux frame uses normals to define LRF. Based on the LRF, geometric relation between all point pair in the support area are calculated.

2.3 Fast Point Feature Histograms (FPFH)

Fast Point Feature Histograms (FPFH) is faster version of the PFH method.

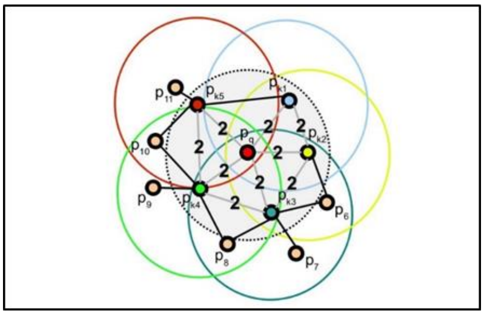

Figure 2. Fast Point Feature Histograms (PFH) diagram

FPFH calculates geometric relation between keypoint and its neighbours. It is named as Simplified Point Feature Histogram (SPFH).

$$FPFH(p) = SPF(p) + \frac{1}{k}\sum_{i=1}^{k}\frac{1}{w_k}.SPF(p_k) \quad (3)$$

2.4 Data

As application data, 3D point clouds of eight objects were used. Point cloud density is 1100/inc2. Point cloud density has been experimentally determined to decrease process load and to obtain sufficient geometric relation.

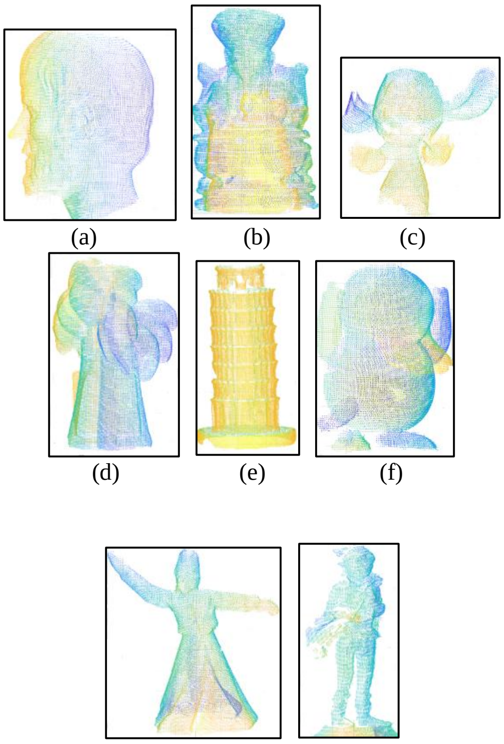

Figure 3. (a) Object 1 (b) Object 2 (c) Object 3 (d) Object 4 (e) Object 5 (f) Object 6 (g) Object 7 (h) Object 8

3. APPLICATION

3.1 3D Object Recognition

The algorithm consists of 3 steps. In the first step, 3D points are defined on the point clouds using ISS method. In the second step, key points are described using Point Feature Histograms (PFH) and Fast Point Feature Histograms (FPFH) histogram methods. In the third step, the keypoints in different point clouds are matched using the feature histograms obtained. Kullbeck-Leibler Divergence method (Wahl et al., 2003) was used for histogram matching.

$$\kappa(H_0, H_{O'}) = \sum_{i=1}^{d} (H_{O'}(i) - H_0(i)) \ln \frac{H_{O'}(i)}{H_0(i)} \qquad (4)$$

3.2 3D Keypoint Detection

Keypoints were detected by using ISS method. For each scan, 3D keypoints were determined with a 4 mm support radius.

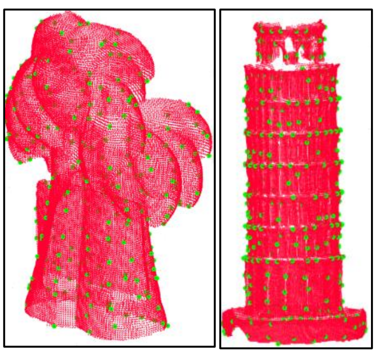

Figure 4. Detected keypoints with ISS

Table 1. Number of ISS keypoints

Objects	Keypoints
Object 1	246
Object 2	183
Object 3	186
Object 4	73
Object 5	363
Object 6	122
Object 7	97
Object8	125

3.3 3D Keypoint Description and Object Matching

PFH and FPFH methods were applied to all keypoints detected by using ISS. The feature histograms were created for each keypoint. A histogram has 27 histogram group.

An external model was given the system to detect same object from gallery. It is expected that the system will match the model with right object.

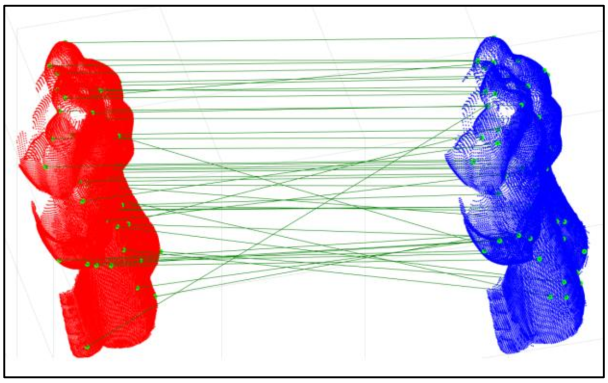

Figure 5. Matching points

Iterative Closest Point (ICP) was carried out for registration of the corresponding object models. If Euclidian distance between two corresponding points has lower values than 10 mm, this matching was accepted as correct. The histogram of correct matching and root mean square error were created.

4. RESULTS AND DISCUSSION

In conclusion, with ISS-PFH 8 of 9 objects were truly recognized. With ISS-FPFH 7 of 9 object were truly recognized. When PFH is used, more key points are matching between the two point clouds. Considering the number of object recognized, it is seen that ISS-PFH is the best method to detect the right object. There is no significant difference between the methods according to root mean square error. In all methods a root mean square error of about 2 mm was determined with an accuracy of 10 mm.

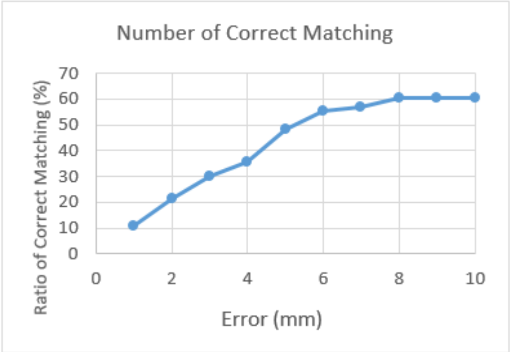

Figure 6. Number of correct match with ISS-PFH

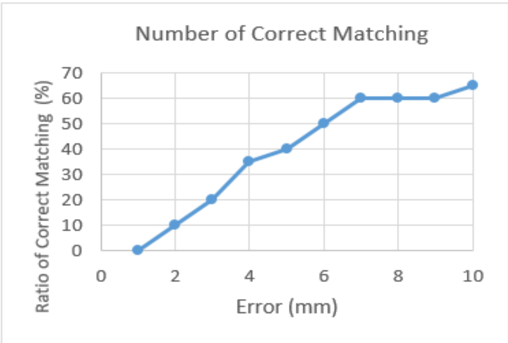

Figure 7. Number of correct match with ISS-FPFH

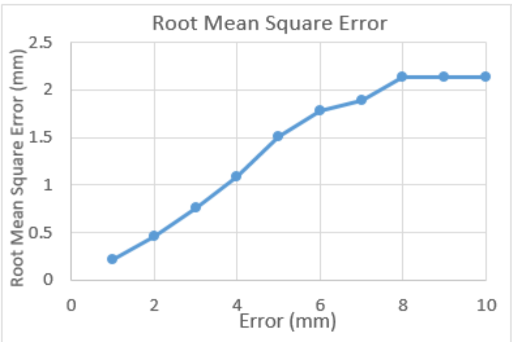

Figure 8. Root mean square error of ISS-PFH

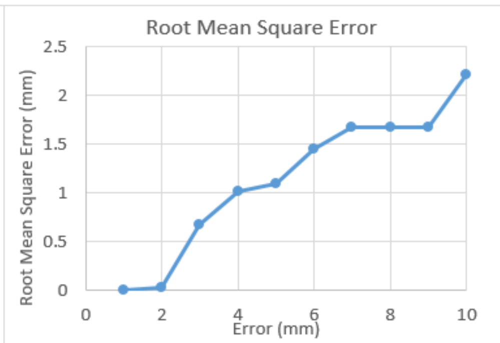

Figure 9. Root mean square error of ISS-FPFH

The correct matching rate for both PFH and FPFH is up to 60% with 10 mm error. When all scans are examined, there is no difference between correct matching ratio. For the future works, there are many methods in literature used in 3D object recognition application. The study can be expanded using different methods. Otherwise, larger database can be used for evaluation of the methods.

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WEB-BASED GIS FOR PUBLIC PARTICIPATION IN URBAN REGENERATION

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ABSTRACT:

Cities are constantly changing depending on factors such as population growth, disasters, migrations and economic fluctuations. In addition, due to the rapidly increasing urban population, uncontrolled and unplanned urbanization, a regeneration or transformation is needed to improve both the physical infrastructure as well as the social, environmental and economic livelihood. Most of the urban regeneration projects are managed through a top-down procedure, in which the powerful hold the decision making process. Amongst the key stakeholders, citizens living in the neighbourhood of the regeneration project –who are going to be affected the most- are usually the least powerful; hence, their experience and comments are overlooked. Geographical Information Systems (GIS) play a key role in this context, especially regarding web based participation, since any urban regeneration project is indeed a spatial event. This paper proposes a methodology based on the success of StackOverflow (SO) question/answer site, in which the users of the system earn reputation by asking good quality questions, providing valid answers, modifying the existing content and in various other ways. In addition to adapting the SO reputation-based evaluation of the users, the methodology presented in this paper would also integrate the different and often conflicting views of different stakeholders including legal bodies, private sector and citizens in an urban regeneration project. This paper outlines the conceptual model regarding how public participation could be achieved in a meaningful and effective way in an urban regeneration project. An open, web based framework is proposed in which different stakeholders have different means to interact, all of which are determined through a relational database design by utilising PostgreSQL and by relying on open OGC standards such as Web Map Service (WMS) or Web Feature Service (WFS).

KEY WORDS: Urban regeneration, web GIS, public participation, StackOverflow

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1. INTRODUCTION

Cities are complex and dynamic structures governing physical, social, communal, economic, environmental and political phenomena. Most of the cities around the world are going through rapid changes in various aspects such as, economic transition and employment change; social and community issues; physical obsolescence and new land and property requirements; and environmental quality (Roberts and Sykes (2000, p.24). These changes and dynamics in the urban area lead to urban degradation. The response of public policy to this problem is known as urban regeneration, a multi-facet process involving different partners with the purpose of enhancing an urban environment. Roberts and Sykes (2000, p.17) define urban regeneration as “comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change”. This definition suggests that an urban regeneration project not only improves or builds new physical infrastructure but also improves the quality of life through social inclusion of people and being environmental-friendly. Consequently, ‘sustainability’ is one of the key words in any urban regeneration project (Jong et al. 2015). Only through focusing on ‘sustainable’ urban regeneration, ‘long term goals’ would be emphasized as well as social inclusiveness and environmental issues are addressed.

In addition to sustainability, strategic vision and partnership are the other key factors determining the success of an urban regeneration project. A detailed assessment of comprehensive solutions should be proposed to address urban problems. In addition to strategic vision, it is clear that urban regeneration is not an individual task, since it has multitude of dimensions, from economic to environmental. By considering the wider city dynamics, an urban regeneration project should be placed within a larger strategic framework negotiated between different stakeholders including the stakeholders, which are private sector, public bodies, local communities and NGOs and citizens. Therefore, a transparent and open partnership between these key stakeholders would more likely lead to liveable neighbourhoods. The opposite have indeed proven to comprise major limitations, as it cannot handle the complexity and multifaceted nature of urban problems (Carter 2008).

According to the Community Involvement in Planning Report of the Office of the Deputy Prime Minister of UK (2004), at its most simple level, a community involvement process should ensure that people:

- have access to information;
- can put forward their own ideas and feel confident that there is a process for considering ideas;
- can take an active part in developing proposals and options;
- can comment on formal proposals;
- get feedback and be informed about progress and outcomes.

The main difficulty regarding the partnership is the large variation of power amongst the stakeholders (Gullino 2009). Amongst the key stakeholders, local communities or simply citizens of a neighbourhood are usually the ones whose voice are not heard. Indeed, even though the aim is to be transparent in an urban regeneration project, politically sensitive information or those that could raise conflict or prejudice could be neglected throughout the whole discussion (Horita 2000).

Information flow between the stakeholders is crucial in the planning process. In this way, different views of an urban regeneration project could be explored and discussed (McCall 2003). Overlooking the experience, which could be gained through living or working in a particular neighbourhood or overestimating the views of the powerful would not lead to sustainable urban regeneration. In other words, information gained through experience and gained through education are both important in decision making. Even though the initial knowledge gained through the exchange of information may not be initially correct, continuation of the process of exploration and debate of different views would eventually lead to the correct path. Simão et al. (2009) describe this information exchange process between citizens and experts in five stages: i) generate alternatives, ii) evaluate alternatives, iii) discuss a solution, iv) seek background information and v) articulate or voice views and concerns. The authors note that even though there is no particular order to execute these steps, ideally all of them should be realised so that citizens and experts could engage in the planning process in an iterative and interactive manner. Therefore, ‘communication’ is an essential stage in the planning process. Only through opening up the communication channels, it would be possible to find a solution that reconciles the conflicting objectives.

The concept of 'governance' emerges in order to make the right decisions in the decision processes. Up until today, experience shows that including local people in urban regeneration projects is one of the important steps in achieving success. People should be able to influence the decision-making process through a variety of participation methods that directly or indirectly affect them. In the academic literature, three different terms emerge regarding the engagement of citizens in the urban regeneration process: i) Participatory GIS (PGIS) and Public Participatory GIS (PPGIS), ii) Volunteered Geographic Information (VGI) and iii) citizen science.

The creation of these concepts will help shape the business processes followed in urban regeneration projects. It is also important for the public to gain access to these processes as well as for the individuals to reach new individuals and to influence the urban regeneration policies. At this point e-Governance is another emerging term commonly used. The concept of e-Governance is the development of web technologies that demonstrates how local and national governments look for ways to connect with citizens and incorporate their feedback in the policy making process (Hachmann et al. 2018). Through such an approach, web-based systems and mobile technologies are used in urban regeneration projects to collect citizens’ viewpoint, requests and complaints. As this would foster the partnership pillar of an urban regeneration project, analysis, planning and development processes can be managed more successfully.

In addition, through web-based platform, local urban regeneration projects could be traced through a single platform instead of a local site for an individual project. Moving public participation to digital platforms will lead to a significant increase in the number of participating citizens, especially on an era in which technology is rapidly evolving and people are living with technology.

The outline of this paper is as follows. Section 2 reviews the literature, section 3 discusses the methodology and section 4 finalises the paper by providing the discussions and the conclusions.

2. LITERATURE REVIEW

The rationale behind public participation in urban regeneration process is to ensure inclusiveness; hence, provide a democratic process. In this way, communication between municipalities, legal bodies and communities and citizens would be nourished. Information and Communication Technologies (ICT) provide a means to achieve this purpose. Even though ICT plays a key role in today's society, many communities still lack of it. Consequently, some researchers argue that, relying on ICT actually creates a 'digital divide', since only those who have the resources, education and interest as well as access to the infrastructure such as broadband connectivity, could benefit from the system (Dijk and Hacker 2003). A geographical consequence of digital divide is that urban areas take much more attention compared to rural areas (Hecht and Stephens 2014). On the other hand, this might not be of uttermost importance in *urban* regeneration, since most of the citizens of an urban environment could have the means to access technology. In addition, researchers have already demonstrated that proactive governmental measures as well as the wide use of mobile telecommunication services can indeed narrow the digital divide (Loo and Ngan 2012; Nishijima et al. 2017).

Participatory Geographic Information Systems (P-GIS) also offer a similar avenue of solution. Previous studies investigated how to incorporate the opinions of 'hard-to-reach' groups, such as elderly, teenagers and mobility-impaired people in the assessment and integration of local concerns into the urban development process. In order to maximise the public participation, especially the 'hard-to-reach' group, researchers have arranged the 'on-street event' on the pension payment day (Cinderby, 2010).

One of the widely cited example regarding the citizen participation in urban regeneration projects is CitiStat of Baltimore, United States. Martin O'Malley, the mayor of Baltimore in December 1999, initiated the project due to fact that the city was having financial difficulties as well as change in demographics. The project is a data-driven information management system designed to monitor and improve the performance of city departments. The project was praised as it utilizes data collected from citizens –from detecting potholes to reporting crime activities. However, the project provided mostly a 'managerialist' approach as the decision making process have not considered citizens' view. Consequently, data might not be interpreted rightly at all times since officials would probably not know the deprived areas as much as the locals of that neighbourhood (Gullino 2009). In other words, a successful regeneration project shall not only focus on physical and economic improvements but also environmental and societal.

Public participation in an urban regeneration process could be achieved in different ways. First, on-street events could be held, in which the citizens could interact with the officers or the employees of the company involved with the urban regeneration project. Since participants do not require to make prior arrangements and such events usually require short amounts of time, citizen interaction could be achieved. In addition, citizens could feel more 'open' as they do not need to justify their opinions. On the other hand, there could be a bias regarding the participating citizens due to working time constraints. Second, obtaining the permits from the legal bodies might be time consuming and unexpected weather might cause frustration (Cinderby, 2010). Another way of interacting with the citizens is to hold official meeting held at Council Hall or a seminar room. Official meetings require prior arrangements and obtaining the permits as well; however, the participating citizens would be known in advance. This information would be useful, since they could immediately start planning their next meeting targeting the underrepresented communities.

Czepkiewicz (2016), proposes a geo-questionnaire tool for participant engagement in land use planning, based on an online questionnaire with an interactive map. The tool aims data collection on the quality of life and development preferences. However, being a one-way data collection method, the tool does not provide interaction with other participants.

Conflict resolution is another important issue that any web based participatory system shall consider. Horita (2000) proposes the use of 'Argument Tree', in which the citizens' comments are listed line by line. Preceding the comments, there would be a '+' or '–' sign indicating whether the comment is adding further support to the previous comment on the tree or against it. In this forum-like discussion, an open discussion platform is provided facilitating dynamic information management. On the other hand, slow operating speed, small display, and lack of sophistication in user-interface were stated as the limitations of the proposed system. In addition, the system cannot relate the comments with locations. The advancements of the technology and map based systems provide the ability to link comments to places (Rinner and Bird 2009).

Atzmanstorfer and Blaschke (2013), improves the highly accepted ladder metaphor of Arnstein (1969) and presents a geo-web e-participation spectrum. The first level of the spectrum provides one-way communication and aims to provide information to the public, using web sites. Second level involves consultation and uses on-line polls to obtain public feedback on analysis, alternatives and/or decisions. Third level envisages involvement of public through online discussion platforms to work directly with the public. Fourth level provides collaboration among stakeholders in decisions on alternatives and identification of solutions, using online services, forms and documents. The final level, empower, provides online decision support systems and place the final decision making in the hands of the public.

3. METHODOLOGY

This paper proposes the public participation in urban regeneration projects through a rationale similar to the workflow of StackOverflow (SO), which is a website dedicated to featuring questions and answers (Q/A) on a wide range of topics in computer programming and software engineering. The success of this question/answer site had indeed led to a much larger community ecosystem and an economic model, which is StackExchange, now containing over 170 sites from chess to vegetarianism to quantum computing. The main thinking behind the adaptation of SO to our methodology is motivating the citizens; hence increasing the sustainability of the system.

3.1 StackOverflow (SO)

SO, which is founded in 2008, is quite a popular web-site amongst software developers. Its success has already inspired data mining challenges (e.g. the competition of the conference 'Mining Software Repositories' on 2013) and over 170 scientific papers on SCOPUS. At the time of writing, 16 million questions were posted on the site with 25 million answers. Comprising of approximately 9.3 million users, more than 6.5 thousand questions are posted on a daily basis. Any user could post a question and provide an answer. However, only those 'good' questions are answers increase the reputation score of a user. The community assesses which question or answer is a 'good' one, so the whole system is indeed metric based. Users could earn 'badges' based on their activity on the site, which is indeed related with the motivation of the users as wells as a way to ensure continued engagement (Cavusoglu et al. 2015).

Consequently, Bosu et al. (2013) proposed various measures to understand the dynamics to reach higher reputation scores. The results suggest that the reputation seekers should not only be correct and active but also fast in answering a question. On average, a question is answered in around 24 minutes; however, this value could drop to less than a staggering of 3 minutes for an expert user. In addition, all questions have related tags and focusing on tags having fewer expert users could increase the chances of obtaining higher reputations in short amount of time. Third, time of day the question is asked, is also important since expert users are located at specific countries and their work-time and leisure-times could affect their response time. If a user wants to earn higher reputation scores, then that person should probably aim those inactive times of expert users. Last, continuous engagement is critical to achieve high reputation scores. For instance, an average expert user would spend 14 hours on SO and answer more than 10 questions per day.

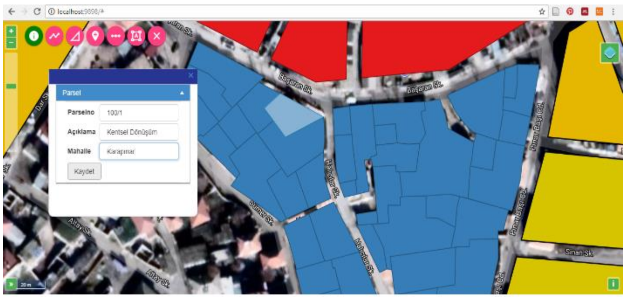
Arnstein's (1969) 'ladder of citizen participation' is widely acknowledged as a means of engagement in planning processes. Consisting of a typology of eight levels, Arnstein also classified these levels into three groups: i) non-participation, ii) tokenism and iii) citizen power. It is unlikely to achieve the highest level in citizen power (i.e. citizen control) in urban regeneration projects. Yet, it would be desirable to achieve the 'partnership' level, in which citizens could negotiate and engage in trade-offs with traditional power holders. In this way, citizens could truly be a stakeholder.

Those of which achieve higher reputation scores on the web based platform could be selected to become on the board of an urban renewal planning project. All of the stakeholders would indeed benefit from this enrolment, since citizens having high reputation scores had already demonstrated their interest and involvement in urban regeneration projects, and obtained a positive-feedback. Apart from setting the thresholds to select the 'associated' citizens, the selection process would indeed be transparent; hence, preventing corruption. This would increase the trust in the participation of citizens in the planning process.

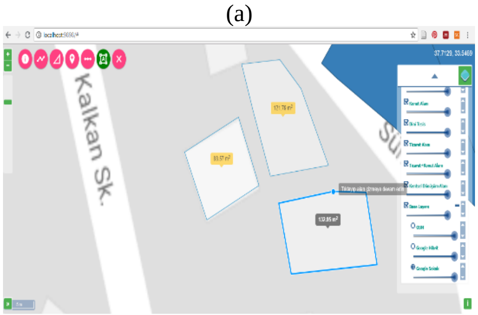
3.2 Web Based Platform

The design of the web-based platform enabling public participation for urban regeneration projects is as follows. We would try to rely on open technologies and open standards in order to lower the licencing fees, which is indeed in relation with the sustainability of the project. The technologies we rely on include, but not limited to, PostgreSQL as the database management system, PostGIS as the spatial query engine, GeoServer as the map server, OpenLayers as the means to visualise base maps and OGC standards such as WMS and WFS to transfer data between the server and client. At the moment, the database design is coarse and it is important to incorporate the "reputation earning" mechanisms into the database design.

A screenshot of the working system is illustrated in Figure 1. Here, the users could view and update the thematic attributes of spatial data. In addition to thematic attribute updates, the users could also calculate geometric properties of spatial units including the area and length. It would be important to follow the user interface guidelines and make sure that the graphical user interface is self-explanatory and easy to use.



(a)



(b)

Figure 1 Thematic attribute editing (a) and spatial unit editing and geometric calculations (b)

In order to make sure that each post has been 'seen' by a sufficient number of people, we would be counting the views of each post. Once it reaches a threshold, then the highly acclaimed posts would be shown at the top of the discussion board. Similar to SO, the details of each object on the system could further be analysed, such as the number of distinct views, the number of up and down votes, the spatial and temporal data relevant to the posts would all be stored and could be queried later on. In addition, the system would not allow citizens to 'spam' the system. For instance, preventive mechanisms such as, a citizen cannot post a comment relevant to the same urban regeneration project more than once in the last 24 hours would be considered. It is important to obtain the thinking of different participants as much as possible and making sure that abuse of the system is prevented.

4. DISCUSSION AND CONCLUSIONS

Cities are complex and living organisms subject to change in short amounts of time. Therefore, urban regeneration is an active research area involving different scientific disciplines ranging from sociology to anthropology to spatial information science. In terms of Arnstein's ladder, it is often the case in which the urban renewal projects do not exceed rung three, 'informing'. The information flow is uni-directional, from professionals to citizens, in which the citizens' rights and different options are not explicitly discussed. Therefore, professionals seek for citizen support through public relations. Loorbach (2010), in his seminal paper, addresses this issue as follows: "*participation from and interaction between stakeholders is a necessary basis for developing support for policies but also to engage actors in reframing problems and solutions through social learning*". Consequently, the need for a web-based platform in which any citizen as well as the other stakeholders such as local municipalities' and relevant ministries' officers could participate in the planning stage of an urban regeneration project is eminent.

This paper proposes a methodology in which the stakeholders gain reputation based on the quality and continuity of their comments and the issues they raise regarding an urban regeneration project. Open technologies would be used to support the exchange of the data between different stakeholders. Involving citizens' views in urban regeneration projects would provide the means of reconciliation, decrease the overall costs and delays. Furthermore, it would eventually ensure sustainability since all parties would have the opportunity to state their position.

At the early stages of this project, we were considering to limit those who could raise comments to an urban regeneration project. In this way, only 'local' citizens could participate the urban regeneration project in their neighbourhood. The rationale behind this idea was to ensure that the system would receive higher quality information, since only 'locals' could possibly know the neighbourhood. However, while discussing the presentation, our session chair, Sohail El Abd, has kindly advised us to make the platform 'mobile' friendly. In this way, anyone having a smart phone could browse the issues regarding an urban regeneration project.

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URBAN RENEWAL WORK AS AN ALTERNATIVE SOLUTION TO THE PROBLEMS OF THE CADASTRE OF TURKEY

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ABSTRACT:

Cities which are living organisms living with the communities on them has changed and shaped depending on the factors such as anticipation of demographic structure, migration, industrialization and disaster. Healthy and sustainable change in urban life depends on the development planning and application process based on cadastral data, which is a large scale of spatial information systems. Recently in Turkey the creation of quality content has been aimed and successful projects have been produced by urban renewal work.

Since property cadastre work hasn’t been completed yet in Turkey land registry and cadastral data are in short of presenting actuality. Nowadays, urban renewal applications as an effective tool in planned urbanization will provide solutions to current cadastre problems while updating the title and cadastral archives.

In this study, the reason why urban renewal work in Turkish Cadastre which is in the process of becoming information society will be put forth and it will be emphasised that urban renewal applications should be considered as an opportunity to solve the existing problems.

KEY WORDS: Problems of Turkey Cadastre, Cadastral Updating, Urban Renewal.

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1. INTRODUCTION

The cadastre, which is accepted as the process of determining and planning all kinds of the places and locations, the areas, the values, rights and obligations of every kind of immovable on the earth; takes on the task of collecting numeric, current and accurate data, storing, making available for necessary multipurpose which is in the content of continuity of today's information systems has given the service of creating data base on property and development relations since the beginning of producing cadastre in Turkey. (Adıbelli 2005).

Cadastral maps of Turkish cadastre that are being in force which doesn't reflect today and far from usage in technical sense have been a problem. The studies focused on 'the completion of the country's cadastre' have not given enough opportunity to overcome the existing problems until today. It is inevitable to renew the linear cadastral maps that lost the feature of applying to the ground and the inexistent land registry information. This need is also a requirement for being an information society and participation in the 'sustainable land management' process. Today, studies for 'renewal of cadastre' started and are still going on. However, giving importance and priority to the projects such as urban renewal or land arrangement in urban areas and land consolidation in rural areas on the aspects of work power and public finance gives the opportunity to application the spatial planning to land, renewal of cadastre archive and updating the registry.

1.1. Current Situation of Turkish Cadastre

Today, contemporary cadastre, which has the responsibility of 'keeping the national spatial data infrastructure ready for use' that information systems require have also improved their tools to keep their data updated and alive (İnam ve Ark, 2004). Despite such a responsibility, the cadastre of Turkey, though perhaps ahead of its planned as a cadastral age at the time when constructed, it is so far not been very successful (Erkan 1979). Today, although the facility cadastre works have been completed throughout the country, a large part of the data (around 60%) produced in about 90 years must be replaced and converted into a legal, legally validated, numerical, country system requirement for spatial information systems.

When we look at the situation regarding the statistical properties of the cadastral map of Turkey, which has been produced ever since, we can see

- different scales (1: 200, 1: 250, 1: 500, 1: 1000, 1: 2000, 1: 2500, 1: 3000, 1: 4000, 1: 5000, 1: 10000);

- using different production techniques (graphic method, polar method, prismatic method, photogrammetric method, numerical method);

- on different layouts (cardboard, cardboard cloth, paper, tracing paper, astrolon, diezo);

- in different coordinate systems (9% in graphic (non-coordinated), 14% in local / local coordinate system, 53% in ED50 coordinate system and 24% in ITRF coordinate system) (İnam 1999, TKGM 2017) .

Examples of these productions are given in Figure 1 (Yıldız ve Meşhur 2005). On the other hand, Article 719 of the Turkish Civil Code states: "*The boundaries of immovable property are determined by registry plans and border signs on earth. If the land plans and the signs on the earth do not fit each other, the main thing is the border on the plan.*" Therefore, the assumption that the plan adopted by the legal cadastre is essential is that the plans should be "highly accurate, fully reflective and practicable"; it is also known that existing productions do not.

Figure 1.a.Former Cadastral Map

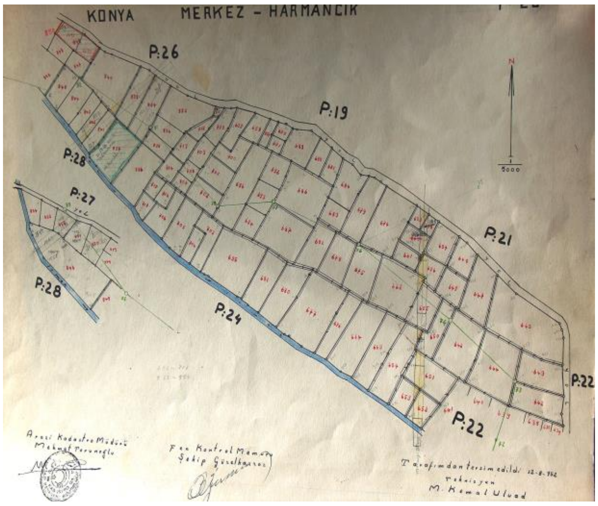

Figure 1.b. Graphic Cadastral Map

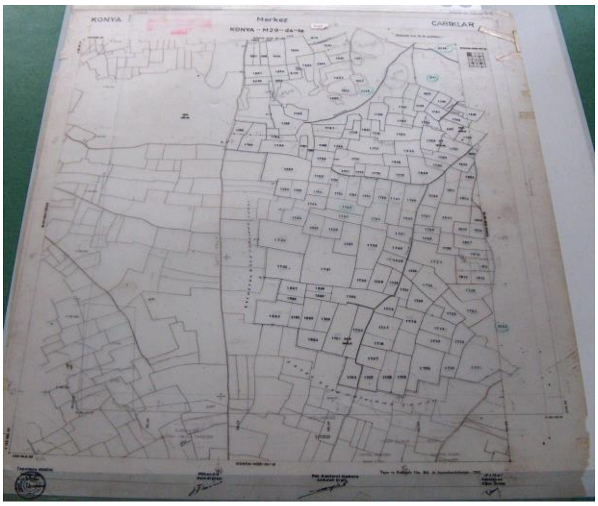

Figure 1.c. Potogrametric Cadastral Map

Figure 1.d. Fotoplan Cadastre Map

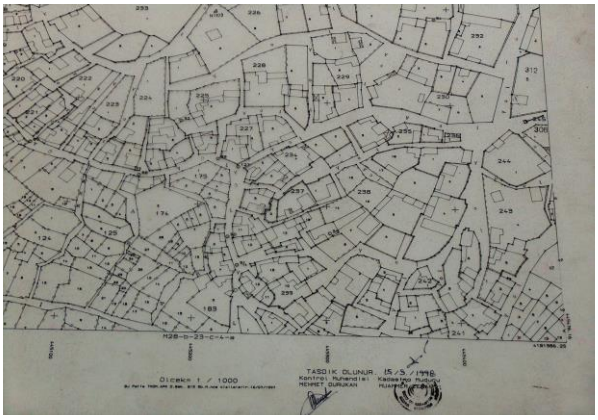

Figure 1.e.Search Cadastral Map

1.2. Necessity of Cadastral Renewal of Turkey

It is possible to define the innovation as "bringing the cadastral maps and the title registers of immovable properties that are constantly changing into the current situation" (Erkan 1979). The concept of updating and survival of the cadastre is also perceived as studies of 'preparing the cadastre to the information systems' in developed countries. What is needed is a consistently updated, consistent, standardized, and multi-purpose database. However cadastre of Turkey must solve the problems of;

• map production techniques do not provide the desired precision,
• the cadastral layout is worn and has lost its update,
• limited level of the areas which are the subject of renewal, digitization etc. for updating purpose.
• the lack of quality, quantity and update of existing cadastral data to be the basis for spatial information systems.
• the lack of adequate spatial correctness due to the fact that the old and graphical cadastral maps have been constructed using methods far from today's technology,
• cadastre data does not have a standard reference system,
• the adjoining cadastral parcels do not border, the openings and bindings between parcels,
• the problems of matching of numerical and verbal data in the integration of land registry and cadastral parcels,

In the last period, since we have no document in the quality that can be used as layout in any public works without making a new map or integration especially in technical aspect, the cadastre of Turkey is in need of renewal Çay and Ark. 2003).

2. URBAN RENEWAL WORK AS AN ALTERNATIVE SOLUTION TO THE CURRENT PROBLEMS OF THE CADASTRE

Urban settlements around the world; has collapsed because of demolished demographic structure, economic conditions, social unconsciousness, wrong place choice. This collapse also felt in Turkey, has not only observed in less developed countries facing urbanization problems, but in developed countries with fast transformation process. This backward trend in urban settlements has prompted administrations to seek alternative solutions. The concept of urban renewal has emerged as a solution to this pursuit.

2.1. The Need of Urban Renewal

Urban renewal can be expressed as *"transformation, remodelling and revitalizing, the urban structure in accordance with the socio-economic and physical conditions of the day which becomes old, corrupted, worn or abandoned in time because of different reasons.* Reconstruction of the settlement units, which are considered to be depressed areas of the city, with a new spatial planning and revival of life is possible by means of urban renewal.

Migration movements that occurred in Turkey in recent times, has increased especially the quantity of the population in big cities has lead up to important quality problems such as shanty settlements and illegal construction. Uncontrolled occurrences in existing settlements bring serious problems both locally and socially (Yıldız and Meşhur, 2005). For this reason, urban renewal is needed.

2.2. Realities of Urban Renewal

While urban planning is perceived as a way of opening new areas for accommodation to the population which are moving to cities in the past, it is observed that the process turned into reconsidering the areas of the city that becomes old and lost its function at present. However, while this transformation is occurring, the situation of the cadastre layouts for the application area is another problem. The areas which are registered Especially in the first years of the Republic and even in the last years of the Ottoman Empire, still in operation today and this technical problem is faced especially in the transformation applications of old settlement areas of cities. (Yıldız and Meşhur 2005).

Turkey is experiencing rapid spatial transformation since the 1950s. Until the 1980s, deformation in the urban structure because of the construction that is far from the understanding of planning become partially legal after the issued amnesty laws but undeveloped areas remained unfortunately (Bayraktar, 2003). Such observed deformation in all urban settlements necessitates handling urban renewal issue in the frame of a plan. Besides the urban aging, cities exposal to natural disasters and great amounts in illegal settlement, uncheckedness and unplannedness due to the disasters are main reasons for urban renewal applications. The purpose of urban renewal applications is to put forth the urban models which being able to live in terms of technical, economic and sociological aspects' and 'sustainable in terms of zoning law and land management'.

2.3. Impact of Urban Renewal Applications on Cadastral Issues

The situation of the cadastre layouts is an important problem in the especially old settlements where the urban renewal projects are implemented. The administration responsible for the project will either contribute to the urbanization by renewing and applying the spatial plans or to the improvements below by means of the process of renewal and updating on cadastre:

a. The use of the property right over the immovable will be guaranteed.

Facility cadastre in Turkey has not completed recently. However, the title deeds of land ownership must be cleared from faults and updated. Problems in the use of property rights constitute the most important issue of the judicial sector. With the urban renewal project studies,

- land management decisions will be put into effect as a result of spatial planning.
- the problem of slums and illegal settlement will be resolved.
- Treasury and foundation lands, lands under the government's provisions and savings will be valued in the immovable development process.
- property-zoning relationship or immovable property with title deed cancellation problem will be resolved.

b. Border disputes between neighbouring immovable will be eliminated.

According to the Turkish Civil Code (Article 719, 997) and the Land Registry Regulation (Article 6) which determine Cadastral and land registry system in Turkey, the sole basis in determining the boundary of immovable have been the cadastre maps and substantially science archive. For this reason, cadastre maps should based on triangulation networks, have standard knowledge about general scale, layout, production technique and coordinate system thruoghout the country, and accurate, up-to-date and capable of applying to the land (Köktürk 2003). As part of the urban renewal project, cadastre layouts will also be renewed and upgraded to national standards.

c. It will contribute to the elimination of the problems in the cadastre and zoning layouts and the formation of urban information systems.

1: 1000 scale implementation development plans prepared to provide a healthy structure of the physical environment, to determine the place selection and development tendencies of spatial use are made on the present time maps which the cadastre layer is wrought on.

If the Local governments, in their urban information systems,
- have faultless and current cadastre layer in the national standard,
- makes a development plan which is compatible with the cadastre layer and the property information is taken into account and apply it to the ground,

In this context, within the framework of the urban renewal project, the infrastructure of sustainable urbanization will be created by producing faultless, renewed development plan layers which has the national standards and integrating it to the city information system.

Urban renewal areas Project 1 and 2 including the obsolete and physically collapsed units of an urban settlement in Turkey were investigated in this study. While the map sheet and ground relationship cannot be made out of the cadastral data of both sites because their maps were in 1: 5000 scale and produced in graphical method and have numerical and verbal data, after the project application it is transformed into 1:1000 scale cadastre map produced by using numerical method in the country system and it became map sheet-ground relation and compatible with the spatial development plans (Figure 2).

Figure 2.a. Sample cadastre layer of Project 1

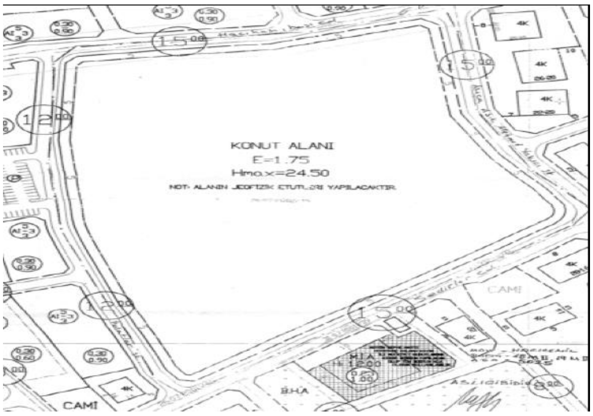

Figure 2.b. Zoning plan layer of sample project 1

Figure 2.c. Example use of the project 1

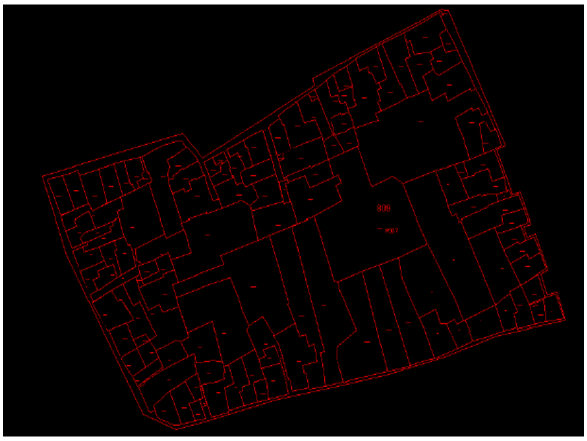

Figure 2.d. The cadastral layer of the sample project 2

Figure 2.e. The development plan layer of the sample project 2 is shown in

Figure 2.f. Example use of the project 2

3. CONCLUSION

It is known that urban renewal projects are now becoming a necessity for our cities. In the leadership of local governments, it is necessary to create healthy urban spaces in obsolete or in settlement units having the tendency to use by protecting where urban identity is protected and developed in the concept of sustainability.

Urban renewal works in cooperation with the local government and cadastral units, with priority given to places where cadastre and property problems exist should be evaluated as an opportunity to renew and update cadastral science archive.

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MEASURES AND PROPOSALS ON TURNING THE VALUE INCREASE TO THE PUBLIC ON URBAN RENEWAL AREAS BY URBAN SETTLEMENT PLAN

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ABSTRACT:

Real Estate as a means of social wealth has an important place in terms of spatial usage diversity and is shaped by urban planning tools and is subject to maturity and value increase. It is the public tools which provide increasing value, and the public should get a share from this increase. Transferring the value increase to the public instead of giving it to the parcel owner is important either for strengthening the local administrations by creating land stock or raising the welfare of the society. However, it is still a controversial issue on Turkey's agenda how this obtained value increase should be transferred to the public.

In this paper, turning the value increase to the public on urban renewal areas of existing settlement units by changing development plan has been studied.

KEY WORDS: Urban Settlement, Urban Renewal, Value Increase.

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1. INTRODUCTION

Urban renewal is a project-based work aimed at improving the areas exposed to physical, economic, social and cultural problems that arise due to the uncontrolled growth and change of urban areas. Rapid urbanization taking place in Turkey, has raised urban land values uncontrollably, on the other hand has led to the emergence of uncontrolled construction areas and development issues in the immediate surroundings of urban areas. Especially in the recent period, old urban and worn urban textures, risky construction sites and the renovation of slum areas have become the primary responsibility of local governments and central government.

The old areas of the city can be a place of urban renewal within its own sociological characteristics and parcel-based ownership and use conditions. Under these conditions, as the area is subject to re-planning and implementation studies during the urban renewal process, the maturity and economic value of the use of the parcels are increasing. This increase in value, which is called the rent, and is not an individual contribution of the landlord, needs to be turned to the public. Indeed, as in decision of Turkish Constitutional Court in 11/07/1972, numbered law 1608 “25% bonus deduction (share arrangement partnership) will be taken for the provision of value increase in immovable because of the arrangements” it is accepted that transferring a certain portion of the immovable to the public without charge would be lawful as a response to the value increase because of the development plan and its application.

1.1. Causes of Urban Rent

Urban areas are complex and dynamic systems that live together with the society within them. They may be subject to change and transformation under the influence of physical, social, environmental, economic and even political and ideological factors (Akar, 2006). Increasing the quality of life and strengthening the urban economy are aimed by urban renewal practices. Construction of the zoning plan and the function given to the immovable and the distribution of the rent due to the intensity of the construction constitutes the dynamics of renovation work. This change between pre- and post-project immovable values is due to a number of factors within the framework of urban renewal development plans such as immovable properties dismantled and reconstruction land use pattern, ownership structure, infrastructure investments built by the administration, social and cultural facilities.

As cities grow due to population growth and migration, spatial uses are being reshaped by means of planning. This situation, on the one hand, increases the value of newly added land to the city; on the other hand it leads to an increase in value due to the changes in the positions of the existing city lands (Ökmen and Yurtsever, 2010). It is expressed that planning in the urban renewal areas is done for public interest. However, despite there is no contribution of the immovable owners in the planning process, they will have the increase in value. For this reason, the zoning plan, which is mostly done in the form of increasing the zoning rights, becomes a means of distributing rents (Ülkü, 1997). Administrations in charge of planning sometimes cause value differentiation by not planning for urban development but by making plans that include the right of high development in the places where the speculation subject is located (Yücel, 2014).

1.2. Application Process in Urban Renewal Projects

Urban renewal is a holistic project application involving planning, implementation and restructuring aimed at solving the social, economic and physical problems of a region that needs improvement. In other words, the redevelopment and revitalization of a lost economic activity; making a non-functioning social function work; the provision of social integration in areas of social exclusion; it is the application of this equilibrium again in areas where the environmental interaction is impaired. This will only be possible if the relevant actors (responsible for urbanization, property owners and producers) who will take part in the implementation are able to make a positive contribution to the process.

2. THE NEED OF TURNING VALUE INCREASE DUE TO DEVELOPMENT PLAN TO PUBLIC IN URBAN RENEWAL AREAS

Urbanization rate in Turkey in terms of both its population and area, and number of metropolitan government shows the rapid increase. As a consequence of this development, state administration is framed on the principle of "strengthening local governments". Therefore, the local administrations need to have a sufficient and conscious management power and personnel structure and strong financial resources. Because the local administrations, especially in the residential units which have the ownership problem under the pressure of the constructions contrary to the zoning legislation, who know and solve the technical-economic-sociological problems of the city on the spot; leading society expectations; it must be able to develop within the principles of planning and city planning. The fulfilment of this responsibility depends on the strength of public finance resources to be used for urbanization.

Although the rise in value with urban planning emerged depending with the land use decisions of administrations on behalf of public, only property owners benefit from this increase in today's Turkey. However, public institutions need to produce social benefits, not personal benefits. In this sense, it is a realistic approach to collect some of the value increase income generated by the zoning plan as tax revenue by the state (Ökmen ve Yurtsever, 2010). Real Estate Value Increase Tax was promulgated in 1970 by the legislature for taxation of gains arising on the increase in value of immovable property; but it was abolished in 1982. It is a fact that the real estate tax system based on the "declaration of the immovable owner" which is in force today does not fulfil this aim.

The increase in immovable value resulting from the urban renewal application should be modeled by scientific analysis showing the relation between "participation value, new land use decisions and distribution value". But this is a difficult process; since the value creation by the zoning plan in the renewal process is not the same for every immovable. To equitably increase the value increase and develop methods to ensure the public return, which is the most appropriate way to do so, is a matter that is on the agenda of all the countries of the world.
The income that will be generated as a result of transferring the immovable value increase in the renewal process should be used for economic and social needs of the city. In addition, urban regeneration practices do not only improve the situation of the project area. It also contributes to regional development by affecting the value of other regions in the neighbouring the project site. For this reason, it is necessary to develop a method for the utilization of the resource that will be generated by taxation of value increases.

In this respect, to establish the legal basis of the central government's legislative body, the most appropriate method using rent income for public interest by local governments is using
- some (X%) for financing the construction and infrastructure activities required by the urban space,
- some (% Y) financing sources for urban renewal work,
- some of them (% Z) are ready to build zoning parcels.

3. APPLICATIONS OF TURNING VALUE INCREASE TO PUBLIC

In the area of application, which is accepted as an urban renewal site, firstly zoning planning work is carried out and zoning parcels ready for construction are produced with the application of these plans to the ground. The administration which is responsible for the application of zoning plan carries out the work in the scope of
- covering the reinforcement areas with up to 40% cut by using the method of land and land arrangement,
- transferring all the immovable in the field to the public property by transferring construction right or expropriation,
- contracting with the immovable property owners in the field and taking a certain proportion of the immovable property to the public property.

3.1. Plan application in land and land arrangement method

With the implementation of the 1894 numbered Urban Development Law No. 3194 and the implementing regulation, the use of property in the area of urban renewal is being improved;
Needed reinforcement areas can be obtained from up to the 40% cuts of the parcels; but no financial resource can be created for the formation of the superstructure. Moreover, when the values given by Yıldız (1987) and the results given in Table 1 are related to the relation between the rate of deduction made from immovable and the increase in the value of the immovable in such an application process, it can be said that the amount of this deduction has never met the value increase in the area of urban renewal.

Cut Rate	Value Increase
% 10	% 11
% 25	% 33
% 35	% 54
% 50	% 100

Table 1. Cut rate-value increase relation

In this application, it can be said that the existing practice method is not sufficient for transferring the increase in value to the public and a new method based on value equality principle should be developed.

3.2. Application of transferring all the immovable in the field to the public property by transferring construction right

The expropriation of the immovable in the urban renewal area is applied according to the existing construction rights and the expropriation legislation. For non-expropriated immovable, the process of exchanging (clearing) or transferring with another immovable under the property of responsible administration or transferring construction right can be made. This method will ensure the transfer of the increase in value for the immovable property to the public property since the land expropriated by predicating on construction rights before the urban renewal and it would open to use according to the new construction right after renewal.

Although this practice is the most acceptable and efficient method of transferring value to the public, the financial resources of the responsible administration need to be strong.

3.3. Application by contracting with the immovable property owners in the field and taking a certain proportion of the immovable property to the public property.

Urban renewal is an application based on a contract to be made between the immovable owners and the responsible administration on the ground of the project and donating a certain part of the property rights of the landlord (X %) to the public or donation to the administration after renewal.

This practice, which is based on the request of the landlord and based on the plan change aimed at improving the right of development, cannot be a recommended method because it is based on mutual compromise principle and has no continuity. Likewise, a sense of compromise, which leaves value-added to property owners, threatens to shape the integrity of the plan and the development of the city.

4. CONCLUSION

Urban renewal studies; should be an application of planning approach to the place that takes into account the identity of the living community, tends to protect and use the cultural and natural assets to be protected, meets the expectations of the property owners as long as they are not contrary to the public interest, and is compatible with the social state model". The increase in the value of the planning that carries such features must also be transferred to the public to create a source of finance for the government, which is responsible for the formation and implementation of the renovation areas. However development laws in force in Turkey has not established a regulation in this regard.

In this context, in order to provide social justice;
- The development plan applications for the urban renewal area must be realized in the method of land and land management model which id modelled in value equality, and in this respect, the legislation should develop the new law design.
- The responsible administration shall open all the immovable properties in the urban renewal area to the public property by expropriation or transferring the construction right and then to planning and implementing the construction.
- Some local governments should control their rent-seeking practices, which are not based on law, but based on consensus with property owners.
- Urban renewal projects should be carried out in the fields and stages interacting with each other.

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ETHICAL PRINCIPLES ON VALUATION

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ABSTRACT:

The ethics as a concept is broadly called the moral principles theory, discipline of philosophy " which criticizes or even convicts the life of the society in which the age and the age of the society is struggling to pass the ideals of a certain life, puts alternative values instead of existing values, defines life rules clearly. Primarily, ethics is the search and understanding of a life that is desirable. In other words, ethics is guidelines, principles and standards that help people to determine how " things should be done ". In order to institutionalize ethics within an organization, there must be the mechanism that defines the system and objectives of the general values of organization, and guiding the decisions made to comply with these principles.
In a broader aspect, it is to know all activities and objectives are put into place, what is to be done or not, what is to be asked or not, what is to be possessed or not to be.
The goal to be attained or to be achieved by ethical codes of conduct is to prevent corruption in general and to dominate honesty in the state and society. In society generally there is a tendency to see all occupations as professions. However, in the western world, the professions are classified as:
• Specialist Jobs
• Skill-Based Jobs
according to the level of education and the quality of the duties.
The profession as one of the most important sources of identity is an area of activity that allows one to be respected in society, to establish relationships with others, to gain a place in society and to live a sense of being useful. A profession should meet the inevitable need of society.
The sum of the ethical principles and standards that guide the behaviour in business is called professional ethics. Professional ethics is the whole set of professional principles that restricts personal tendencies of a certain profession group, profession members, compels them to act with certain rules, excludes inadequate and unprincipled members from the profession, regulates professional competition and aims to preserve service ideals. Occupational ethics; is the rewriting of general moral principles in the context of the profession. Establishing ethical standards is a very difficult process. This challenge includes fundamental questions about how ethical standards will be based and how these standards will be applied when specific situations are encountered.
What a profession member does is closely related to his colleagues after a certain point. Wrong behaviour does not only humiliate a person, but it can destroy all confidence in the profession.

KEY WORDS: Valuation, Valuation Ethical Principles, Cadastre and Ethics Relations.

1. INTRODUCTION

In the globalizing world, the rapidly increasing capital, the international circulation of goods and services, has given unlimited power to profit-making competition. Fortune has been transferred and even carried from one place to another in the World. The research and studies in this area conducted by Western universities, organized labourers, employers and professional associations, which give importance in the concept of professional ethics and social responsibility, are illuminating and instructive.

The decline in the standards of business and professional ethics in the emergence of social imbalances is a major influence. For this reason, human resources in the society should be made both in terms of technical knowledge and in terms of ethical behaviour (İşgüden 2009). Research on business ethics began with the weakening of traditional liberal understanding in Europe and America and the strengthening of the socialist movement in the early twentieth century (Dalyan 2013).

Business ethics began to develop in the US in the 1970s and in Europe in the 1980s and in the following years in other countries. With this development, business ethics contributed to the increase of the value of business life. Until the 1960s, the US passed through many stages of questioning capitalism. Within this transition process, many issues such as improvement of working conditions of women and children, compensation rights of workers, unjustified price increases that could endanger the living of a family, and truthfulness in advertisements have been discussed (Dalyan 2005). When it came to the 1980s, both business ethics in USA and Europe started to be used as profession ethics. Professional ethics have been recognized as a study field in many universities and professional organizations.

Ethics principles, commissions and boards have carried out in many fields. passed by. The most important of these organizations was the "European Business Ethics Organization" established in Holland in 1987.

2. ETHICS STUDIES IN TURKEY

II. Due to reasons such as World War I, Implementation of Ataturk's reforms after the declaration of the Republic, the developments related to professional ethics were slow. In this period, religious issues on professional ethics and post-war social problems were emphasized. Serious ethical problems were experienced in social relations in the Turkish society between 1950 and 1990. The understanding of ethics based on traditional and religious grounds weren't shown to be functional due to various reasons but ethical understanding based on secular and rational principles that will take its place and solve the problems of society in this matter weren't produced (Dalyan 2005).

Today, many reasons such as the development of mass media, global competition and uncertainties, changes in economic policies, and the tendency to take more serious social interests have led to the prominence of professional ethics. In 2000s, the Ethics Committee of Civil Servants was established for public institutions, and has set ethical rules for public employees and their contacts. In addition, TOBB, TÜSİAD, YÖK, some conglomerates and professional chambers established ethic committees to control the members. However, although most of these organizations have professional behaviour principles they don't have any application field, and the codes of behavior cannot be operated.

3. EVALUATION AND ETHICS RELATIONSHIP

The fact that the national income is below the European countries and economical affection with the rapid impact of cyclical movements has led investors generally to invest immovables. Since immovable;

1. Is a product that can not be produced,
2. Leastly affected by economic crises,
3. Protects investors' savings against inflation and makes a gain over inflation,
4. Population growth,
5. Migration,
6. Development plans,
7. Unfinished plan amendments,
8. Urban transformation work,
9. Nationalization,
10. Housing deficit,
11. Planned plot production inefficiency

It can provide serious rants and investors and profiteers enter the real estate market beside those who really need. This trend is further increased in countries like Turkey where other investment vehicles open to speculative movements. (Ertas 2011).

The following groups also participate to the market;

1. Disclosing,
    a. The property owner himself,
    b. Industrial Institutions,
    c. Government Institutions,
    d. Banks,
2. Profiteers,
3. Black Money owners,
4. Customers
    a. Those who want to use the land for themselves,
    b. Construct and selling firms
    c. Those who want to temporarily use of the immovable,
    d. Estate Agents,
    e. Investors,
    f. Those Who Need a Certain land,
    g. Construction companies

For this reason, we can see that many different people involving in the market. As a natural consequence, it is a field which is open to exploitation. According to the results of a research for the General Directorate of Land Registry and Cadastre (TKGM) (Fire 2005) (Chart 1, 2, 3);

1. 76.5% (varying degrees) of bribery and corruption,
2. 57.3% (varying degrees) employees are engaged in unethical acts,
3. Nearly 100% (varying degrees) of unlawful interest is provided.

can be reached.

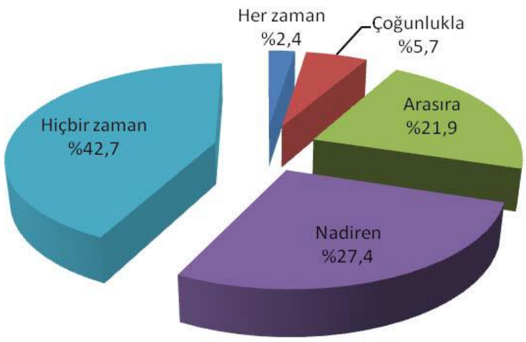


Chart 1 Prevalence of corruption and bribery in the Directorate of Land Registry

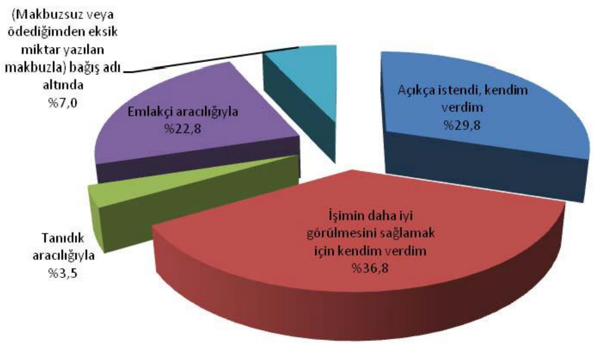
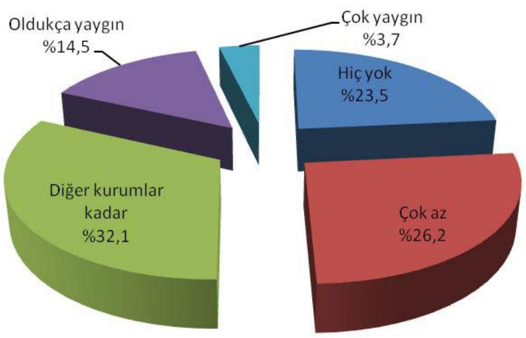


Chart 2 Frequency of TKGM Employees making unethical acts



Graph 3. Methods of Providing Extraordinary Benefits

If a similar study has been done for the municipalities that are the source of the planning, we might perhaps encounter a worse result. It is necessary to congratulate the TKGM for making such a study and sharing it with courage. Because knowing the problem is the half of the solution.

4. ETHICAL STUDIES ON VALUATION

The first ethics study about the Map Engineering in Turkey (the Boards 2005), contains generally accepted rules for our profession. To a certain extent this work can also be applied for **valuation**. However, since Article 10 of Regulation on Evaluation and Discipline of **Association of Valuers**, ethical principles related to valuation have been given (URL1). But these are the penalties. In other words, it is for act of crime. However, ethical principles exist to educate members of a profession with the principle of **becoming a good member** and to gain behavioral habits.

We can see in the **International Valuation Standards** (also accepted by the Capital Markets Board) that this issue is dealt with in more depth (URL2). The 1st Article 1 is an objective to determine the principles regarding the valuation services provided. 1st Paragraph of UDES (International Valuation Standards) says "Those using valuations made under International Valuation Standards should be confident that they are prepared by expert professionals with high ethical standards". That is, the studies to be carried out aim at evaluating high ethical principles, not ordinary ethical rules. It is explained in the section "Code of Conduct (Principles of Ethics)" in Chapter 4 of the UDES (p.19). In addition, studies on the subject have been made at Anadolu University (Dalyan 2005).

The most comprehensive study of the subject was carried out by the American Appraisal Institute (ADE 2013). Such studies have also been carried out by different institutions in Europe. But as they all gave rules in the form of ethic rules, this institute set 5 basic rules as canons. As you know, canon is a rule in Christian religion. We can understand this as a basic rule, but the essence is to be attributing sacredness to ethic rules.

5. ETHICAL RULES ON VALUATION

The basic rules to be presented here are summarized in the following sources and experience. Of course they can be expanded.
Avoiding harmful behavior: Any action that may harm the public, society, customers and colleauges should be avoided.
Assistance: Works of colleauges which are involving etical standars of vocational organization should be helped to fulfill
Prejudice avoidance: Services, reports, reviews and customer behaviors should not be prejudiced.
Confidentiality and secrecy: Information of clients and the public should not disclose the to unauthorized parties.
Avoiding unfair competition: over-price cut for getting the job, mislead advertisements or forced labor should be avoided public benefit should be protected.
Follow-up of the agenda: The regional, national and international political and economic agenda should be aware of to be able to correctly interpret the data used in valuation.
Avoidance from darkness: Stay away from speculators and money launderers should be stayed away.
To be honest and fair: The public society, customers, colleagues, suppliers and employees must be honest and fair.
Effective use of resources: The resources of the public, the client and the organization should be effectively used.
Professional care and diligence: Careful care and diligence must be shown in the reviews, in the calculations and in all the services offered.
Transparency: Behaviour towards the public, society and customers should be transparent.
Customer identification: In all services provided, the customer should be addressed his instructions should be complied, he should be informed and his interests should be protected.
Conflict of interest: conflict of interest between groups and customers should be avoided.
Neutral and independent: One should be impartial when examining business conduct, business behavior, and reporting. One should also stay away from conflict of interest.
Proficiency and competence: Profession knowledge should be sufficient, current scientific studies on the profession should be followed and the practices of colleagues should be watched.
Ads and advertisements: Vague advertisement, exaggeration, hope pumping in advertisements and speculative behaviors should be avoided.
Commitment to standards: quality of the service for the job should not be fallen below the standards.

Integrity and trust: One should be trusted in the quality and the result of the services that he is directly involved in hisprofessional and private life.
Job loyalty: One should avoid any kind of behavior that may damage the reputation and raise suspicion of profession and colleagues.
Legality: All services must be legal and should not exploit its gaps.
Responsibility: One shouldn't forget that he is responsible in all services; customers, the public and the professional organizations.
Developing the rules of the profession: One should be in the effort to adapt the valuation criteria to the region and to develop the calculation method.
Relationship with the environment: There should be a relationship with colleagues and public institutions that is in line with the rules of ethics and avoids abuse and suffering.
Auxiliaries and organizations: Help should be demanded from people and institutions when necessary for valuation, and the identity and at what stage and in which quantity you are benefited and identity should be explained.
Employees: One should be fair and honest to his employees, and ensure that they behave well to their customers and they should not exploited
Information security: The valuation specialist should be sure of the correctness and legality of the information he uses when providing his services to the customer.

6. CONCLUSIONS

Valuation expertise is a profession that is new in our country, increasing in importance day by day and open to misappropriation due to its content. The valuation expertise is referred to as a profession in many of laws and regulations in justice. In addition, some institutions, such as the SPK and organizations such as DUD (Association of Valuation Experts) have published some general codes of professional ethics for their members or suppliers to receive services. However, there are no ethical principles related to valuation in municipalities, banks and other institutions and organizations that make a great contribution to the formation of rants. For this reason the subject of this study is the valuation subject of:

1. Valuator
2. Customer
3. Political institution,
4. Academic structure,
5. Public institutions

Here, some ethical principles have been tried to be given. Undoubtedly these principles should be developed with ethical codes. The concerned should go into action as soon as possible to determine the codes of ethics. Different pressure groups may try to block some work to influence this market. For this reason, the real estate market should be taken as an effective countermeasure and prevented from being used outside of the purpose of the land.

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Türkiye Değerleme Uzmanları Birliğinden: *Türkiye Değerleme Uzmanları Birliği Değerlendirme ve Disiplin Yönetmeliği*

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ASSESSMENT AND COMPARISON THE LOCATION OF SIX UNIVERSITIES IN TEHRAN CITY USING GIS AND MULTI CRITERIA DECISION MAKING METHODS

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ABSTRACT:

Universities are the engine of science in any country. Thus improvement of a university led the country to development. Location of the university is one of the factors which are effective on the quality of research and educational activities at the university. Crowded or polluted areas are not proper places for the universities. There are also the other criteria such as quality of transportation system which may affect the satisfaction of the people who deal with the university. GIS has powerful tools to spatially analyze the location and produce the outputs to be considered as the indexes of properness of a location for a specific activity.

In Iran most of the major universities have been constructed in the capital: Tehran. Tehran is a crowded, polluted and large metropolis which contains various neighborhoods with various conditions. This research aims to assess and compare the spatial conditions of six important universities in Tehran. To extract the effective factors more than 500 students were interviewed. The extracted factors were categorized into two main categories of spatial and environmental and then were divided into five subcategories, namely: greenness, air pollution, noise pollution, accessibility and compatibility of surrounded land-uses. Using GIS analyzes the quantitative values extracted from the maps, satellite images and statistical data. Then Multi-Criteria Decision Making (MCDM) methods were used to combine the factors. The results revealed that Amirkabir University of Technology achieves the highest score while Allameh Tabataba'i University is ranked below among the considered six universities

KEY WORD: University, Location, Compatibility, Access, Environment, Tehran

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1.Introduction

Educational period is an important part of the life of any educated people. Thus, spending nice time in the educational places can help people to improve learning. One of the factors that may affect the quality of educational places is their locations. Students usually like the places with some properties such as good access to facilities and transportation network as well as silent and clean places. This study aims to analyze and compare the desirability of the location of six universities in Tehran, Iran.

GIS is a professional system to deal with the spatial data. Therefore, in this research GIS is used to analyze the maps and extract the indexes of desirability. On the other hand combination of various indexes of desirability is done through Multi Criteria Decision Making (MCDM) methods.

One can find several records of site selection of educational places in the scientific literatures. However if the case is a university, the records are very limited. In this research we do not aim to find the best places to construct a university. Instead we extract the corresponding criteria and then we assess and compare the location of existing universities. It is obvious that the extracted criteria for assessing the location of universities may valuably be used for site selection of new universities. However, it depends to the demands. In the following some related researches are briefly reviewed.

Moller (1998) analyzed the process of site selection of educational places in Copenhagen, Denmark. He then produces a pattern for site selection of educational places (Moller-Jensen, 1998). Pizzolato et al. (2004) aimed to find the best sites for schools. They considered various criteria such as geology, slope, faults, population and urban areas. Using Analytical Hierarchy Process (AHP) the criteria were weighted and then combined. Finally the best sites for constructing schools were selected (Pizzolato et al., 2004). Taleai et al. (2007) aimed to develop a model for assessing land-use compatibility in densely built-up urban areas. In this process, a new model was developed through the combination of a suite of existing methods and tools include: GIS, Delphi methods and spatial decision support tools: namely multi-criteria evaluation analysis, analytical hierarchy process and ordered weighted average method (Taleai et al., 2007). Okan (2012), in his research, studied the role of GIS in education. The main purpose of the research was to use Web GIS technology to analyze the geographical location of Tbilisi schools. The data used in the research include: the capacity of each school, the number of students, the spatial distribution of schools, the physical conditions of schools, the location of schools in relation to other land-uses, and so on (Okan, 2012). In the study of Shahraki et al. (2016) the first aim was to analyze the distribution pattern of existing educational sites across a case study city and to examine an optimal model to redistribute the schools. The ultimate goal was to give a new map on the spatial distribution of educational sites in tune with new urban needs and development. Their research used an integrated spatial equity evaluation method, which is analytic and descriptive. They used the Moran's I index to classify and analyze the collected data. (Shahraki et al., 2016).

2. The study area

Six universities in Tehran, capital of Iran has been chosen for this research. There are various reasons for the authors to select these universities among several universities in Tehran. They are almost known for the authors, their locations are distributed in the city and each of them is a top university of Iran in some areas of science. The location of six selected universities is illustrated in Figure 1.

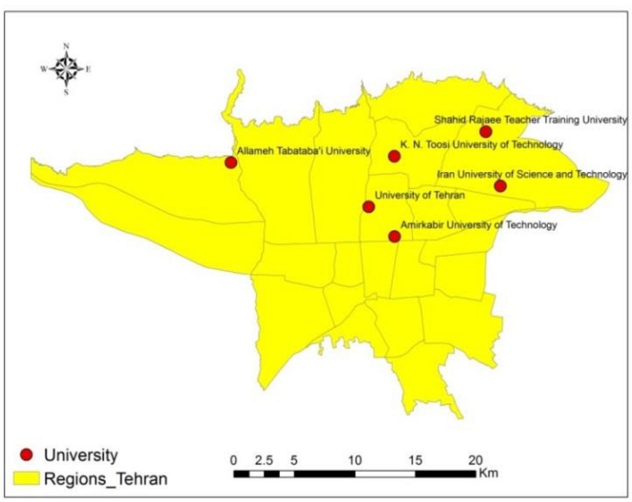

Figure 1: The location of six selected universities in Tehran

3. Methodology

The first step of this study is to identify the criteria of desirability for the location of a university. To do this task more than 500 students of the selected universities were interviewed. The ideas of students indicated that the criteria can be categorized into two groups of spatial (or physical) and environmental factors. Next the factors were divided into subcategories. Environmental factors include greenness, air pollution, and noise pollution. Spatial factors involve accessibility and compatibility of surrounded land-uses.

The next step is to define indexes to determine the values of criteria (factors) and then combine them to rank the desirability of the location of six universities.

In environmental category, greenness can be achieved by using satellite images. NDVI1 is a usually used index in this field. NDVI is defined by (Tucker, 1979):

$$\mathrm{NDVI} = \frac{\mathrm{NIR} - \mathrm{R}}{\mathrm{NIR} + \mathrm{R}} \qquad (1)$$

where, NIR is the value of near infrared band and R is the value of red band in the satellite image. The value of NDVI index is in the range of -1 and +1 where intense green coverage equals to +1 and less values indicates the less greenery.

In Tehran metropolis air pollution and noise pollution (especially the former) are unsolved problems. A suitable location for an educational land-use (such as university) should have the minimum possible air and noise pollution. For this task the maps of noise pollution and air pollution for the whole city must be prepared. In this study air pollution map is produced using land-use regression method (Rawlings et al., 2001). The reference for detecting the amount of air pollution is the fixed air pollution sensors which are mainly managed by the municipality of Tehran. On the other hand, the data of noise pollution sensors are the reference for preparing noise pollution map. Kriging method is applied to produce noise pollution map (Abbaspour et al., 2015).

To produce accessibility map, first it must be defined that which places are important to access. Interviews with the students of the universities revealed that possibility of walking to eight places is important which are: bus stops, subway stations, mosques, sport fields, clinics and hospitals, cultural shops and centers, green spaces (such as parks) and educational places (such as educational institutes). The possibility of walking means that the distance between the origin and the destination must be almost short. In this research the maximum distance of walking on the network considered as 3000 meters on the network of streets. It is obvious that except point destinations (bus stops and subway stations) for the other destinations the capacity is important. The capacity of destinations is approximated by their area. Thus the accessibility is evaluated by the following relation (Tsou et al., 2005):

$$A_i = \sum_{j=1}^{n} W_j * D_{ij} * P_j^l \qquad (2)$$

Where, A_i is the accessibility index of the origin i to the destination j, W_j is the weight of destination j, D_{ij} is the standardized distance between the origin i and destination j. D_{ij} is calculated by the followings(Tsou et al., 2005):

$$D_{ij} = \begin{cases} 1 & \text{if} \quad d_{ij} < d_0^l \\ 1 - \frac{d_{ij} - d_0^l}{d_d^l - d_0^l} & \text{if} \quad d_0^l \le d_{ij} \le d_d^l \\ 0 & \text{if} \quad d_{ij} \ge d_d^l \end{cases} \qquad (3)$$

where, $d_{ij}$is the distance between the origin i and destination j on the network, d_0^l is the optimum distance between the origin and the destination and d_d^l is the final possible effective distance to the destination. P_j in relation (2) is the index of attractiveness of the destination and is calculated by:

$$P_j^l = \frac{S_j^l}{\bar{S}^l} \qquad (4)$$

where, S_j^l is the area of destination land-use and $\bar{S}^l$ is the average area of all similar land-uses in the effective distance.

Compatibility of surrounded land-uses is calculated using compatibility matrix. In fact, for any land-use the compatibility with other land-uses can be estimated. Thus the compatibility of university land-use can be compared with other surrounded ones using pair-wise comparison. Finally the weights of compatibility of land-uses with the considered land-use (university in this research) are calculated (Taleai et al., 2007). In addition to the weights of compatibility the area of land-use is another effective factor which should be taken into account.

[1] Normalized Difference Vegetation Index

4. Implementation and analysis

Each of considered factors is extracted from a corresponding map and this is the point that highlights the role of GIS. For environmental factors three maps was produced and then combined. Greenness map in this study is a map showing the NDVI index which covers Tehran. To produce this map, image of Landsat 7 satellite, ETM+ sensor, band 3 and 4 was used as the input of relation (1). Figure (2) shows the produced NDVI map. ENVI software was used for this process and NDVI obtained within a thousand meters radius of each university. For the other map processes in this study ArcGIS 10.3 software was used. Figure (3) and (4) show the noise pollution and air pollution maps respectively. Afterward, three factor maps were combined using Index overlay method with the equal weights and environmental index map was created (Figure (5). It is worth noting that time of gathering data for each factor map is different. It depends on the accessible data and suitable time for the particular factor under the consideration. Air pollution is at the highest in winter. Noise pollution is significantly higher on days in the mornings. Real greenness is observable in summer when all the trees have leaves. Different time of gathering will not affect the results because the relative conditions of the target universities are fairly constant during the interval of collecting data. The obtained values for environmental factor are listed in Table 1.

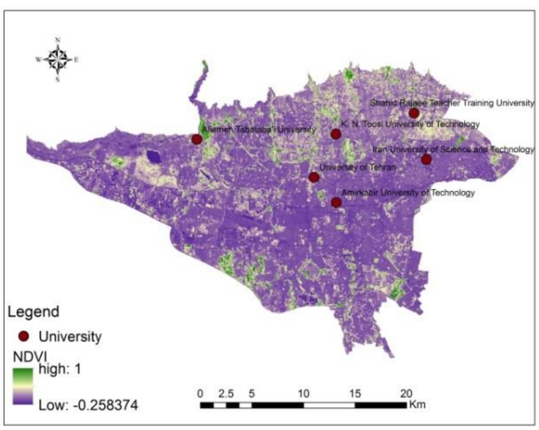

Figure 2: NDVI map(2013/6/22)

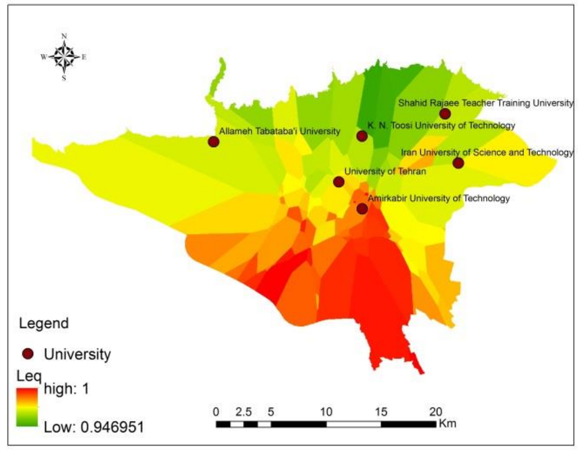

Figure 3: Noise pollution map (2017/10/23)

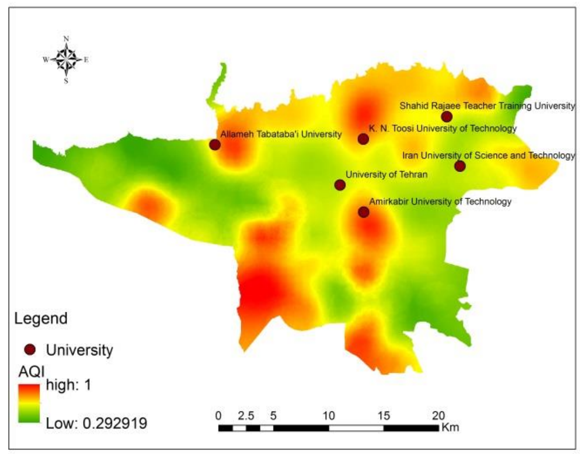

Figure 4: Air pollution map (2012/12/21)

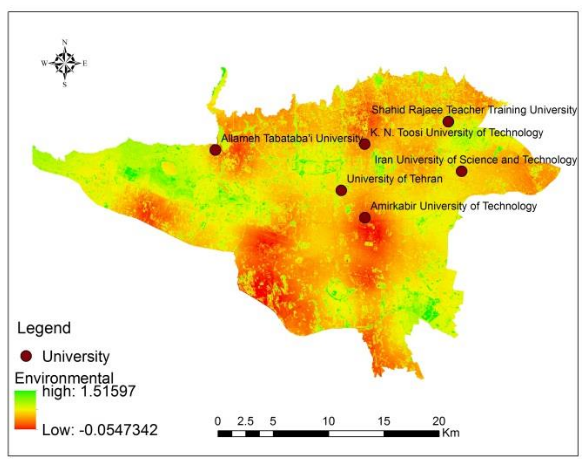

Figure 5: Environmental map

Table 1: The values of environmental indexes

University	NDVI	AQI	Leq	Environmental
Iran University of Science and Technology	0.140	0.554	0.968	0.617
Shahid Rajaee Teacher Training University	0.229	0.636	0.965	0.627
Allameh Tabataba'i University	0.240	0.735	0.969	0.536
Amirkabir University of Technology	0.121	0.834	0.987	0.3
University of Tehran	0.170	0.568	0.974	0.626
K. N. Toosi University of Technology	0.165	0.764	0.962	0.439

To produce physical index map, accessibility and compatibility of surrounded land-uses must be determined. Accessibility was extracted on a 1:2000 map of Tehran using OD-cost matrix in ArcGIS. Table 2 shows the related distances and weights used for calculating accessibility index.

Table 2: The distances used for calculating accessibility and their corresponding weights (Hoseini et al., 2016)

Land use	$-d_d^l d_0^l$	W_j
Educational	1000-2500	0.073
Health & Therapy	650-1500	0.048
Cultural	800-2000	0.170
Religious	1000-2000	0.024
Sports	1500-3000	0.121
green space	650-2000	0.146
Subway	1200-2500	0.219
bus stop	1200-2500	0.195

To generate compatibility various land-uses around the target universities were determined and their compatibility with university land-use was compared pair-wisely. The compatibility expressed in five levels. Levels of compatibility have then been assigned different weight based on previous works (Taleai et al., 2007). Calculated accessibility and compatibility are illustrated in Figure (6) and Figure (7) respectively

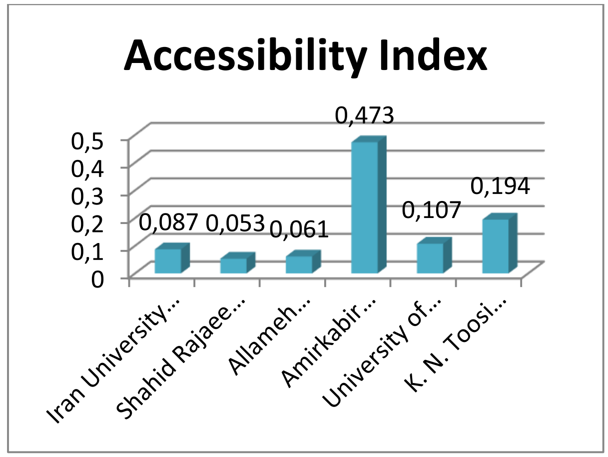

Figure 6: Calculated accessibility of universities

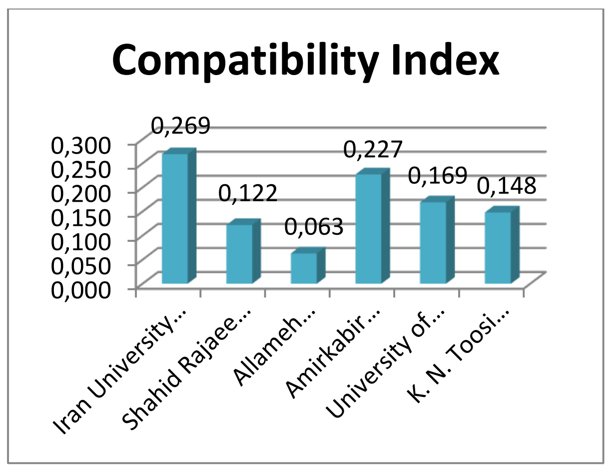

Figure 7: Calculated compatibility of universities

Once the values of factors obtained, they can be combined to get the final index. However, the weights of each criterion must be assigned. Like the previous works these weights are calculated using AHP[1] as multi criteria decision

[1] Analytical Hierarchy Process

making method. The weights of accessibility and compatibility of surrounded land-uses were calculated equal to 0.75 and 0.25 respectively. On the higher level of AHP hierarchy the weights of physical criterion calculated as 0.6 while the weight of environmental factor is equal to 0.4. All of the weights in this research were evaluated based on the idea of interviewed students.

At last, the final index for desirability of the location of target universities achieved by combining sub-criteria. The achieved values are demonstrated in Figure (8).

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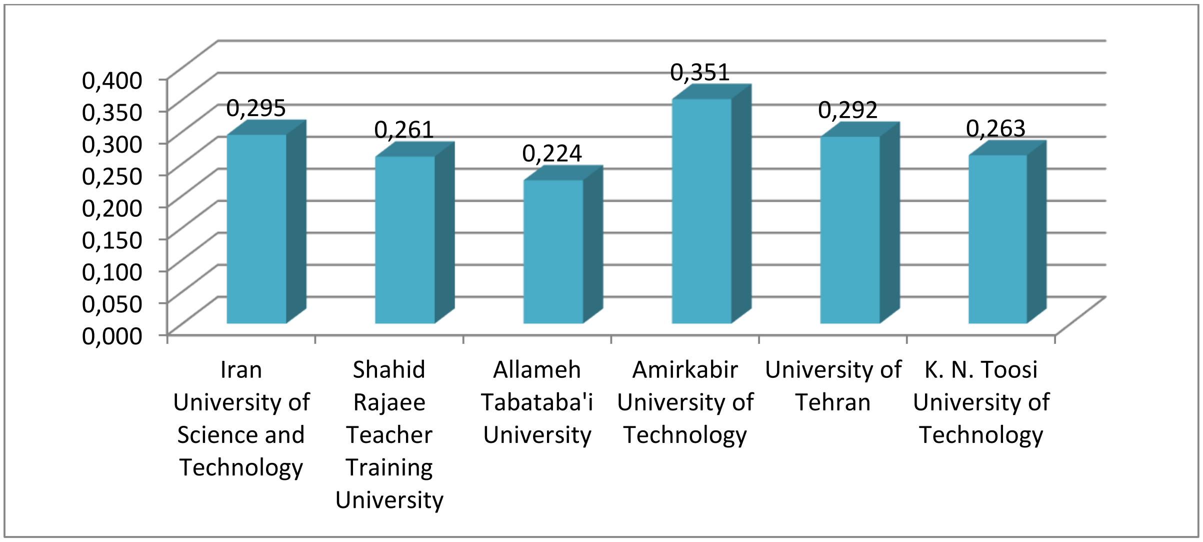

Figure 8: The comprehensive calculated index of desirability of the location of six selected universities in Tehran

As can be seen in the Figure (8) Amirkabir University of Technology was ranked first while the lowest score assigned to Allameh Tabataba'i University. The main factor of this result is accessibility. The other factors were not at a level to be able to compensate the large amount of difference between the accessibility factors of highest score and lowest score universities. These results reveal that despite of high values of air pollution and noise pollution at the central districts of Tehran, steel these districts are the best locations for the universities. To make the suburban area of Tehran the better places for the universities the accessibility of the selected locations as well as the compatibility of surrounded land-uses should be considered precisely.

5. Conclusions and Recommendations

This research analyzed and assessed the location of six universities in Tehran using GIS and multi criteria decision making methods. In this research more than 500 students from six universities were interviewed to find out the effective factors on the desirability of the location of the university as well as the relative importance of effective factors. The extracted factors were categorized into two main categories of physical (spatial) and environmental and then were divided into five subcategories, namely: greenness, air pollution, noise pollution, accessibility and compatibility of surrounded land-uses.

It may be obvious that crowded or polluted areas are not proper places for the universities. However, the results of this study revealed that in the students' point of view it is very important that the facilities such as transportation network or parks etc. be accessible on foot from the university. The results showed that location of Amir Kabir University of Technology achieves the high score among the six assessed locations of universities. It is recommended to address the effects of the location of universities on the quality of education.

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SOIL ORGANIC CARBON POOLS ESTIMATION BASED ON DIGITAL MAP OF ORGANIC CARBON STOCK IN 30-CM SOIL LAYER OF RUSSIA

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KEY WORDS: Organic carbon stock, Digital map, Soil mapping, Soil-geographic database, Bulk density

ABSTRACT:

Digital map of organic carbon stock in 30-cm soil layer of Russia was created for GSOC-17 GSP FAO project. Our objective was developing and testing algorithms for soil organic carbon (SOC) mapping on the basis of information accumulated in the Information System "Soil-Geographic Database of Russia", i.e. vectorized different-scale soil maps, analytical characteristics of reference profiles and attribute data of the regular monitoring surveys. The calculation of main SOC map have performed in the form of synthesis of two types of source data: a map of the entire territory of the Russian Federation based on the Soil Map of RSFSR (ed. V.M. Fridland, 1988) at the scale of 1:2.5 M combined with sparse and irregular grid of about 2000 soil profiles and maps of separate agricultural areas based on the large- and medium-scale soil maps and a dense grid of regular soil observations. Both maps were merged in one grid. The SOC map for litter is calculated on the base of previously published map adapted to the GSOC17 requirements. The SOC map for duff and peaty litter horizons of semi-hydromorphic soils was calculated by using the averaged expert estimations of bulk density values. The final version of the SOC map of Russia is a per pixel sum of above maps. Our calculations indicate that the total carbon stock in 30-cm soil layer of Russia is about 150 Pg, and nearly half of these stocks (45%) are concentrated in organogenic horizons.

1. INTRODUCTION

Soils play a key role in the biogeochemical cycle of carbon. Carbon reserves in soil are almost three times as much as those in vegetation and twice as much as those in the atmosphere (Batjes, 1996; Smith, 2008; Zdruli et al., 2017). Tentative estimates of the carbon stock in the 1-meter soil layer of the Earth range from 1061 to 1576 Pg, i.e. may differ by 1.5 times (Milne et al., 2007). Russia's share in the global soil carbon stock is about 20% (Kurganova et al., 2014). By increasing the quality of the estimates of total organic carbon stock and shares of various carbon pools and their dynamics, we may significantly contribute to research and prediction of climate change, prevention of desertification and development of regional and even continental level strategies for sustainable development.

The Food and Agriculture Organization of the United Nations (FAO) established the Global Soil Partnership project (GSOC17) to refine the estimates of soil carbon stock. The specific goal of the project was to develop a Global Soil Organic Carbon Map for a depth of 0-30 cm. Within the frameworks of this project a map of Russia was produced that shows the soil organic carbon stock within a 0-30-cm soil layer. It is not possible to compile a map based on the FAO Guidelines (Brus et al., 2017) for such a country as Russia, with huge area and extremely diverse natural conditions, without joint efforts of many academic and applied research organizations. All organizations, which took part in the project, are listed at the FAO web site (http://www.fao.org/global-soil-partnership/pillars-action/4-information-and-data/global-soil-organic-carbon-gsoc-map/gsocmap-contributors/en/).

There are several assessments of carbon content, stock and balance in various natural components of Northern Eurasia, some of which are available as cartographic material. The geographic analysis was as a rule conducted for large nature formations with natural borders, including basic vegetation types, zonal and intrazonal vegetation formations of each thermic belt, ecosystem types, soil types and natural and agricultural zones, and soil complexes, taking into account diversity of parent material etc. (Rodin et al., 1965; Bazilevich, 1993; Bazilevich et al., 1986; Isaev et al.,1993; Kolchugina et al., 1994; Orlov, 1994; Kudeyarov et al., 1996; Tishkov et al., 1995; Orlov et al., 1996; Rozhkov et al., 1997; Full Carbon Account…, 2000; Cherkinsky et al., without date). In addition, the results were calculated and mapped for a geographic grid of 1-by-1 degree trapezoids. Within the latter, depending on the biomes, different calculation methods were applied (Moiseev et al., 2002; Moiseev et al., 2007).

The soil carbon stock in the 0-100-cm soil layer of Russia is estimated in a number of publications using various averaging and extrapolation methods. These estimates differ by 10-30% (285–364 Gt), despite being based on almost the same original data. This is due to the fact that there are limited number reference soil profiles that have complete data sets, including bulk density values for horizons (Kudeyarov et al., 2007; Orlov et al., 1996; Rozhkov et al., 1997; Schepaschenko et al., 2013; Stolbovoi, 2002; Budiman et al., 2017, etc.).

The main goals of the study were:

- to develop and test algorithms for mapping soil organic carbon stock based on information accumulated in the *Information System «Soil-Geographical Database of Russia» (IS SGDR);* and
- to estimate proportions of basic organic carbon pools of the 0-30-cm soil layer of Russia territory.

2. MATERIAL AND METHODS

2.1 General principles of mapping

In accordance with the FAO guidlines, the following characteristics of original data are used in calculations:

a) organic carbon content in the 0-30-cm soil layer, % (for a soil profile or polygon of soil map);

b) bulk density of horizons in natural condition, g/cm^3 (for a soil profile or polygon of soil map); and

c) stone content, % or grades (for a soil profile or polygon of soil map).

The maps were proposed to compile using $^1/_{120}$ angular degree grid (approximately 1x1 km); the same format was proposed to use for an error map – to assess calculation errors of the basic map (Brus et al., 2017).

The research is conducted using IS SGDR. This system permits to exchange with diverse soil data within a distributed network of soil data processing centers and to use various types of information: vector maps of different scales, analytic characteristics of soil profiles, results of regular monitoring etc. The carbon stock map is compiled by synthesizing several types of original data:

a. Soil maps of the Russian Federation compiled using the Soil Map of RSFSR at scale 1:2.5M (1988) (at present this is a soil map with the largest scale available for the whole country compiled using the unified approach and legend) combined with a sparse irregular grid consisting of about 2000 soil profiles. In our calculations 25000 soil map polygons were used; the map legend has more than 300 units. The carbon stock for each polygon of the Soil Map of RSFSR was calculated considering only the type of the main soil, associated soils were disregarded;

b. More detailed maps were compiled for several agricultural districts – two administrative regions located in European Russia – using medium and large scale soil maps and data of dense regular grid of agrochemical soil observations. For these areas, data of recent soil research (dated 2012-2016), as well as archive data (since the 1970s) were used. In total, more than 150 000 point data (dated 2012-2016) and more than 15000 map polygons were used.

The maps **a)** and **b)** are combined in one soil organic carbon layer by calculating values for the grid whose cell size was specified for each map and then by superimposing more detailed **b)** maps over the **a)** map.

c. The map of forest floor carbon stock was prepared and adapted to FAO requirements by D.G. Shchepashchenko based on an earlier publication (Schepaschenko et al., 2013);

d. The map of carbon stock in organogenic horizons of semihydromorphic soils.

The map of Russia was included in the global map GSOC17 as a sum of all aforementioned layers (**a+b+c+d)**. An error map was also produced for the united layer (a+b).

2.2 Original data for calculating organic carbon stock in soils

As mentioned above, when compiling the basic map layer (**a**), soil carbon stock is estimated using information from IS SGDR. We also had information on about 2000 soil profiles, some of which lack bulk density data of horizons. In order to ensure more comprehensive use of the data accumulated in IS SGDB, additional research was conducted. As a result the bulk density of mineral soil horizons was estimated using an equation proposed by O.G. Chestnykh and D.G. Zamolodchikov (2004), which permits to predict the bulk density of soil horizons depending on humus content and horizon's depth:

$$BW = a_1 - a_2/(MID+a_3) + a_4/(HUM+a_5),$$

where BW – bulk density, g/cm^3

MID – average depth of horizon, cm

HUM – humus, %

Calculation for soil groups, which we provisionally called *Taiga*, *Meadow* and *Steppe*, were made using equation parameters listed in Table 1.

Soils	a_1	a_2	a_3	a_4	a_5
Taiga	0.252	9.110	9.939	110.999	78.805
Meadow	1.413	27.045	33.905	2.390	5.449
Steppe	1.451	13.137	20.414	0.012	-0.177

Table 1. Equation parameters

Carbon stock in peat soils (Histosols) of bogs was assessed using the ash content and bulk density of relevant peat varieties published in reviews (Table 2) (Carbon in Forest and Bog Ecosystems of Russia, 1994; Vomperskiy et al., 1994; Inisheva et al., 2012).

A separate layer of organic carbon stock in duff and peaty horizons of semihydromorphic soils was produced. The lack of empirical data described these horizons did not permit correct assessment of their variability. Therefore, this layer was not considered in the error map.

Characteristics	High-moor bogs	Transitional bogs	Low-moor bogs
Ash content, %	3.5	7.5	20
Carbon content in organic matter, %	55.5	56.0	55.3
Bulk density, g/cm^3	0.07	0.09	0.13

Table 2. Characteristics using for calculating SOC stock of Histosols

2.3 Compilation of large scale maps of carbon stock in agricultural regions

For two regions of the chernozem zone in European Russia (Rostov and Belgorod regions), where soils were historically strongly transformed by agricultural practices, maps were compiled using a regular 30 angular minute grid. This was implemented on the base of results of online assessment of humus reserves calculated on digital medium and large scale soil maps, analytic characteristics of reference soil profiles and data of regular agrochemical research.

Several calculation methods for mapping were tested: using of archive large and medium scale maps and data of analytic research of reference soil profiles; using agrochemical monitoring data and expert assessments of soil bulk density; using agrochemical monitoring data and soil bulk density calculated via pedotrasnsfer functions (PTF). The final regional maps are generated up-to-date carbon stock maps of agricultural lands superimposed on a small scale map.

2.4 Error mapping

Since the map of soil carbon stock was compiled using different approaches and methods, different approaches were employed for mapping errors. For the most of Russia territory, the relative error of carbon stock in layers beneath the forest floor is estimated for each legend unit. In this case, the error was estimated as the quotient from dividing the standard deviation by the mean, assuming the normal distribution. For some legend units, the relative error of the estimate sometimes exceeds 200%. In areas with high density of observation, a regression equation was used to calculate the bulk density. In this case, the relative error of carbon stock estimates is around 25%.

3. RESULTS AND DISCUSSION

3.1 Calculation of the bulk density of soil horizons

Some authors (Stolbovoi, 2002; Xu et al., 2015) speculated that one of the reasons why the estimates of soil carbon pools have low accuracy is the lack of the data on soil bulk density. In order to solve this problem, a number of methods were proposed to fill this gap. Quite often for this purpose researchers apply employ pedotransfer functions that permit to calculate the value of bulk density using other soil characteristics that are available. PTF are empiric and thus have a limited field of application. Everyone should be especially careful when using them under conditions significantly different from those under which they were obtained. Therefore, it is quite challenging to select PTF that would permit for the least error in determining soil bulk density for a specific region (Jalabert et al., 2010; Benites et al., 2007; Boschi et al., 2018, etc.).

The preliminary analysis of applicability of PTF proposed by various authors (Hollis et al., 2012; Manrique et al., 1991; Chestnykh et al., 2004) for calculating bulk density of soil horizons was conducted. It showed that the least error was obtained when a five-parameter nonlinear function proposed by O.G. Chestnykh and D.G. Zamolodchikov (2004) was used. The function reflects the dependence of bulk density on humus content and depth at the middle of horizon range, with equation parameters specific for various groups of soils. The authors proposed to use different equation parameters for five groups of soils. Since the method for soil grouping was not specified in the work, we used a set of soil profiles included in IS SGDB and tested the applicability of these parameters for different groups of genetically similar soils.

Our calculations showed that for soils, that were provisionally grouped as *Taiga* (Table 3), the values of bulk density calculated by the aforementioned equation with applying parameters for *Taiga* soils quite well matched the experimental values. The data were tested for 301 horizons from 61 soil profiles. The average relative error was around 15%. While for organic horizons (with organic matter content more than 15% by weight) the relative error reaches 95% (it ranges from 3.4 to 410.8%), the relative error is significantly lower in mineral horizons (8.6%) (it ranges from 0.01 to 50.1%) (Figs. 1 and 2). The test showed that the same algorithm could be also used when calculating the bulk density of mineral horizons of other soils that provisionally were included in the group of *Taiga* soils (Table 4).

Soil Map of the RSFSR legend	WRB
Iron-illuvial podzols, soddy podzols	Albic Umbric Podzols; Albic/ Dystric Retisols
Podzolic soils	Albic Retisols
Soddy-podzolic soils	Albic/ Dystric Retisols
Gley podzols, gleyed soddy-podzolic soils, peat and peat-podzolic gley soils, soddy gley soils, and mucky gley soils	Histic Gleyic Podzols; Gleyic/Stagnic Retisols; Gleysols
Light gray forest soils, gray forest soils, dark gray forest soils	Albic Luvisols; Luvisols; Luvic Phaeozems; Greyzemic Luvic Phaeozems

Table 3. Soils in group « *Taiga*» soils according to the Soil Map of the RSFSR legend and approximate analogue in the WRB

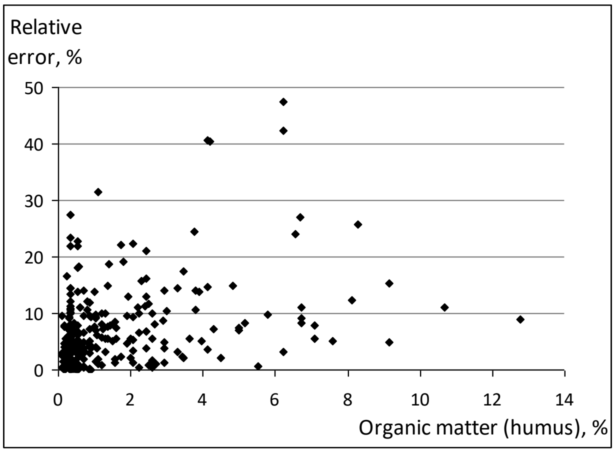

Figure 1. Relative errors of mineral horizons soil bulk density obtained using «podzolic soils » equation parameters

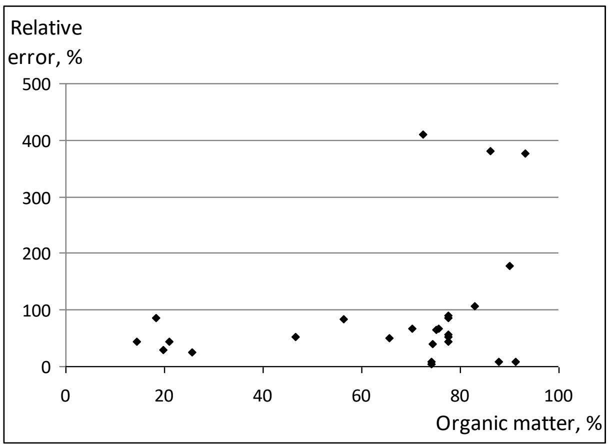

Figure 2. Relative errors of organogenic horizons soil bulk density obtained using «podzolic soils» equation parameters

Since it is generally unknown, whether a data set used to develop the equation overlaps with the SGDB set, which we used to test the applicability of PTF, or not, the latter was also tested on a data set that is known to be independent. This set consists of soddy-podzolic, mainly slightly gleyic and gleyic soils and of mineral horizons of several peat soils (Histosols), whose organogenic horizons were not present in the set. The humus content in all considered horizons was less than 6.8%. In total 125 horizons from 31 soil profiles were analyzed. The average relative error for determining the bulk density of these soils was 7.5%.

Soils	Average relative errors, %			N
	Horizons			
	All	Organogenic	Mineral	
Equation parameters «*Taiga*» soils				
Retisols, Luvisols	15.0	94.7	8.6	301
Podzols	24.5	80.7	10.5	55
Cambisols	23.2	113.4	12.3	37
Entic Podzols	87.8	315.2	13.2	77
Equation parameters «*Steppe*» soils				
Chernozems, Kastanozems	9.2			427
Equation parameters «*Meadow*» soils				
Phaeozems, Fluvisols	23.8		14.7	102

Table 4. Average relative errors of soil bulk density obtained using different equation parameters

The similar algorithm was applied to a big group of humus-rich soils, that included all variants of Chernozems and Kastanozems. Relative errors for all data set (450 horizons) vary from 0.02 to 54.4%, with the average relative error is 9.2% (Table 4). The applicability of the equation and coefficients was also tested for soils of this group using the independent data set – 307 horizons of 111 soil profiles of Rostov region soils, including different chernozems, meadow chernozems, meadow soils and alluvial soils. The average relative error is 7.6%.

Somewhat worse results were obtained for a group, which unites meadow floodplain soils (Phaeozems and Fluvisols) (Table 4). Therefore, it was shown that for mineral horizons of soils provisionally united in the group of *Taiga* and *Meadow* soils, as well as for all horizons of *Steppe* soils, calculation of the bulk density of horizons by the indicated formula using equation parameters specific for the given soil group produces satisfactory results.

3.2 Map compilation

When compiling a SOC map based on Soil Map of RSFSR (1988), the organic carbon stock in mineral horizons of soils considered above was calculated using the bulk density of horizons obtained by the analyzed equation (in case of the absence of direct measurements). For other mineral soils, bulk density was obtained using statistically averaged rare empirical data or expert estimates. Carbon stock in peat soils (*Histosols*) of bogs was estimated using ash content, bulk density and carbon richness of relevant peat (Table 2). Then organic carbon stock was calculated to a depth of 30 cm for each soil profile and then these stocks were averaged for each legend unit.

In soil complexes, the carbon stock was calculated proportionally to the number of soil units included in the complex. For complexes that included two soil units, the share of the former was taken as 60%, while the latter, as 40%. In three-unit complexes, the share of components was assumed equal to 34, 33 and 33%, respectively. When considering soil complexes with the presence of frost cracks, the share of crack was taken as 25% based on the size of polygons and cracks as cited in different sources (Boch, 1974; Karavaeva, 1969).

When compiling medium- and large-scale maps of agricultural regions (Rostov and Belgorod regions), several approaches were tested that used various volumes of original information and different calculation algorithms. At the first stage, the mapping was made using a traditional expert approach based on vector medium- and large-scale maps, characteristics of reference soil profiles and generalized information about humus stock from reports of soil surveys conducted by agricultural organizations. It was assumed that several specific soil profiles were representative for a relevant mapping unit within the study area. Maps compiled using a regular 30'-grid reflect the results of online estimation of humus stock based on dense grid of humus content data collected during agrochemical monitoring and then statistically averaged, expert's or calculated (using different methods) values of soil bulk density without considering cartographic material. Different variants of mapping were tested: with averaging data over all years of observation, with neighbors averaging using variable radius, with calculation based on PTF. Analytic soil data of reference soil profiles were used for verification of obtained maps.

Thus, based on all dataset of available information, both archive and recent, up-to-date maps of soil carbon stock on agricultural lands of Rostov and Belgorod regions were compiled. These maps were superimposed on a general small-scale map.

3.3 Ratio between carbon pools

All vector and raster map layers presented in ArcGIS v.10.1 project are accessible by link:
https://drive.google.com/open?id=1QilNuRzjiHjZLCrxRBv9FeJnqJ3N46Z-

The final basic map layer of Russia shows the organic carbon stock in the 0-30-cm layer of mineral horizons of all soils and of peat sols of bogs (Histosols). The total stock of organic carbon in this layer is estimated as 115 Gt, including 84 Gt in mineral horizons and 31 Gt in the 0-30-cm peat layer (Table 5).

Soil organic carbon	Pg	%	
		Total	Organogenic horizons
Total	151	100	
Mineral horizons	84	56	
Organogenic horizons, including	67	44	
Histosols	31	20	46
Duff and peaty litter horizons of semi-hydromorphic soils	21	14	31
Litter	15	10	22

Table 5. Organic carbon pools structure in 30-cm soil layer of Russia

Carbon stock in forest litter of Russia ranges from 0 to 36 t/ha. The maximum values are found for old-growth coniferous forest, often in poorly drained soils. The total organic carbon stock in forest litter of Russia is estimated as 15 Gt (Table 5).

The situation is more complicated with estimates of the carbon stock in duff and peaty horizons of semihydromorphic soils. The data in available publications are quite variable: the organic matter content may reach 90%, while the bulk density may vary from 0.4 to 1.1 g/cm^3. Therefore, a separate layer of the carbon stock in duff and peaty horizons of semihydromorphic soils was developed using statistically averaged data and expert data of carbon stock, without any calculations based on organic carbon content and bulk density of horizons. It is likely that carbon stock estimates in the layer are characterized by maximum uncertainty among all considered pools. According to our calculations, the total carbon stock in duff and peaty horizons of semihydromorphic soils of Russia is about 21.0 Gt (Table 5).

The final map of soil organic carbon stock represents a sum of all described layers. According to this map, the organic carbon stock in the 0-30-cm soil layer of soils of Russia varies from 0 to 330 t/ha, the overall organic carbon stock is about 150 Gt.

4. CONCLUSIONS

While compiling a map of organic carbon stock in the 0-30-cm soil layer of the Russian Federation, algorithms were developed permitting to use data from multiple sources, having different spatial scale and spatially and attributively sparse but which mutually complement each other with varying reliability.

The availability of big data sets (dense grid of observations) permitted to calculate statistically significant coefficients of pedotransfer functions as well as to estimate spatially the calculation error. Technical solutions on organization of calculation based on distributed (in the internet) network of data centers will enable online calculation, including timely update of the results in case of obtaining new information or refining of the existing one.

According to our estimates, the overall organic carbon stock in the 0-30-cm layer of soils of Russia is about 150 Gt. Almost half of this stock is within organogenic horizons (44%). Therefore, 44% of overall soil organic carbon is represented by organic substances, which are unfixed or poorly fixed to soils mineral components. The most decomposable pool – forest litter – could make up to 10% of the overall carbon pool, i.e. being just slightly less of a quarter of the carbon pool of organogenic horizons (Table 5). About 20% of the total soil carbon stock (almost half of the pool of organogenic horizons) concentrates in the 0-30-cm peat layer, while about 14% (31% of carbon stock in organogenic horizons), in peaty and duff horizons of semihydromorphic soils. So, most deal of carbon stock of organogenic horizons is concentrates in wetland soils.

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CONTRIBUTE TO TURKEY ECONOMY OF IMPROVEMENT AND MANAGEMENT OF CADASTRAL DATA

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ABSTRACT:

Production and management of cadastral data is implemented by General Directorate of Land Registry and Cadastre (TKGM) in Turkey. All the cadastral work from the past to the present day was carried out by different methods and different coordinate systems according to past time requirements. Today, the necessity of combining and managing all cadastral data in a single coordinate system is accepted by all stakeholders. Therefore**,** at the end of the collected statistics and studies, TKGM projects are being carried out to improve the 40% of the total parcel amount (≈23 million) in the country and to present them to the ITRF coordinate system. These projects are carried out in two different ways (22/a article and Annex-1 article of the Cadastre Law no 3402). These methods are planned to be implemented by TKGM through its own possibilities and private sector services. It is envisaged that the data produced in ITRF coordinate system will be transferred to MEGSIS under the control of TKGM and shared with stakeholder institutions and web services, real and legal persons via web applications and e-government portal in secure electronic environment.

In this study, it is planned to prevent the technical and legal problems caused by the cadastral datas in expropriation, land consolidation, development applications and similar projects carried out by investment companies with the projects carried out in accordance with article 22/a and article Annex-1 of Cadastre Law. Moreover, in light of the technological developments of today, the benefits and profit of providing quick and reliable access to the correct cadastral data of the real estate sector, municipalities, private sector and citizens have been discussed at national level.

KEY WORDS: Renewal Working of Cadastre Law, MEGSİS, Cadastre, TKGM, Digitization Working of Cadastre Law

1. INTRODUCION

The mission of the General Directorate of Land Registry and Cadastre (TKGM) is protecting, updating and the servicing of ownership's data by the government guarantee. TKGM was established in 1847, so the business shared by the private sector and the public sector in the field of the mandate, which has been in the field of activity for 171 years; It is in the effort to continuously develop the information that constitutes the basis of the geographical information systems and provides the basis for the national spatial data infrastructure, both in terms of quality and scope. Using the most advanced information and communication technologies for fast, uninterrupted, timely, secure, able to provide quality and effective e-government integration of services related to, also have reached international standards in line with the target year of 2023 Turkey's strong and is committed to being an efficient institution.

In accordance with the data presentation standards, TKGM present digitized cadastral data which are matched and updated with orthophoto maps and up to date land registry information and thus, the plans for raising the quality of life and the realization of real estate valuation studies are laid. In this context, the numerical cadastral data of the digital cadastral maps and the submission of the title deed information to the public and private sector institutions increase the effectiveness and efficiency of the land registry and cadastral services.

TKGM provides online services to approximately 900 public institutions and organizations and serves to question the immovable geometries and attribute information of our citizens through the e-government gate. In order to improve the data quality and to share the legal and current cadastral data, cadastral data improvement works also underpin all works based on land, especially real estate valuation studies.

2. INSTITUTIONAL ORGANIZATION

TKGM is one of the most important contact points for citizens and government. There is a central organization with 970 Land Registry Directorate and 81 Cadastre Directorate in 22 Regional Directorates in TKGM and it provides service to an average of 20 million people with more than 7 million operations per year by approximately 19,000 personnel. Organization schema of TKGM is shown in Figure-1.

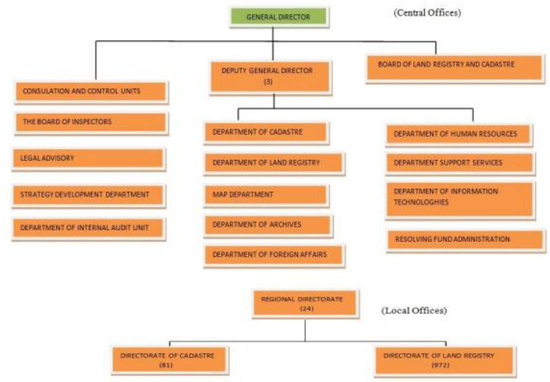

Figure 1. Organization schema of TKGM

3. CADASTRAL SITUATION

Cadastre studies in our country have been carried out for more than 90 years since the first years of the Republic. In this context, only 285 village/neighborhood's cadastre were not completed because of some problems over 52048 village/district in total.

TURKEY'S CADASTRAL SITUATION (April 2017)				
TOTAL DISTRICT AND VILLAGE	BEFORE 2003	BETWEEN 2003 AND 2015	CONTINUING	PROBLEM *
52.049	38.796	12.861	107	285

Table 1. Projects provided by TKGM

Although the cadastral works of our country have been completed to a great extent, cadastral maps have been produced in different scale, sensitivity and system as a result of the works on the deeds and cadastre made since the establishment of TKGM. In this production process, a standard data structure has not been achieved until the last 15 years and therefore non-standard data has been produced. In the process starting from 2003, the first cadastral units were produced in accordance with the relevant laws and regulations and in accordance with the technological conditions of the day. However, the changes in the data produced by the relevant laws and regulations were made on the cadastral maps of the base on which they were produced and they have registered without a standard again. This situation is still the case today for various technical and legal reasons. In addition to the updated data, maps that are still in non-standard bases are still used.

When the cadastre studies carried out to date are examined, it is seen that the parcels in the Cadastre Offices (geometric data) are produced in 4 different coordinate systems.

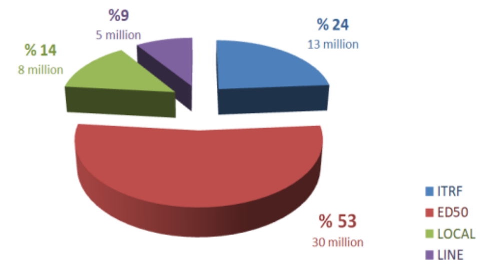

Figure 2. Cadastral Data Infrastructure

Cadastral data that can integrate with each other in a healthy way without any technical and legal problems despite their different production methods are 60% of the total parcel amount. We can see that inside the organizational structure of regional directorates, like figure-3. The data with the best data quality within this segment is usually in areas marked with red color. The reason for the existence of the regions with the best data quality is the fact that the units having the first facility cadastre after 2003 were in these regions.

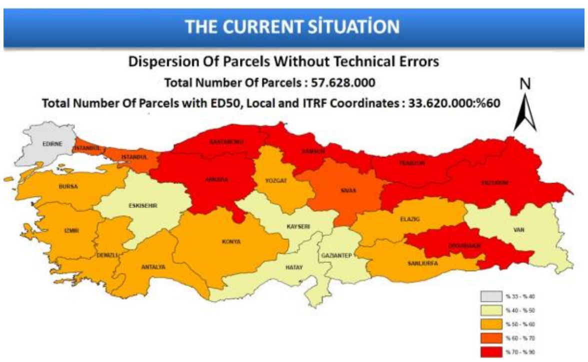

Figure 3. Total Current Cadastral Data Rate in Turkey

In recent years, due to the projects developed for land planning, there has been an intensive demand for renewal of cadastral data from public institutions and organizations together with private individuals and organizations, and this demand has been increasing. As a result of the inventory study conducted by TKGM, it has been concluded that there are approximately 23 Million parcels which have been identified as the need for digitization and renewal. This amount is 40% of the total parcel amount in Turkey (Figure 4).

4. IMPROVEMENT AND PRESENTATION OF THE CADASTAL DATA

It is planned to update all cadastral data of the country by two methods that are carried out by TKGM and complement each other. These methods are "Digitization" studies carried out in accordance with Annex 1 of the Cadastre Law and "Renewal" studies implement in accordance with Article 22/a of the same law. Both of these methods have advantages and disadvantages over the each other. For example, while digitization works are more advantageous in terms of costs and procedures, Renewal Studies give the actors of cadastre implementers greater powers to correct errors. Therefore, it is envisaged that both methods are applied together and the corresponding method is preferred. These implementations will be carried out by the co-operating public and private sector, so the troublesome cadastral data will be resolved while produced in the current coordinate system (ITRF).

As can be seen in Figure 4, the regions where the digitization and renewal works are predominant throughout the country are highlighted with red color. The presence of experienced personnel in the regions where these studies will be done intensively is extremely important. Because the planned work is aimed to be carried out in a short period of 4 years. In this regard, TKGM organizes various training programs for the relevant personnel and contractor companies in order to carry out the work and complete it with minimum errors and disruptions.

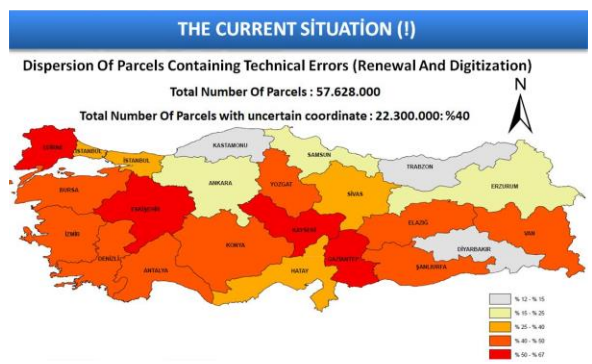

Figure 4. Cadastral data rate which are needs to be improved in Turkey

4.1 "Renewal Working" of Law No. 3402

In the scope of Article 22/a of the Cadastre Law No. 3402, the Renewal Works are generally applied in places where technical reasons are inadequate, the quality of the application is lost, the lack of (?WHAT?) which cannot be provided from the map and technical documents or where there is no compliance between the layout and the current ground condition (Figure 5). Unlike the digitization working, the demarch and experts of the unit are involved and the errors that can be detected in accordance with their declaration are also eliminated. For example, it is possible to determine a detail point which has been forgotten during the cadastre and to add this point to the cadastral sheet, with the help of the demarch and experts. Within the scope of these working, the road, creek, canal, etc., which were opened after the cadastre but not registered structures are officially processed their cadastral map within the consent of the owners of the parcels corresponding to these structures. In the broader sense, all changes except for the change of ownership that has a legal basis, such as separation, leaving the road and completely changing borders, can be applied to a parcel that is included in 22 / a works.

Figure 5. Example of a map to be modernized which application of renewal working

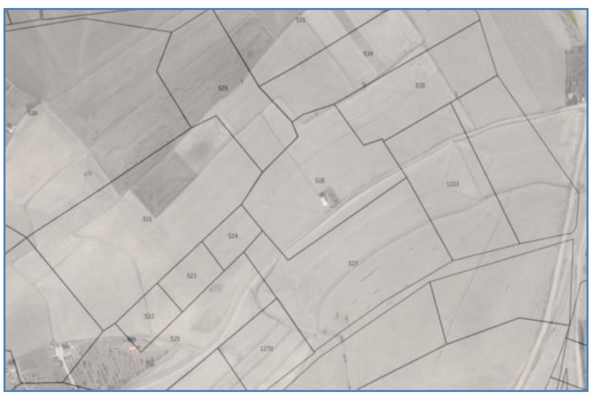

Figure 6.Sample area which renewal working to be applied

4.2 "Digitization Working" according to Annex-1 Application of Law No. 3402

Digitization Studies carried out within the scope of Annex-1 of the Cadastre Law No. 3402 are the transfer of the existing cadastral maps to the current coordinate system and the elimination of errors detected during these works where cadastral map and ground in harmony and cadastral maps contain a small amount of measure, limitation, inverse or account error. As a result of the analyzes performed by the cadastral directorates in the units that need to be updated, in general, if the layout and the ground alignment are observed, these places are considered within the scope of Digitization Studies (Figure-7). Then, the cadastral data belonging to this location are carried to the current coordinate system with the determined measurement, drawing, limitation and calculation errors (Figure-8). If it is found that the cadastral map and ground mismatches are dense after the unit has been taken into the program of work, these parts which are identified as mismatches, are included in 22/a within the same work program and their errors are corrected and updated. The similarities and differences of Digitization and Renovation works are given in Table-2.

Figure 7. Sample area where digitization application must be done

Figure 8. Example of corrected parcels as a result of digitization application (old and new state together)

4.3 Comparison of 22-a and Annex-1 Applications

Digitization Working	Renewal Working
Demarchs and experts do not work in these studies. (They take part for forest parcels)	These works are carried out with the participation of reeves and experts.
Only registered buildings and parcel detail points are measured in the field.	All the registered / unregistered buildings and parcel detail points are measured in the field surveys.
In these studies, cadastral maps are digitized by eliminating their mistakes.	If the roads, creeks, etc. found to be present before the cadastre, the implementer can show these on the cadastral maps but if these structures built after the cadastre, the

	implementers can be registered in the map if the owners are approved.
The implementers have to calculate all the points position accuracy of parcel details.	The implementers determine parcels boundaries according to the declarations of demarchs and experts and the technical documents of parcels.

Table 2. Comparison of Digitization (Annex-1) and renovation (22-a) studies

4.4 Spatial Real Estate Information System (MEGSIS)

MEGSIS Project is a Geographical Information System project arranged by the Ministry of Development and developed in line with the strategic objectives of the Ninth Development Plan, the Government of the Republic of Turkey.

Article 1 of Law No. 5304 on Amending Law No. 3402 is as follows.; "The purpose of this Law is to establish the land registry foreseen by the Turkish Civil Code numbered 4721 and to establish the infrastructure of the spatial information system according to the country coordinate system based on the cadastral or topographic cadastral map of the country by specifying the legal status of the land on the map and land by specifying the legal status." The spatial information system emphasized here is a system that is designed to be able to manage any temporal dimension with full integration of all physical, verbal, graphical and dynamic data. MEGSIS is the product of this study which is considered as the first version of the system to be designed, but which can offer many opportunities to our institution and our stakeholders even though the company has shortcomings with its experience and facilities. MEGSIS is a platform in which not only the cadastral data but also the jointly produced data with the institutions and organizations that we cooperate with various protocols are managed and presented. After the Cadastre Data Consolidation (KVK) implementation was put into operation in August 2011, the Spatial Real Estate System (MEGSIS) was prepared in order to form the cadastral automation infrastructure of the General Directorate of Land Registry and Cadastre in accordance with the demands from the directorates and the institutional needs. Then, as of 25.02.2013, it has been put into operation in all directorates.

In this context;

- Control of land register and cadastre data in response,

-Collection of attribute information,

- Integrating and presenting in the ITRF96 coordinate system,

-Verification using air images (Orthophoto etc.),

-Increasing the quality of data with control queries,

-It is aimed to keep the data up to date.

As of 30.11.2016, 99% of the 57 million parcels registered in the land register were transferred to the MEGSIS database.

Data which collected;

-More than 900 institutions and organizations, "e-government" project are shared with the relevant, in this way, it forms the basis of many national strategic projects.

Moreover, these data are presented to all of our citizens on the website of our institution: "cbs.tkgm.gov.tr/parselsorgu.aspx.". Thus, it is used as a very important information tool in the investment sector and other private sectors. As of 2018, 40% of the data managed in MEGSIS is capable of direct use (Figure 9). The data that are considered to be temporary define the cadastral data in which the metadata is not defined correctly and in a standardized way contains deficiencies and the data of which the definite data can be obtained. The ratio of temporary data is 60% (Figure 9).

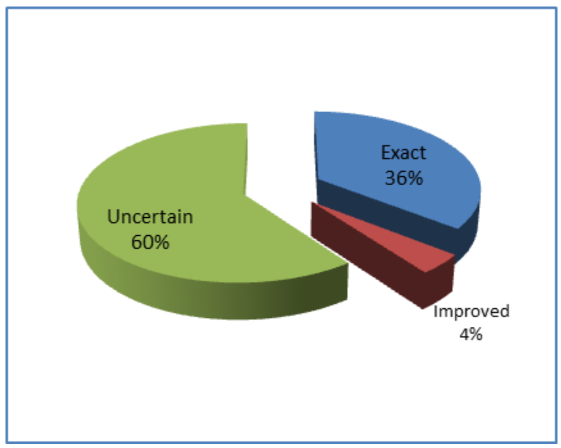

Figure 9. MEGSIS data status

As a result of the country-wide renovation and digitization studies, the data in the MEGSIS database will be improved and the data will be given as definite data. After this, full integration with the data of the land registry will be provided and the final data presentation will be performed with the citizens through the institutions, organizations and the e-government gate. It is a system designed to offer and share the exact cadastral data that will be the basis for the investments and activities of the organizations.

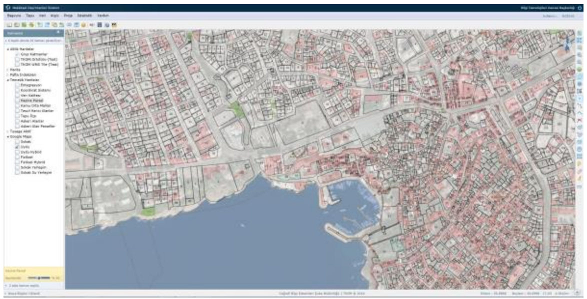

Figure 10. MEGSIS interface

5. CADASTRAL DATA AND ITS CONTRIBUTIONS TO ECONOMY IN TURKEY

The main function of the cadastral studies is to create the cadastral topographic map of our country, to establish the records of the lands without deed with the identification of the immovable property and to modernize the old records by linking to current maps and to ensure the registration and security of the immovable property. In this context, the registration of the assets on land and the fact that these records are current and reliable are of great importance in terms of time and cost.

With the developing world, the importance of the cadastre, which forms the basis of many investments, is increasing. About this subject, The Peruvian, Nobel Prize-winning economist Hernando De Soto said in his book, "The Secret of Capital," " The fact that Western countries are economically developed compared to Eastern countries and that this is not a divine fate and that every country can be rich.." Explaining the economic development gap between developed countries and underdeveloped Third World Countries with "property system", Hernando De Soto argues that the only way out for developing economies is to introduce unregistered property into the system. According to De Soto, every country can develop, every society can be rich. The first thing that needs to be done is to recognize and protect the property of the real estate and to include it in the economic processes (De Soto H., 2005).

The main areas where cadastral data will be used are spatial planning. Cadastral data are basic Stone for evaluations of beginning development planning and decisions to be taken. Plan decisions cannot be applied if spatial planning is not done with accurate and reliable cadastral data and even if implemented, the wrong decisions may disrupt public order and cause many other legal dimensions. Disruption of the plans, implementation, giving the wrong plan decisions will return us as an economic loss. It also causes changes in the property and business activities for large projects such as dams, highways, and bridges.

As a result of the rapid growth of urbanization, the phenomenon of ownership has been strengthened and as a result, the necessity of the right, healthy, up-to-date and legal validity of the cadastral data has gained importance. From the cadastral layouts produced with the techniques that are not used now, especially the linear maps which do not have the technical ability to implement, should be brought into the form that will form the base of the spatial information system, and it is thought that this demand will increase and increase. As a result, the property data are cadastral data; The fact that the cadastral data to be received is accurate and reliable will contribute to shortening the time of the applications to be made, to make the decisions to be taken correctly and to decrease the costs as a result.

The General Directorate of Land Registry and Cadastre, three or four times more than the income received from the state through budgetary appropriations earns income to the state. Fees are collected from the citizens as land registry fees by land registry services. The fees tariffs are determined by the government and are updated every year (Aliefendioğlu v.d. 2017). In this respect, it is very important for the public to register and secure land and other property rights.

Better service provision through data improvement from our institution will be provided to private and legal entities, public institutions and organizations and the private sector. In addition, the quality and efficiency of the public services provided by our institution will increase in the scope of effective and widespread e-government applications and a wider user population will be served in a short time. It will be ensured that the locations of the parcels are displayed correctly, the citizen satisfaction will be increased in the services provided to the courts in relation to the immovable cases, and more effective support will be provided in the development and agricultural activities. However, the budget allocated for the project will be converted into a socio-economic benefit and TKGM will provide an increasing amount of recycling depending on the volume of transactions carried out.

Data reclamation projects will provide the core services of TKGM to be provided under the e-Government gateway, data will be obtained for TAKBIS, and the foundation of spatial information systems will be contributed.

In addition, in the private sector, approximately 20000 people, including 10000 technical personnel, will be employed.

6. CONCLUSION

The basic information systems needed in e-government gate delivery are developing day by day. The establishment of common infrastructures and the determination of common standards are continuing. Collective practices in the public sector, including local administrations, are being disseminated. In this context, land registry and cadastre data constitute the most important basis for projects and investments such as MEGSIS, TAKBIS, National Geographical Information System Infrastructure, Integrated Urban Development Strategy and Action Plan (KENTGES 2010-2023), Spatial Information Systems. Because of the land registry and cadastre data constitute the most important basis for projects and investments such as MEGSIS, TAKBIS, National Geographical

Information System Infrastructure, Integrated Urban Development Strategy and Action Plan (KENTGES 2010-2023), Spatial Information Systems, it seems inevitable that demand for these areas will continue to increase. The cadastral data obtained as a result of the improvements emerge as a very important need in the formation of municipal information systems of municipalities and in rural and urban area regulations.

The driving force of the work to be done consists of cadastral renewal and digitization for approximately 23 million parcels. The benefits of the project are:

- In the scope of the project, the digital maps to be produced in the places where renewal and digitization are made will constitute the base of the city information systems.
- As the service quality will increase, the efficiency of the staff and the operations will increase.
- Since the making of the same operations will be eliminated (including the production of similar materials for internal resources and the local market), significant savings will be achieved.
- Since the number of lawsuits related to the property will be reduced, financial savings will be ensured for the society as well as the courts will be less occupied.

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De Soto, H., 2005 Thy My stery of Capital

MONITORING THE LONG TERM URBAN EXPANSION OF ZANJAN CITY USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS

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ABSTRACT:

The growing phenomenon of urbanization, especially in developing countries, has led to the enlargement of urban areas. Due to the complex structure of cities, changes in the boundaries of a city, whether horizontally or vertically, affects the ecosystem and the quality of life of the corresponding communities. It is also important for the urban planners from the perspective of sustainable development to identify land use/cover changes. The purpose of this paper is to study and evaluate the spatiotemporal expansion of Zanjan city in five time periods. In this research, aerial photographs of 1973, 1982, 1998 as well as satellite images of 2008 and 2016 of the Zanjan city were used. After data preparation in GIS environment, each produced map was classified into two classes of built and not built. Two spatial distribution indexes (PD and CONTAG) as well as land surface and class level measurements were used to determine the characteristics of urban physical development in Zanjan. The results revealed that during the assessed time period, the city has become more sprawled, discontinuous, and in terms of variety of land uses has become more diversified. These results warn that if the urban expansion continues with the existing trend, historical contiguity and compactness of Zanjan city will loss in the near future. This trend may cause several problems.

KEY WORDS:GIS, Remote Sensing, Urban Expansion, Zanjan

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1. INTRODUCTION

The increasing urban population and the urbanization process, which are the most important aspects of global change, have played a major role in the history of human civilization in term of land-use change (Deka, Tripathi et al., 2010). The second half of the 21st century will be accompanied by a population density of developing countries, and according to studies, in 2020, are expected that cities be host two thirds of the world's population, that a large share of these changes will occur in developing countries (Garau, Sclar et al., 2005). Uncontrolled growth and development of the population and residential areas in the city will lead to uncontrolled horizontal growth. Urban(sprawl). The sprawl phenomenon (urban creep) causes serious problems such as scarcity of food, creating the illegal settlements, environmental pollutions, environmental degradation, occupation of fertile farmland, forest degradation, reduction of surface water, unsustainable expansion and a lot of changes in the spatial structure of cities, tendency towards the suburban landslide and irreversible changes in land cover (Alsharif and Pradhan 2014). The importance of preventing and addressing the above problems of has been caused that geographers and urban planners studied seriously about urban expansion. Awareness of the form of space and the shape of the city is one of the factors influencing in the success rate of city planners and executives and helps to improve urban environments (HojatSheikhi 2012).

For example, Deng et al. (2008), Ebrahimzadeh (2009) and Bagheri and NedaeeTousi, in 2017, have investigated the urban sprawl phenomenon. They concluded that Urban Sprawl, as an unplanned, unrestricted and scattered unplanned physical expansion to suburban areas, is one of the global challenges in spatial development planning in recent years. It is easy to defined urban sprawl as a quantity the urbanized area and the extent of the dispersion of that area; therefore, in the horizontal expansion are increased the urban areas, the, which are usually non-interchangeable and shows the dispersion of these levels of horizontal dispersion (Jaeger, Bertiller et al., 2010). Due to the large number of measures, the existence of a correlation between some of them based on a large review of scientific resources (Burke, 2000; Weng, 2002; Herold et al., 2005; Lausch& Herzog, 2002; Zhang et al., 2004) and bachelor's knowledge, and according to the appropriateness of the measurements with the aim of studying and paying attention to the correlation between their concept were selected two samples of spill density and continuity of aggregation metrics and distribution of landforms were selected for this study. The purpose of this research is to investigate the spatial distribution of horizontal dispersion in Zanjan by using aerial photos, geographic information system and two examples of landmark form composition and distribution. In this study were used from aerial photographs of three periods of 1973, 1982, and 1998, and satellite images of two periods of 2008 and 2016 to determine the areas constructed in the study area. Finally, we introduced the land use map as input in the software of the fragmentation, and are obtained the results.

2. BASICS THEORETICAL

In a general view, urban form is a combination of characters associated with land use patterns, urban transportation systems, and urban design. Kevin Andrew Lynch considers the urban form as a widespread, permanent, and sustainable spatial pattern of physical elements in the city, form is the result of a relatively slow recruitment of urban elements (Lynch 1984); therefore, urban form is the result of the convergence of the formation of many urban concepts and elements. The dominant shapes of urban form in Iranian cities are radial, checkered, linear, organic, and hybrid (Azimi et al., 2013). In another classification, urban forms are divided into five dispersed, compact, marginally, corridor and lobe groups based on Persman's views in 1985 and Monirie in 1992 (Burton, Jenks et al., 2013), which are presented as follows:

2.1 Scattered City

Continuous development of suburbs with low population density, housing construction and job creation and further infrastructure investments in road transport. This kind of development more has been seen in Australian cities.

2.2 Compressed City

Increased population and concentration in internal groups of urban suburban along with investment in public transportation.

2.3 Border City

Population growth, condominium construction and job creation in selected city areas; increased investment in orbital highways with the goal of linking between marginalized cities.

The city of Corridor: concentrated growth along the lines of the reinforced line from the central business district and supported by the public transport infrastructure.

2.4 Edge City: Extra Growth Mainly on the Edge of the City

In another classification, the city forms divide into two main groups, which are: (1) dense and urban compression; and (2) urban distribution and expansion (Masnavi, 2002). Issues related to sustainable urban development will enhance the consistency of views on the transformation and modernization of the modern city, and resulted to the sustainability of new ideas in urban planning, among which ideas that emphasize on urban densification and its use in urban regeneration is the intensive city idea and it try to provide more sustainability with the evolution of the elements of the city's physical form. In the form of a compact city has been emphasized on the growth of existing urban centres and redeveloped land and in the same time on away from marginalization. The second form of the city pattern, which is completely opposite to the shape of the compact, is the widespread form. This pattern, which in the past few decades was first created in developed countries due to the high use of private and suburban cars, especially in Australia, the United States and Canada, is now seen in many urban cores in developing countries. Urban horizontal distribution is a term that entered to the Urban Research Literature in the last half century and in “sprawl “format, now, is the focus of most urban seminars in developing countries. The history of the use of this term dates back to the middle of the twentieth century when the expansion of urban spaces flourished in the United States as a result of the excessive use of personal vehicles and the development of highway systems (Hess, Daley et al., 2001). A speral or horizontal distribution is a term that means the rapid and scattered growth of the metropolitan areas, and even small towns, which in some cases are drawn up to rural areas. Urban sprawl in most developing countries illustrates the perspectives of poverty, deformity and illicit patterns of land use, along with the lack of a structure and foundation for public facilities and basic services. This pattern has a clear difference with the United States pattern (Lungo 2001); therefore, it can be said that the horizontal growth of the city is in total a kind of urban dispersion and an excessive increase in urban land, which reduces population density, increases the share of open and unused spaces, and as a result of urban segregation and separation Spatial and ecological selection.

3. AREA OF STUDY

Zanjan city is the capital of Zanjan province, located in the northwest of the country. The geographical location of the city is 48 degrees and 29 minutes' east longitude and 36 degrees and 40 minutes' north latitude. The relative positions of Zanjan city in terms of influencing growth and development are: placing on the route of one of the privileged axes of the country according to the route of Tehran-Tabriz-Bazargan, and hence enjoying excellent communication facilities; adjacent with two developed and developed poles of Iran (Tabriz-Tehran) with approximate distance of 300 km.

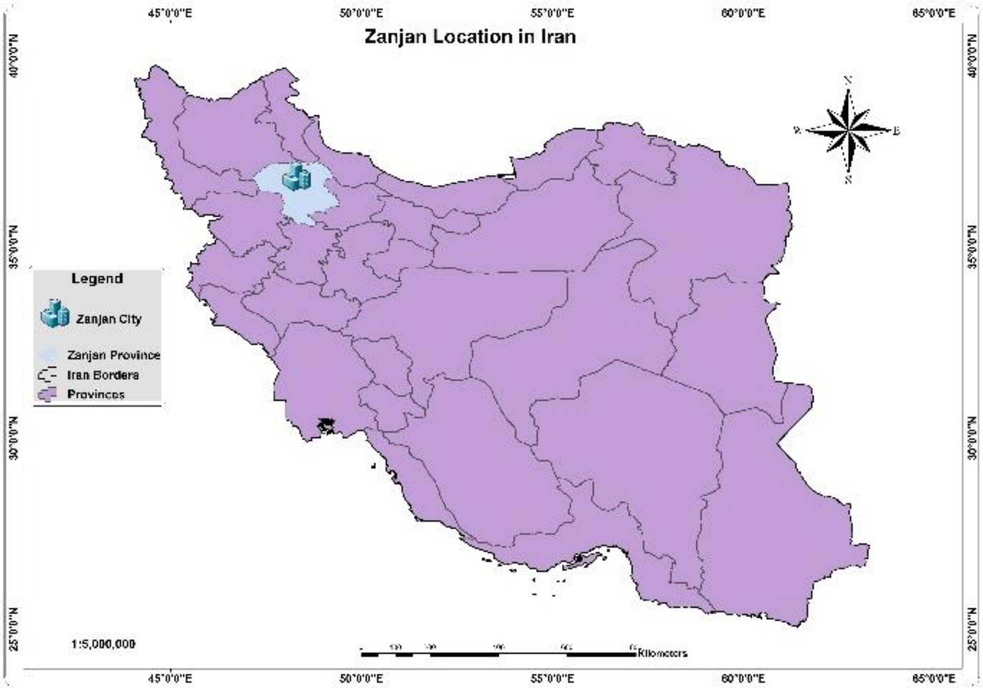

Figure 1. Area of study , Zanjan City

Figure 2. Zanjan Location in Zanjan Province

4. RESEARCH METHOD

After selecting the realm were prepared the aerial photographs with a resolution of 28 microns with 1: 10000 and 1: 8000 scales belonging to three periods 73, 82 and 98, as well as satellite imagery of 2008 and 2016 IRS single-band satellite with accuracy of 2.5 meters. Initially, data were evaluated in order to control the quality of the data and to be aware of the atmospheric, geometric and radiometric errors, then were performed the integration process and reference ground for aerial photos based on WGS 84 and the UTM coordinate system. Then the Orto photo was taken on air photos. In the next step, with the help of ArcGIS 10 software, aerial imagery was converted to binary maps that contain two values of zero and one, representing the constructed and unconstructed areas and after providing a land use map and determining the type of usage, the measurements have been calculated by using Software FRAGSTATS 4.2. After adjusting the software parameters for each of the maps separately were calculated, the boundary gauge at the surface of the land and the spatial density measurements at the class level and their results were transmitted to Excel 2016 software. Finally, the plot of the spatial temporal variations of the measurements was mapped and the process of land surface changes was evaluated.

Name of the metric	Symbol	Unit	Range of changes
Patch Density	PD	Numbers per 100 hectares	≥ 0
Contagion	CONTAG	Percent	0 to 100

Table 1. Characteristics of the measures used in evaluating land use changes in the studied area

Patch density: This measurement shows the number of spots in level unit and allows comparison between different areas. This measure is used as an indicator of habitat fragmentation. This measure is equal to the total number of spots per class, divided by the total area of the land plot multiplied by 10,000 100 to 100 hectares (Karami and feghhi, 2012).

$$PD = \frac{n_i}{A} (10000) (100) \quad (1)$$

Where $n_i$is the number of spots of the type (class) A. i, the total area of the land.

Continuity: This measure is expressed as a percentage, and is one measure of degree of integration of the spots of the land, as well as the degree of fragmentation of the terrain. When all sorts of spots and patches are completely dispersed on land, this measure will be zero, and when the surface of the land consists of only one type of spell, the conjugation is at its highest. (Dejkam et al., 2015).

$$\mathbf{1} + \frac{\sum_{k=1}^{m} e_{ik}}{\mathbf{2}Ln} (\mathbf{100}) \quad (2)$$

Where e_{ik} isThe total length of the margin of class I spots on the land view

Metric / Year	PD(unbuilt)	PD(built)
1973	0.03	0.1
1982	0.04	0.07
1998	0.18	0.3
2008	0.27	0.73
2016	0.34	0.78

Table 2. The results of calculating terrestrial landmarks at the level of the class for built land and unbuilt land

5. RESEARCH ANALYSE

The results showed that the density of patches in the made land class was increased from 0.1 to 0.7 for this period. This increase reflects the fragmentation of the class of lands and the creation of new human areas during this time period. Also, in the class of non- made lands, the density of patch from 0.03 to 34.0 has increased in the given time frame. This is due to the change in land use not made during this period, and it is confirmed that this is indicative of the fragmentation, the reduction of continuity, the complexity and the more unevenness of the region during the time of the study due to human user competitiveness with these uses. The bulk density analysis in level in Table 2 shows that the expansion of urbanization and the increase in built-in use, the development of activities and user-driven changes caused the non-made land degradation in the same years to decline, and since 1998 there are more differences than in previous years which has caused more fragmentation than other years, which should provide less damage through proper management changes and the proper use of land-view in this area. . Figure 3. Pattern of patch density at the class level during the studied period.

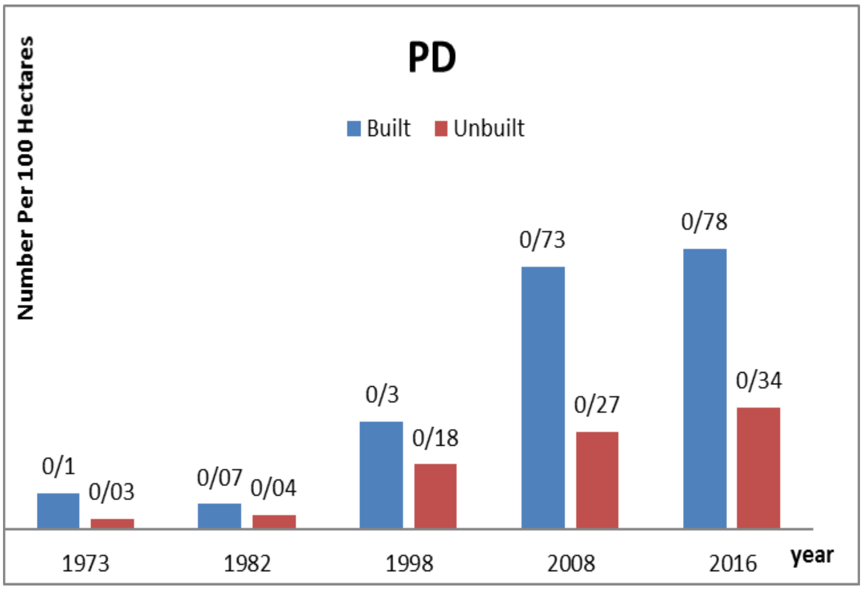

Figure 3. Pattern of patch density at the class level during the studied period

Metric / Year	CONTAG
1973	94.25
1982	90.86
1998	82.96
2008	75
2016	70.11

Table 3. The results of calculation of continuity gauge at land surface level in the study period

The measurement contagion of landform is expressed as percentage. This index is a general criterion of the heterogeneity of terrain and shows the disruption of terrain and in fact represents the extent of destruction in the landform. The results of this study in Figure 4 indicate a decrease of 24% from 94.25 to 70.11 in this area during these years, which in during period from 1982 to 1998 was around 16%, indicating a widespread decline in integration and increased fragmentation in land view.

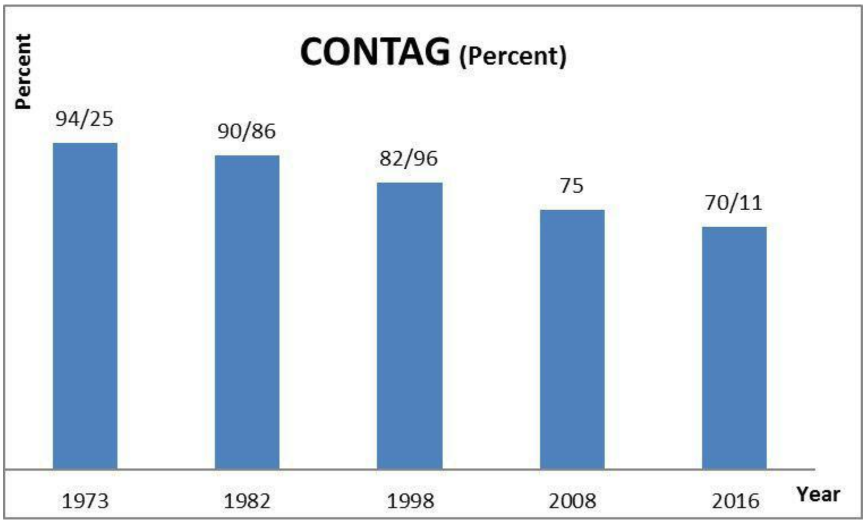

Figure 4. Land plot continuity chart on the surface of the land plot during the studied period

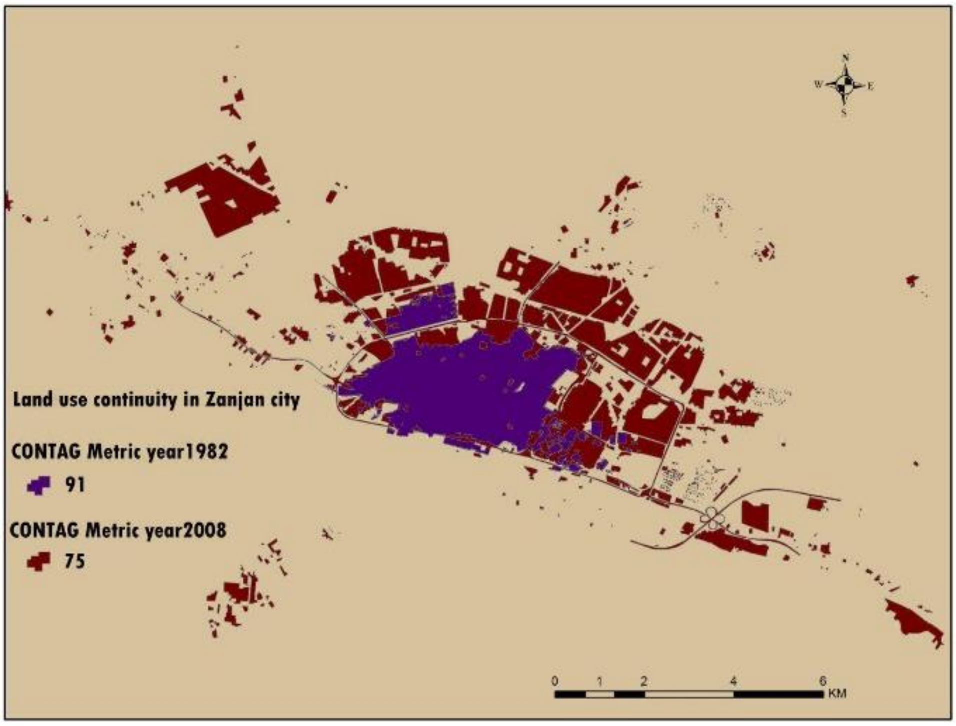

Figure 5. Disturbance of user continuty in Zanjan between 82 and 98 years

6. RESULTS

The determination of the use showed that since the 1980s, different uses have been made in the region, and since the 1990s till now it has grown to a large extent inappropriately so that, in line with the increasing population, the built levels have also been expanded to in a way that the shape of the city in the 1970s and 1980s, from the central to linear state of the 90s and the more severe in the 2000s and 2010s, was extended to the eastern and western directions of communication, which developed in the context of biodiversity degradation. For example, human use has been expanding, including residential settlements, in a very heterogeneous and inappropriate way in the northern, eastern, and north-eastern parts of Zanjan. Also, by using the land surface and class level measurements, it is stated that, in general, the shape of a fragmented land is more complex and irregular in terms of the degree of integrity of the structural elements, the more discontinuous, and has become more diversified in terms of the type of coverage available in the level unit.

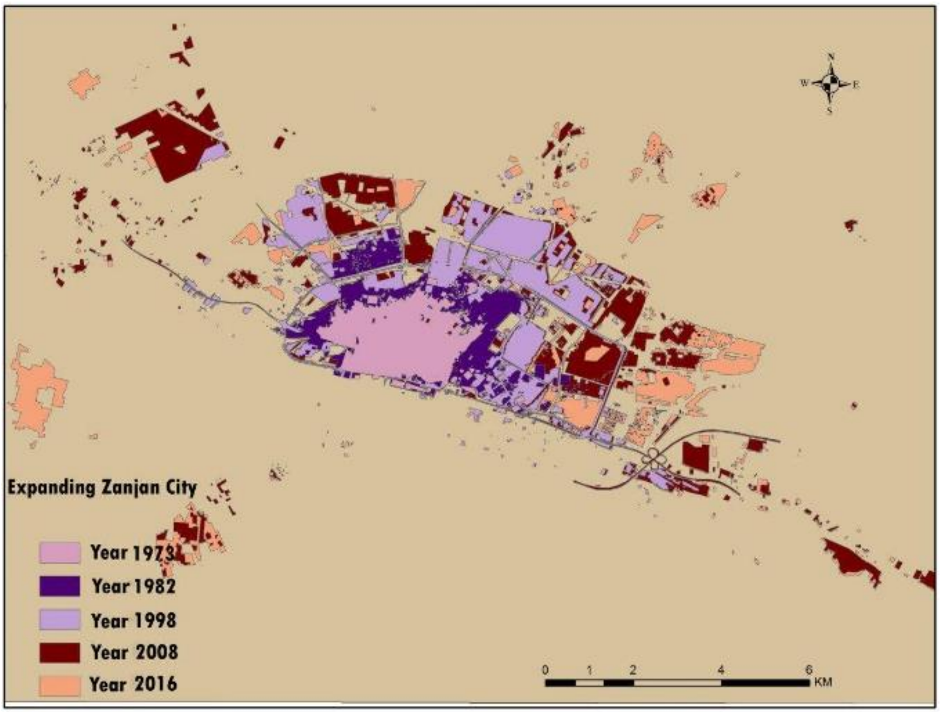

Figure 6. Extension of the city of Zanjan during the study period

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TRACING TEMPORAL CHANGES WITH GOOGLE EARTH ENGINE: A CASE STUDY FROM LAKE ULUABAT, SOUTHERN MARMARA REGION, TURKEY

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ABSTRACT:

With the developments in technology, remote sensing and geographic information systems methods have become standard approaches frequently used in various disciplines ranging from geosciences, medical imaging studies, engineering applications to sociological researches. This widespread use of methods leads to more visual processing, more data generation and storage. In particular, the need to use multiple image frames for a time interval in the course of monitoring temporal changes in large-scale areas, and the implementation of many processes, makes these methods cumbersome nowadays with the greatest advantages of saving time and cost. 'Google Earth Engine' (GEE) is a remote sensing and spatial data information system developed by Google to meet this demand worldwide. This system, which is used as an online system, enables to reach all the images and to process them on the day when they start their activities of many different platforms such as Landsat, Sentinel and MODIS. In this study, areal changes of Lake Uluabat, which is located in the southern Marmara region in Turkey, were monitored via Google Earth Engine and discussed the benefits of the program. Between 1985 and 2010, the lake was monitored using Landsat 5TM images and the rate of shrinkage in the lake area was calculated by NDVI (normalized difference vegetation index) and NDWI (normalized difference water index) methods. On the other hand, a time series was created using all the cloudless Landsat 5 TM images for the same periods in GEE and the lake area changes in the study area was plotted. When all the results are compared, it is clear that using GEE, a much larger number of images are processed in a more practical and results have higher detail.

KEY WORDS: Google Earth Engine, NDVI, NDWI, areal change detection, Lake Uluabat

1. INTRODUCTION

Using remote sensing methods in different disciplines saves both time and human effort. Earth observations from satellites, which began in 1972 with the Landsat 1, have progressed rapidly along with the developments in technology. Over the years, the increase in the number of Earth observation satellites, the use of newer and more advanced sensors together with each new satellite, and the provision of images of these sensors free of charge have increased the intensity of these studies. Coupled with the improvements in sensors, the size of the data obtained also increases, thus both the process of supplying and processing data, especially in large field studies are extending. This reduces the speed and gain that can be achieved when using remote sensing methods.

In recent years, many open source software applications have been introduced to increase the number of users as well as the commercial softwares that are routinely used by remote sensing and GIS employees. Google Earth Engine (GEE) is a fast data provider, manufacturer, analyst and publisher platform that is added to this area in this direction and move ahead of the other programs (e.g., Gorelick et al., 2017). In this study, areal change detection of one of the Turkey's most important wetlands, Lake Uluabat, between 1985 and 2010 using Landsat 5 TM time series on the GEE platform analysed and the results were compared with the findings of the classical remote sensing approach.

1.1 Study Area

The study area, Lake Uluabat is located in the northwest of Anatolia, in the southern Marmara region, where a large portion of the population of Turkey live (Fig. 1). Because the lake is an important fresh water source for the region and it is located on bird migration routes, Lake Uluabat is a valuable ecological area. Due to these features, the lake was protected by the RAMSAR contract in 1998, so it is important to follow the physical and chemical changes continuously, in order to ensure the sustainability of the lake.

Figure 1. Location of map the studied Lake Uluabat.

2. MATERIAL AND METHODS

A time series analysis has been performed on Google Earth Engine to examine the long term watermass changes of Lake Uluabat in a practical manner and to scrutinise the consistency of the results obtained with classical remote sensing approach. Google Earth Engine analyses petabyte size satellite imagery and geographical data sets on a planetary scale and allows users to detect changes and measure discrepancies (Gorelick et al., 2017). The platform has two basic features. The first one is the database exceeding 5 petabytes. In the database, satellite images of

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different satellite sensors (e.g., MODIS, Landsat etc.) and local and regional scale geospatial data are available for all users. It is possible to access free of charge these data, which are constantly updated, and to process directly without downloading.

The second fundamental feature of the platform is the ability to write algorithm to be used according to the process will be performed. In this way, the desired flexibility can be achieved without the transaction restrictions in a package software (e.g. Gorelick et al., 2017).

In this study, time series which is one of the most important advantages that the GEE platform provides to the user is used. The Landsat 5 TM time series between 1985 and 2010 was chosen to understand the wetland's areal changes in the study area. There are 363 cloudless images in the entire image that the sensor has captured in this time range.

Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI), which are frequently used in land cover classification studies, were applied to the images with an algorithm (Jackson et., al., 2004, Gu et al., 2007). In the Normalized Difference Vegetation Index (NDVI) application, the vegetation coverage is measured by calculating the difference between the near infrared (a high reflection and red wavelength), which is highly absorbed by vegetation cover (örn., Nemani and Running, 1988).

$$NDVI = \frac{\text{NIR}-\text{RED}}{\text{NIR}+\text{RED}} \qquad (1)$$

NDVI ranges from -1 to 1. The NDVI value is close to + 1, indicating dense green vegetation.

In the NDWI application, while the water reflectance is maximized by using the green wavelength, the low reflection of the near infrared is minimized. As a result, the water mass is positive because it is enriched, while the soil and vegetation is negative or 0 (e.g., McFeeters, 1996).

$$NDWI = \frac{\text{Green}-\text{NIR}}{\text{Green}+\text{NIR}} \qquad (2)$$

Long term changes in the NDWI and NDVI values in the lake and surrounding area, which were uniquely determined, were plotted by using the time series images (Fig. 1b).

After the indexes have been applied, to understood the wetlands over the images more clearly, the wetlands have been masked and separated from waterless areas.

On the other hand, images of the same period of the year between 1985 and 2010 were determined and the lake surface areas were measured and plotted in these images (Table 1), as well as many of the classical remote sensing studies for the purpose of change detection analysis.

Table 1. Landsat 5 TM images ID of the study area used between 1985-2010

	Date	*Scene ID*
1	1985/05/14	LT05_L1TP_180032_19850514_20171212_01_T1
2	1986/05/17	LT05_L1TP_180032_19860517_20170217_01_T1
3	1987/05/20	LT05_L1TP_180032_19870520_20170212_01_T1
4	1988/07/09	LT05_L1TP_180032_19880709_20170613_01_T1
5	1989/06/26	LT05_L1TP_180032_19890626_20180210_01_T1
6	1990/05/12	LT05_L1TP_180032_19900512_20170717_01_T1
7	1991/06/16	LT05_L1TP_180032_19910616_20170908_01_T1
8	1992/05/01	LT05_L1TP_180032_19920501_20180210_01_T1
9	1993/06/21	LT05_L1TP_180032_19930621_20180210_01_T1
10	1994/05/23	LT05_L1TP_180032_19940523_20180210_01_T1
11	1995/05/26	LT05_L1TP_180032_19950526_20180210_01_T1
12	1996/06/13	LT05_L1TP_180032_19960613_20180210_01_T1
13	1997/07/18	LT05_L1TP_180032_19970718_20180210_01_T1
14	1998/04/16	LT05_L1TP_180032_19980416_20180210_01_T1
15	1999/05/21	LT05_L1TP_180032_19990521_20180210_01_T1
16	2000/05/07	LT05_L1TP_180032_20000507_20171210_01_T1
17	2001/06/11	LT05_L1TP_180032_20010611_20180311_01_T1
18	2002/07/16	LT05_L1TP_180032_20020716_20180616_01_T1
19	2003/07/03	LT05_L1TP_180032_20030703_20161205_01_T1
20	2004/07/05	LT05_L1TP_180032_20040705_20180310_01_T1
21	2005/06/06	LT05_L1TP_180032_20050606_20180126_01_T1
22	2006/04/22	LT05_L1GS_180032_20060422_20180310_01_T2
23	2007/05/11	LT05_L1TP_180032_20070511_20180117_01_T1
24	2008/05/13	LT05_L1TP_180032_20080513_20180127_01_T1
25	2009/06/17	LT05_L1TP_180032_20090617_20161025_01_T1
26	2010/05/03	LT05_L1TP_180032_20100503_20180302_01_T1

3. RESULTS AND DISCUSSION

Under favour of the extensive database provided by the Google Earth Engine platform, between 1985 and 2010, 363 satellite images of the study area were quickly analysed using the written algorithm without downloading any images, and the NDVI and NDWI were plotted for the period (Fig. 2, Fig. 3).

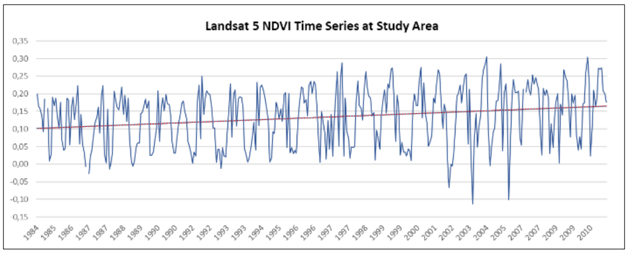

Figure 2. NDVI time series of the study area between 1985-2010.

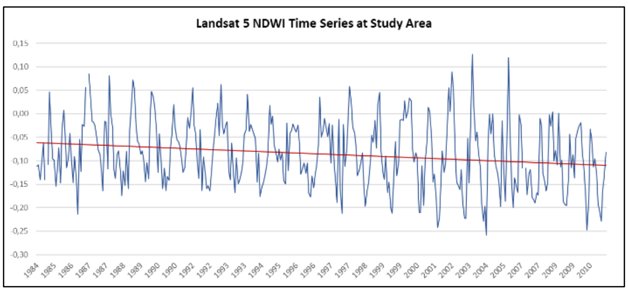

Figure 3. NDWI time series of the study area between 1985-2010

Although the NDVI and NDWI values represent irregular increase and decrease over the years, the NDVI values show a general increase and the NDWI values show a general decrease trend. The calculations using the .shp files prepared from the images show that the mean lake surface area is 126.114 km^2 (Fig. 4, Fig. 5). Largest lake area was calculated as 158.056 km^2 during the studied period (the calculated image coincided with a period of high rainfall term in the region). Long term measurements indicate that the lake area varies between 105 and 160 km^2 and is generally in a decreasing (shrinking) trend.

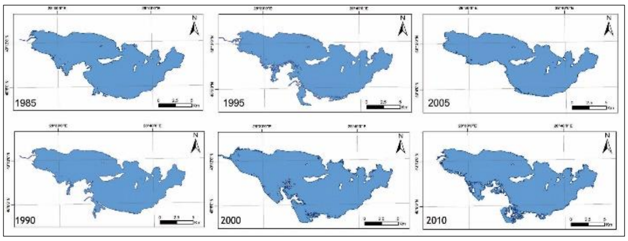

Fig 4: Lake Uluabat surface area change for the years 1985, 1990, 1995, 2000, 2005 and 2010.

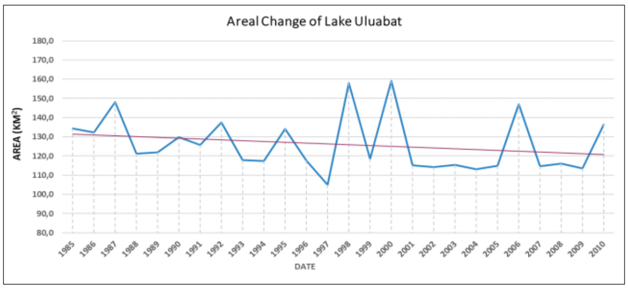

Fig 5: Areal changesof Lake Uluabat between 1985-2010.

4. CONCLUSIONS

In the study area, the graphs of the areal measurements calculated from the images taken for the same period of the year between 1985-2010 and the change curves of the NDWI graph prepared using Google Earth Engine are compatible with each other. This shows that using GEE is more practical and highly detailed to graph using the necessary algorithms for image series (for a long period), instead of provide and calculate fewer images using classical methods. This indicates that Earth Engine can be used easily for Earth resources management.

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ASSESSMENT OF FLOOD POTENTIALS OF RIVER BASINS IN SW TURKEY USING HYDROMORPHOMETRIC INDICES

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ABSTRACT:

The flood potentials of the Namnam, Dalaman and Eşen river drainage basins located in southwest Anatolia and reaching to the Mediterranean Sea have been evaluated using hydromorphometric approach. Digital elevation models (DEMs) obtained from ASTER GDEM and SRTM data were used for the implementation of these methods, and index calculations were performed in Geographic Information Systems (GIS). The studied drainage basins cover an area of approximately 8600 km^2 in southwest Turkey within the provinces of Muğla, Denizli, Burdur and Antalya. According to the meteorological data, mean precipitation values are as 80.6 mm/m^2 for the Dalaman river basin, 89.7 mm/m^2 for the Namnam stream drainage basin and 68 mm/m^2 for the Eşen river basin. In spite of these rates, it is known that the region has been flooded with intense floods in the past and today. The most important feature of this region in terms of socioeconomics is the importance of tourism and agriculture. For these reasons it is necessary to assess the flood and deluge potential of the region. As a result of the hydromorphometric analyses we conducted within the scope of the study, it was evaluated that the flood risk was relatively high for the Namnam stream drainage basin because the values were lower than the mean bifurcation rates in the 4th and 6th grade streams according to the Strahler classification. While this risk is seen in the 4th grade streams for the Eşen river basin, was found in the 6th and 7th grade streams for the the Dalaman river drainage basin. However, the existing four dams constructed on the Dalaman river control the streamflow. In addition, we suggested the risk of flooding in the upper part of the Dalaman river basin decreases due to relatively low amount of precipitation. Roughness, length and circularity ratios and hypsometric integral values calculated for basins also supported these results. As a result, when geologic, climatologic and hydromorphometric data are evaluated together; the decrease in precipitation in the upper parts of the Dalaman river drainage basin and the dams built on the river reduce the flood risk. The Eşen river basin is more suitable for torrents than floods due to the high relief rate on the main stream channel. It can be said that the Namnam stream basin has relatively high potential flood risk within the scope of hydromorphometric analyses.

KEY WORDS: Hydromorphometry, southwest Anatolia, fluvial geomorphology, Geographic Information Systems

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1. INTRODUCTION

The Namnam (Lake Köyceğiz), Dalaman and Eşen river basins, which has a total area of ~ 8600 km², is located within the borders of Muğla, Denizli, Burdur and Antalya provinces of Turkey. While the Dalaman river is the longest river in of southwestern Anatolia with its approximate length of 185 km, the Eşen river is ~ 65 km long, and the Namnam stream has a length of ~ 50 km (Figure 1).

There are 4 hydroelectric power plant (HEPP) on the Dalaman river, there are also 10 reservoirs in total on the substreams of the river, including 2 HEPPs and 4 irrigation dams. There are 2 HEPPs on the Eşen river and 3 HEPPs on the streams flowing to Lake (MAM, 2013). The main income source for the mentioned provinces in the river basins is agriculture. A total of 1134 decare area within the boundaries of the river basins is agricultural land. According to the meteorological data, the total annual precipitation ratio for the drainage basins is approximately 238 mm/m². The months with maximum precipitation are January, February and December (MAM, 2013). This makes it important to evaluate the flood and flood potentials of the basins.

Within the scope of the study, the hydromorphometric characteristics were calculated to determine the flood potentials of the three river basins. The drainage characteristics of the river basins prepared with Geographical Information Systems (GIS) were calculated by applying the most preferred hydromorphometric indices. The results obtained were used to determine the flood potentials of the river basins, taking into account the geological characteristics of the region.

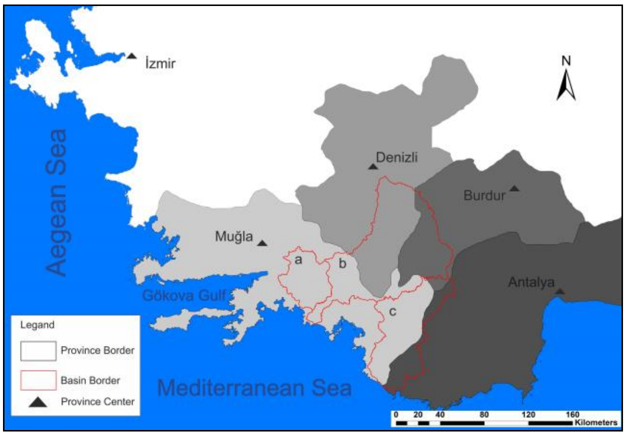

Figure 1. Location map of the studies three river basins in southwestern Turkey. a - Namnam stream basin, b - Dalaman river basin, c - Eşen river basin.

2. GEOLOGICAL SETTING

The geological units in southwestern Turkey are composed of allochthonous and autochthon units. The autochthon units in the region are represented by the Cenomanian-Langian Beydağları autochthon, while the allochthonous units are known as the Upper Lutetian-Lower Burdigalian Muğla (Lycian) Nappes. Between the Muğla Nappes and the Beydağları autochthon, which appears as tectonic windows, there is the Upper Lutetian-Priabonian Yeşilbarak Nappe, which is defined as an intermediate zone (e.g., Şenel, 1997). In the study area, lithologies are majorly represented by limestones and ophiolitic melange (e.g., Pamir, 1964). The Namnam, Dalaman and Eşen basins which developed during the Quaternary period represent an alluvial plain filled with the materials carried by the Namnam, Dalaman and Eşen rivers, respectively (Figure 2).

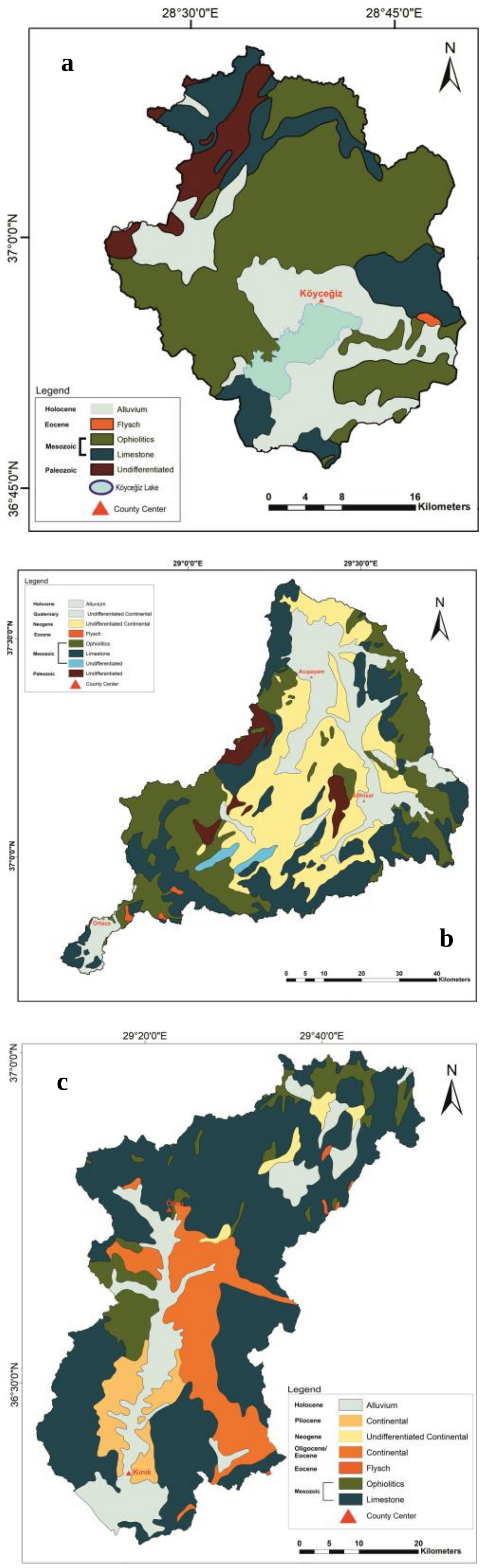

Figure 2. Geological maps of the (a) Namnam, (b) Dalaman and (c) Eşen river basins (modified from MTA, 2002).

3. METHODS

The 30 m resolution Shuttle Radar Topography Mission (SRTM) data obtained from the United States Geological Survey (USGS) database was used to determine the drainage network of the Namnam, Dalaman and the Eşen river basins. The Digital Elevation Model (DEM) required for hydromorphometric index calculations was processed with the ArcHydro module in the ArcGIS 10.5 program by making the necessary improvements (Figure 3). The hydromorphometric properties of the drainage basins are evaluated under three titles: linear, areal and relief characteristics. Analyzes made and the interpretations of findings are mainly based on Horton (1932, 1945), Strahler (1952, 1964), Schumm (1956), Melton (1957), Carlston (1963), Patton and Baker (1976), Zimpfer (1982), Scheidegger (1987) and Ritter et al. (2002).

4. RESULTS

The average bifurcation rates of the basins were estimated to be between 4.17 and 4.68. In general, the geology of the drainage basins with a bifurcation value between 3 and 5 consists of homogeneous units (Table 1) (Figure 4) (Ritter et al., 2002). The values are relatively high and indicate the presence of low and broad peak flows that reduce the flooding risk. However, for the Namnam stream basin, the fact that the bifurcation values in the 4^{th} and 6^{th} grade tributaries and the 6th and 7th grade tributaries for the Dalaman river basin are lower than the average bifurcation values indicates the flood risk in these tributaries (Strahler, 1964). In the Eşen river basin, the risk of flooding is low because the bifurcation ratio of the tributaries is close to the average bifurcation ratio.

When the average stream length values are taken into consideration, it is seen that the Dalaman and Eşen river basins are very close. The Namnam stream basin is as high as 2.44. However, when the river length ratios are evaluated for the tributaries of each grade, the values in the 6^{th} and 7^{th} branches of the Dalaman river basin and the 4^{th} and 6th branches of the Namnam stream basin are below the average value. This shows that the water from the previous grades is quickly transferred to the next one without being trapped. Furthermore, a high value of average stream length ratio indicates a circular basin shape. Texture ratio of the Dalaman river basin is calculated as 7.39. The values of the other drainage basins are close together. The high textural value indicates that there are more branches in the 1st grade that flow to the main stream (Özdemir, 2011).

The drainage densities of the drainage basins were calculated between 1.08 - 1.28. This is due to the presence of relatively permeable units and the vegetation density. The values of the drainage density indicate that there is a rapid surface flow. According to the rates of circularity, the Namnam stream basin has a more circular shape than other basins with a value of 0.39. The basin length ratio and the form factor ratio represent a circular shape for the Namnam stream basin, while the Dalaman and Eşen river drainage basins represent longitudinal value. On the other hand, the lower density of drainage and the basin length ratio in the Eşen river basin indicate that the permeability is higher. The basin length ratio, form factor ratio and drainage density are low; the higher the bifurcation rate, the lower the flooding risk. In the Dalaman river basin, high drainage density with lower bifurcation rate than the Eşen river basin indicate that flood risk is higher than the Eşen river drainage basin. High form factor and basin length ratios of the Namnam stream basin

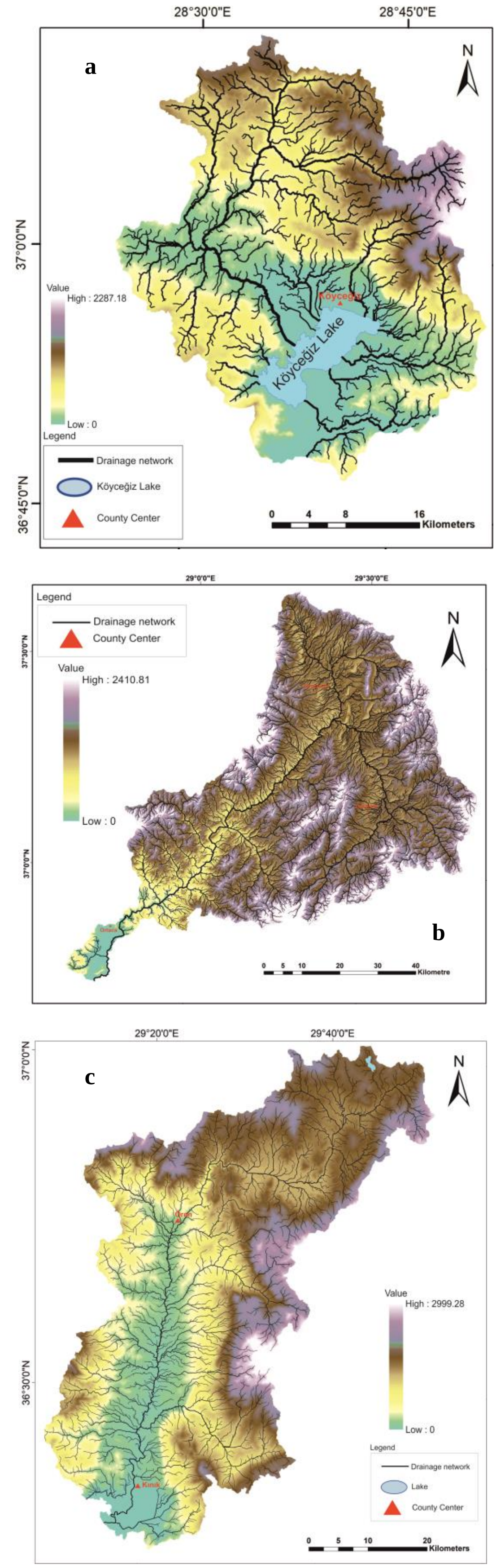

Figure 3. Physiographic images of the studied three river drainage basinsin SW Turkey, the (a) Namnam, (b) Dalaman and (c) Eşen river basins, respectively.

represent values that increase flood risk. The roughness rate of the Eşen river basin has a high value of 3.54. Patton and Baker (1976) suggest that high roughness rate was seen in basins with flood potential. According to this parameter, the flood potential of the Eşen and Dalaman river drainage basins is higher than the Namnam stream basin (Figure 5).

The drainage densities of the drainage basins were calculated between 1.08 - 1.28. This is due to the presence of relatively permeable units and the vegetation density. The values of the drainage density indicate that there is a rapid surface flow. According to the rates of circularity, the Namnam stream basin has a more circular shape than other basins with a value of 0.39. The basin length ratio and the form factor ratio represent a circular shape for the Namnam stream basin, while the Dalaman and Eşen river drainage basins represent longitudinal value. On the other hand, the lower density of drainage and the basin length ratio in the Eşen river basin indicate that the permeability is higher. The basin length ratio, form factor ratio and drainage density are low; the higher the bifurcation rate, the lower the flooding risk. In the Dalaman river basin, high drainage density with lower bifurcation rate than the Eşen river basin indicate that flood risk is higher than the Eşen river drainage basin. High form factor and basin length ratios of the Namnam stream basin represent values that increase flood risk. The roughness rate of the Eşen river basin has a high value of 3.54. Patton and Baker (1976) suggest that high roughness rate was seen in basins with flood potential. According to this parameter, the flood potential of the Eşen and Dalaman river drainage basins is higher than the Namnam stream basin (Figure 5).

5. CONCLUSIONS

Considering the hydromorphometric indices, it is seen that the Namnam stream basin is close to the maturity stage. The Dalaman and Eşen river basins are morphometrically younger than the Namnam stream basin. The results show that the basins have a partially homogeneous geology. Geological units in the Eşen river basin are seen to be more permeable than other basins. Dense vegetation and erosion activities in the drainage basins are the factors that control the development of the drainage network. In addition, the fact that the units have many fault and joint systems as the products of the tectonic phases are also important factors determining the drainage networks in the region. The results of hydromorphometric measurements of the Dalaman River Basin indicate that it has a flood potential. However, many dams on the Dalaman river are reducing this risk. The results of the rivers located in the Namnam stream basin show predominantly flood character. The Eşen river basin is more overflow-dominated. However, the dams on the main stream are thought to have an effect in reducing this risk.

ACKNOWLEDGEMENTS

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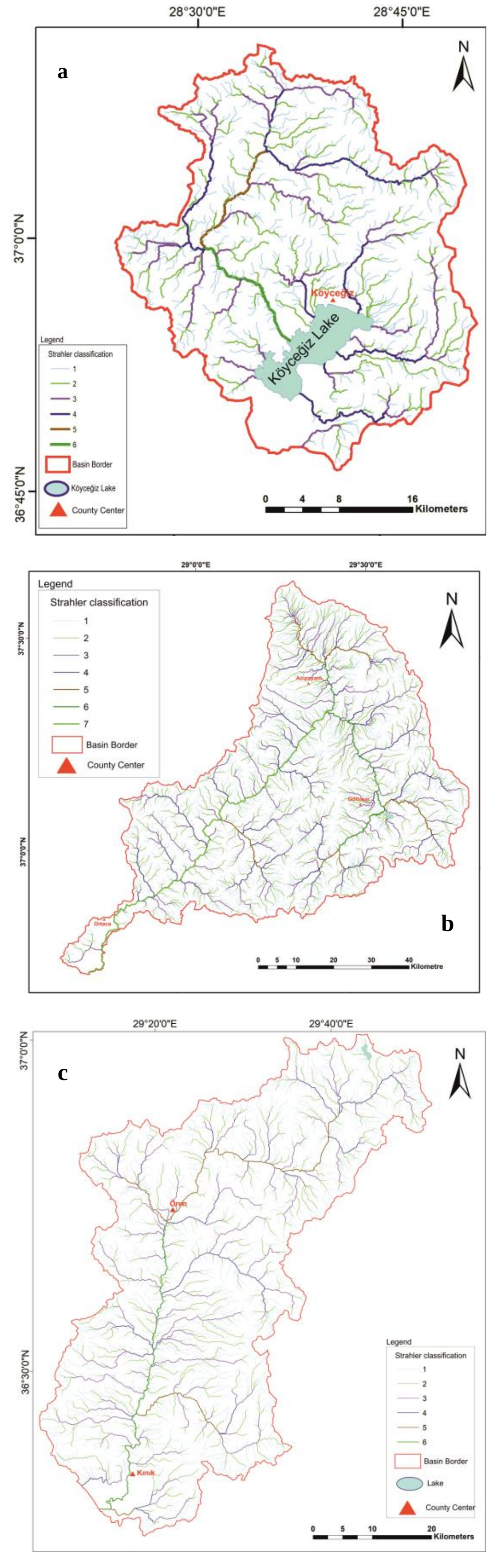

Figure 4. Fluvial network of the (a) Namnam, (b) Dalaman and (c) Eşen river basins.

Basin Lineament Characteristics						
Morphometric parameters	**Formula**	**Namnam**	**Dalaman**	**Eşen**	**Unit**	**Reference**
Stream grade	Hierarchically	1 to 6	1 to 7	1 to 6		Strahler (1964)
1. grade stream (Suf)	Suf=N1	684	3529	1796	number	Strahler (1952)
Stream number (Nu)	Nu=N1+N2+…Nn	882	4523	2317	number	Horton (1945)
Stream length (Lu)	Lu=L1+L2+…Ln	1201.68	6268.15	3159.74	km	Horton (1945)
Bifurcation ratio(Rb)	Rb=Nu/Nu+1	1 - 4.58	2 - 6.666	3.62 - 6		Horton (1932)
Mean bifurcation ratio (Rbm)	Rbm=(Rb1+Rb2+…Rbn)/n	4.68	4.17	4.54		Strahler (1964)
Main stream length	CBS	16.5	121.75	70	km	
Mean stream length ratio (Lur)	Lur=Lu/Lu+1	2.44	1.95	1.94		Horton (1945)
Mean stream ratio (Lum)	Lum=Lu/Nu	1.36	1.38	1.36		Horton (1945)
Basin Geometric and Texture Characteristics						
Basin length	CBS	40	120	89	km	
Basin area	CBS	1109	4880.37	2676	km2	
Basin perimeter length	CBS	188	477.58	371.58	km	
Relative perimeter length (Pr)	Pr=A/P	5.89	10.21	7.2	km	Schumm (1956)
Form factor ratio (Ff)	Ff=A/Lb²	0.69	0.34	0.33		Horton (1945)
Basin length ratio (Re)	Re=2/Lb*?(A/π)	0.93	0.65	0.65		Schumm (1956)
Texture ratio (Rt)	Rt=N1/P	3.65	7.39	4.83		Schumm (1956)
Circularity ratio (Rc)	Rc=12.57*(A/P²)	0.39	0.27	0.24		Strahler (1964)
Circularity amount (ration) (Rcn)	Rcn=A/P	5.89	10.21	7.2		Strahler (1953)
Circularity texture (Dt)	Dt=Nu/P	4.69	9.47	6.23		Horton (1945)
Drainage density (Dd)	Dd=Lu/A	1.08	1.28	1.18		Horton (1945)
Surface flow length (Lo)	Lo=(1/Dd)*0.5	0.46	0.39	0.42		Horton (1945)
Stream frequency (Fs)	Fs=Nu/A	0.79	0.92	0.86		Horton (1932)
Channel aspect (C)	C=1/Dd	0.92	0.77	0.84		Schumm (1956)
Basin Relief Characteristics						
Basin mouth height	CBS	0	0	0	m	
Maximum basin height (absolute relief)	CBS	2287	2411	2999.2	m	
Total basin relief (H)	H=Z-z	2287	2411	2999.2	m	Strahler (1952)
Relief ratio (Rhl)	Rhl=H/Lb	0.05	0.02	0.03		Schumm (1956)
Relative relief (Rhp)	Rhp=H*100/P	1.21	0.5	0.8		Melton (1957)
Roughness value (Rn)	Rn=H*Lb	2.47	3.09	3.54		Melton (1957)
Hypsometric integral (Hi)	Hi=(Zort-z)/(Z-z)	0.21	0.48	0.34		Scheidegger (1987)

Table 1. Hydromorphometric indices applied to the Namnam, Dalaman and the Eşen river basins and their results.

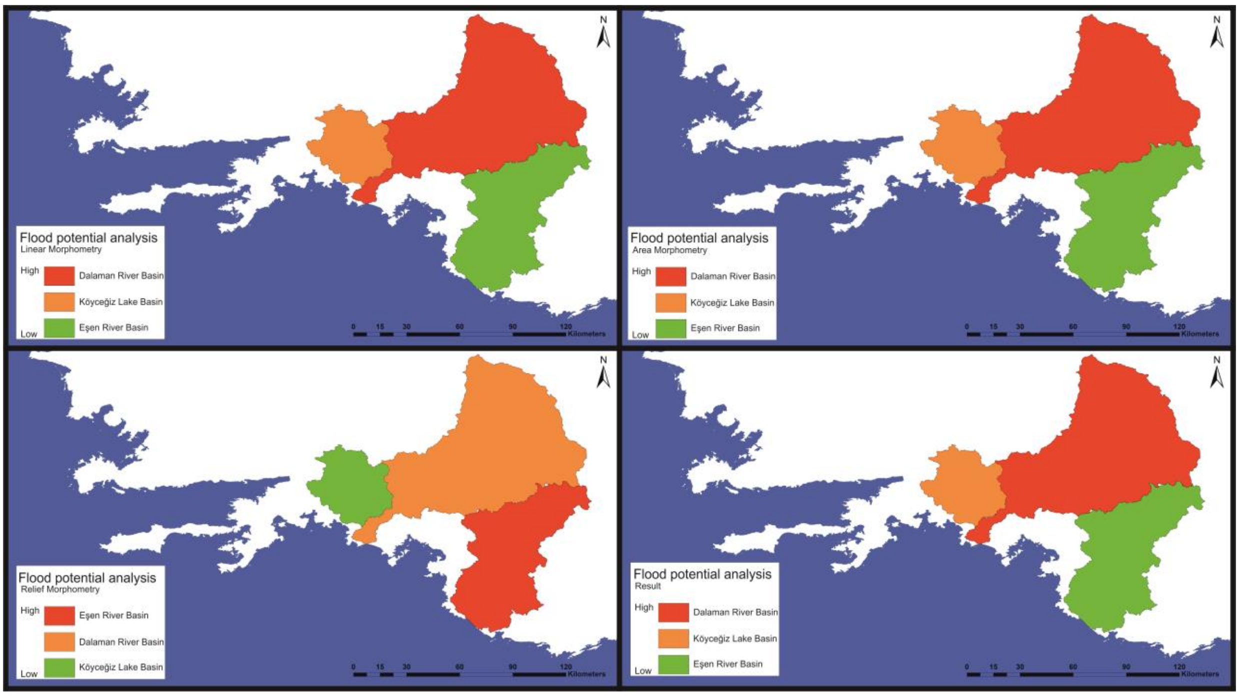

Figure 5. Flood potentials of the three river basins in southwestern Turkey according to the different hydromorphometric analyses.

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A MULTI-CRITERIA DECISION MAKING APPROACH TO PLAN A PATH FOR OIL PIPE LINE IN GEOGRAPHICAL SPACE

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ABSTRACT:

The path of pipe lines used to conduct the energy containers such as oil, is under technical and financial effects as well as the environmental adaptability considerations. The numerous criteria from such considerations make researchers handle a comprehensive system like GIS to contribute all of them. In this paper Fuzzy Analytical Hierarch Process in accordance with spatial analyses in GIS is exploited for planning an optimum path for a 12 inches oil pipe line from Shirgah to Sabzab in Khuzestan province in Iran. The applied approach handles and aggregates the opinions of experts as well as the different data types in a geographical space. The weighted spatial layers from technical to environmental criteria are overlaid and resulted to an appropriate corridor for laying down the oil pipeline. To discuss on appropriateness of results, some different scenarios are compared. The results showed that choosing the best route between the Darre-Rig to the Sabzab by combining the FAHP method and GIS have resulted in 941 meters reduction from the route through the economic scenario, reducing 635 m from the route through the environmental scenario and a reduction of 586 meters from the route through a comprehensive scenario.

KEY WORDS: GIS, MCDM, Pipe Line, Iran

1. Introduction

The use of pipelines in order to transfer oil and gas and improvement of their distribution on long routes is inevitable [1]. These lines are efficient, affordable and environment friendly tools for carrying such liquids and gases [2]. Pipeline routing is considered an issue of high importance in which proper designing is a necessity to maximize its yielding benefits, and with proper scientific planning, it is possible to save time and operational costs which assures that the selected route has the least destructive life in the environment [2]. The inefficient conventional methods of pipeline routing are mainly based on money and time consuming applications that are not qualified to meet the appropriate criteria for pipeline design using paper maps [2]. On this foundation, the most important disadvantages of traditional routing can be considered as:

• Lack of proper structure for data management
• Inaccuracy in defining the parameters
• Not covering all effective criteria
• The opinions of the experts are relative
• Need of a long time
• High cost [3]

Sheikh Kazemi made a routing operation for a rural road in Markazi province in 2000, combining seven parameters which define the risk of earthquakes, erodibility of soils and rocks, land use, ground water resources and protected areas. Using the GIS analysis, it is possible to design the optimal route, which is not necessarily the shortest one [8].

Vulkan et al. (2007) conducted a study entitled pipeline routing using GIS in Turkey. In this paper, Vulkan et al. used a conceptual model for pipeline routing in Turkey. In their research ArcGIS software is used to query and perform all spatial analyzes in the raster data sets. At the end, the results was a brief discussion of the pipeline variables and showed the number of passing roads, parts, pastures, and flow paths. It's paid a lot of attention to reduce the environmental hazards associated with the pipeline [13].

Another studies that he conducted in 2008 in order to find the route between two points in Nigeria were successful. In these researches, using satellite images, field maps were classified into five classes by an unobserved method, and using the DEM, the slope map was prepared and weighted sequentially through the series of analysis process [8].

2. The study area

In this study, the scope of the study is defined on the requirements for the purpose of changing the part of the 12-inch pipeline route to the 12/20-inch transmission system of the Labsefid unit in the city of Dezful and along the passage of this range with an approximate length of 58 km from the Darre Rig to the Sabzab basin with the aim of increasing the safety and continuity of the flow by oil engineering and replacing the description of previous needs (Fig. 1).

Description of the next requirement with the aim of constructing about 58 km of 12-inch pipeline to redirect the 12-inch pipeline from the 12 / 20-inch transmission system of the Labsefid unit to the city of Dezful and along the passage of this boundary between the Darre Rig area and Sabzab has been developed by the Deputy Director of Oil Engineering with an estimated 213 billion Rials to increase the safety and continuity of oil flow, and has been approved at the meeting.

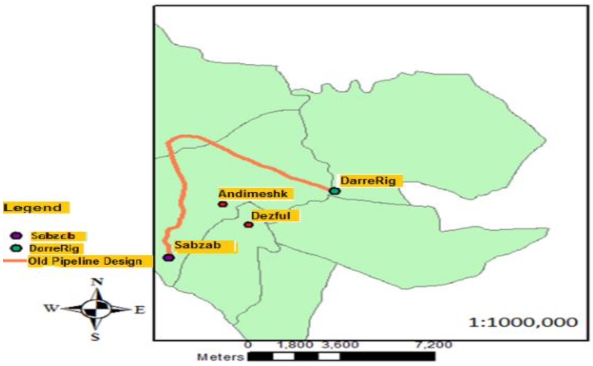


Figure 1: The route designed as an alternative in the traditional procedure

Sabzab area is one of the sub-urban regions of the city Dezful in Khuzestan province, Iran. The city of Dezful has been geographically expanded at 48 degrees and 24 minutes, with a geographic width of 32 degrees and 22 minutes north, which elevates 140 meters to the sea (Fig. 2 and 3).

Figure 2: Dezful city location

Figure 3: Andimeshk Township Location

The Darre Rig is also a village of Andimeshk township, which has longitude in the north at 48 degrees and 22 minutes from the Greenwich Meridian and 32 degrees wide and 29 minutes north of the equator.

Considering the progress of residential and commercial buildings and intersections of 12/20 inches with multiple channels of water and agricultural activities, access to these pipelines and the carrying out of inspection and repair work required high cost due to its old age and bad architecture. There has been founded a significant corrosion on the basis of the investigations carried out by the Technical Inspection and Corrosion Inspection Offices of the National Iranian Oil Fields Corporation, and the pipeline and the results of the Cscan. Therefore, in order to ensure continuity in the production and distribution of crude oil, as well as to ensure the safety and ease of inspection, the construction of a new 12-inch oil pipeline, replacing the Lab Sefid before entering Dezful, in the Darre Rig area and as a transit route from Dezful has been put on the agenda. In The implementation of this project the risk of leakage and firing of the existing pipeline aroused from corrosion and its exposure which puts the city of Dezful and its neighboring residential areas in danger. In accordance with the objectives of Chapter V of the 5th Development Plan in Iran, as well as environmental protection and sustainable development. The imaginative route for the 12-inch pipeline was replaced mainly in the area of Andimeshk from the Darre Rig to the 56.147-kilometer along to Sabzab abstraction facility and was designed to bypass the urban boundaries of Dezful and Andimeshk and from the lands of the southern margin. The environmental-wise protected area CHALPA is located in the north of Andimeshk and the agricultural lands are in the west of Dezful, in the Dezful-Andimashk plain. This new pipeline will cut off the DEZ and the BALAROOD rivers. There are two options for this plan.

Option 1: Construction of a 12-inch pipeline on a new route and replacing the new route with the existing route from the DARRERIG at the beginning of the line before the entry of the existing pipeline into the city of Dezful, to the ending points of the pigment pipeline in the SABZAB with 56,147 km length.

Option 2: No new construction of a line and the continuation of the exploitation of oil produced from the LAB SEFID field using the existing 12.2 "inch pipeline.

Tools used in the research are introduced in table 1.

Table 1. The tools used in the research.

Research Tools	
	Topographical map of NCC 1:25000
Maps	Geological map 1:250000,1:100000
Software	ArcGIS10.3, Microstation, CIVIL3D ، EXCEL
Systems	REFERENCE_DATUM WGS84
	Map projection UTM
	Zone number 39

Research Method

In this research, the procedure of traditional routing of oil lines was first studied. Then, regarding the analysis of the requirements of the oil pipelines, a number of interviews were taken with experts in the oil and gas industry. Weighted measures were taken, and finally the optimal route was selected. In this method, the study area is also limited due to avoiding extra time spending. These steps are summarized as follows (Fig. 4):

• Identify the various criteria affecting the route design process in the target area and the development of the GIS for launching the oil pipeline

• AHP Fuzzy-based approach to obtain expert judgments for weighting the factors affecting the route and choosing the best option (Table 2).

• The use of these weights in the least cost algorithm in the ArcGIS environment to reach an environmentally, economically and comprehensively optimal designing of the route. In fact, using the Short Path function in ArcGIS software, the shortest path between two points is obtained. In order to integrate information, the methods such as index overlap are investigated and selected with different fuzzy operators such as the algebraic multiplication operator, and at the end, a more suitable model that proposes a better path.

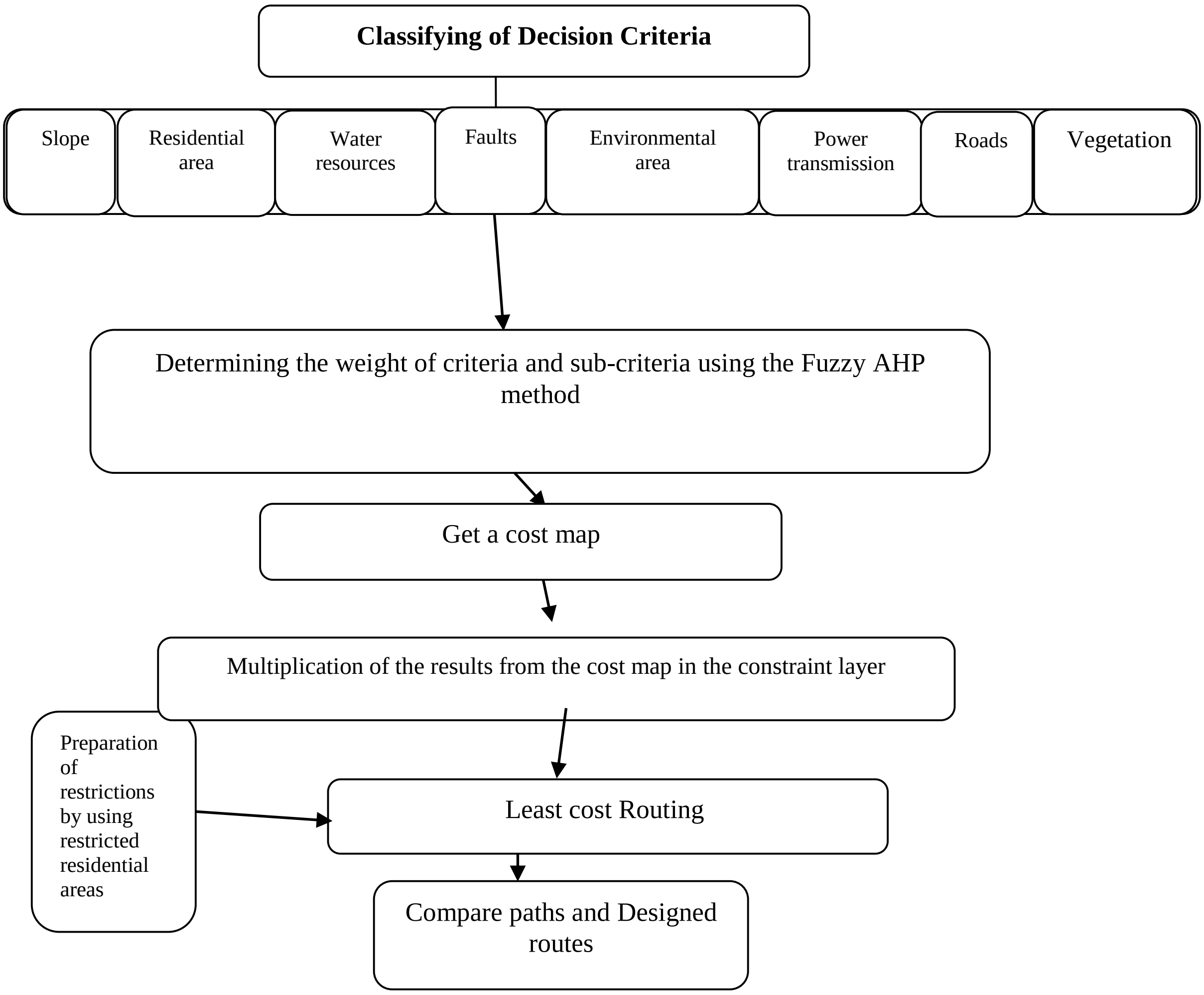


Figure 4: Workflow to conduct the research

Weighting the criteria using fuzzy AHP

In the routing process, a decision-making system is needed to be able to accurately calculate the appropriate route, with consideration of weights assigned to the selected criteria. A study on multi-objective and multi-criteria decision-making methods to compare different methods in this field has been more or less considered by researchers. However, the subject of this research is to determine the appropriate criteria for comparing. With this regard, the criteria for choosing the method include:

- The operational issues of the methods
- The ability to be executed according to user topics
- The ability to be executed on the structure of the problem

There are three methods to calculate weights in the fuzzy AHP method:

1- Chang Development Analysis Method
2. Improved method
3- Fuzzy method MIKHAILO [50, 51]

In 1996 a method called the Development Analysis Method was presented by a Chinese scholar named Chang (Chang, 1992 # 91). The numbers used in this method are triangular fuzzy numbers.

Table 2: Conversion of linguistic words into fuzzy numbers

Fuzzy equivalent of priorities				Prioritys
Up Level	Middle Level	Low Level		
1	1	1	1	Equal importance
3	2	1	2	Equals up to somewhat more
4	3	2	3	Relatively more important
5	4	3	4	Somewhat important, more important
6	5	4	5	Great importance
7	6	5	6	Great importance so much
8	7	6	7	Very important
9	8	7	8	The importance is so much more important
10	9	8	9	Much more important

Calculate the final weight in a fuzzy hierarchy

Assume that the goal is to obtain the weight of cases a and b (Fig. 5) in a fuzzy hierarchy. In this case, we first multiply the weight of each criterion in the weight of each option obtained from a pairwise matrix based on the same criterion. Then all these values are accumulated and the final weight of the option is calculated.

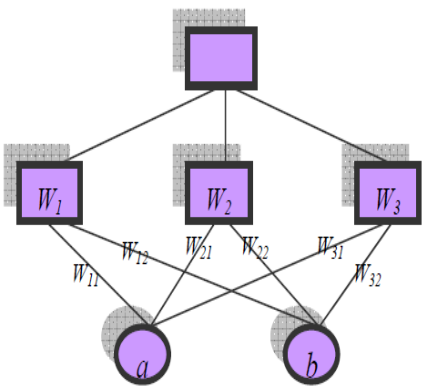


Figure 5: Calculating the final weight in a fuzzy hierarchy

The final weight of options a and b are obtained from the following relationships.

$$W_a = w_1 \times w_{11} + w_2 \times w_{21} + w_3 \times w_{31}$$
$$W_b = w_1 \times w_{12} + w_2 \times w_{22} + w_3 \times w_{32}$$

Calculate the inconsistency rate

A pair comparison matrix is compatible if the condition aik. akj = aij is established for the elements and otherwise the matrix is incompatible [38].

Routing using the least cost algorithm in GIS

Generally, the use of raster or vector data models depends on the needs of spatial analysis.

Spatial Data Model

The raster spatial data model is suitable for the purpose of this research (Fig. 6), considering the appropriate functions and facilities, including the possibility of simpler overlapping operations that are used in combination of different information layers and spatial analysis. So, routing analysis have been done using routing methods of raster-level methods.

Routing in the spatial information systems of the raster

The routing algorithm in the Raster model is similar to the algorithms in the vector model, but moving in the directions in the raster network is not simply a grid, but it may be possibile. In order to find the path with the lowest cost, you first have to move on a cumulative cost level, which represents the cost of resistance to the pass from one cell to another cumulatively. To move on the surface of the cost, the various quantities of cells must be combined. This operation is a bit complicated, but with algebraic operations in the GIS raster analysis, computations will be done easier [55].

GIS software when it is used to calculate the shortest path in raster typed data, at first obtains the level of cost of movement from the source to the destination and gives each cell a cumulative cost. Then, the action is performed on the contrary. From destination to origin, in order to find the least costly route.

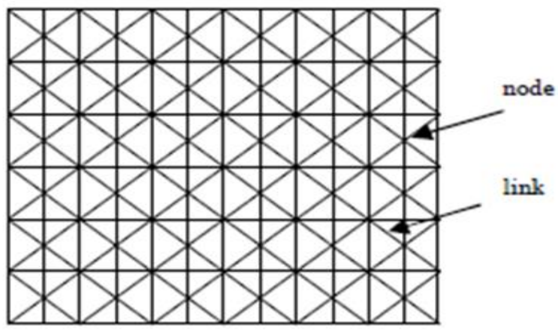


Fig. 6: raster network with nodes and links

Routing on a network level using ARCGIS

The routing algorithm in the Raster model is similar to the algorithms used in vector modeling. But modeling the directions in the lattice networks is not as simply as the vector data. The reasons for the difficulty of moving in the directions of the lattice networks over vector networks are:

1- Networks of nodes and lines in fact represent a graph in which each node can be contacted in 8 directions, and in this model cells represent the shape of the network as an estimate. The cellular network only estimates the exact shape of the lines in the network.

2- The directions are not given as a vector model.

Each edge has a weight or resistance to motion, in which this resistance or charge is extracted from the corresponding cost level of that edge. Of course, it is also important to move. If we move in the four main directions, the cost is equal to the cost of moving from one cell plus the cost of moving the other cell in that area (Fig. 7 and 8).

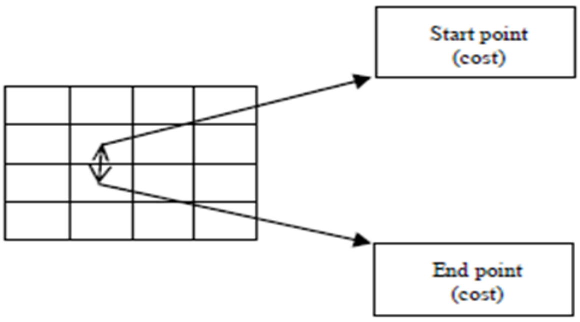


Figure 7: Move in four main directions at the network level

Cost cell 1 and cell cost 2.
Cumulative cost of cell 2 is determined by the following formula.

$$accum-\cos t_2 = (\cos t_1 + \cos t_{2)})$$

$accum-\text{cost}_2$ is the cumulative cost to move from cell 1 to cell 2.
If the diameter is moving, the cost of the movement is equal to the cost of the cell 1, plus the cell 2 will be the radial multiplier 2.

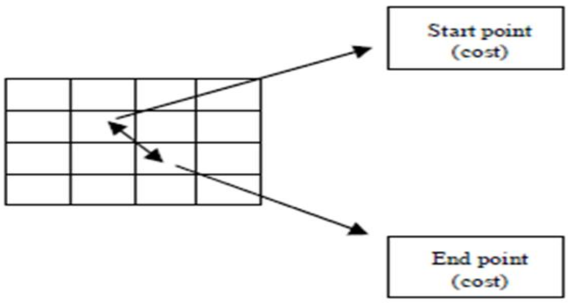


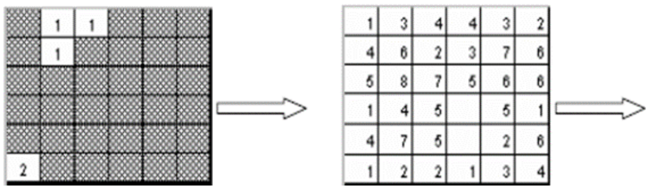
Figure 8: It is a diagonal movement in the grid

Cumulative cost of cell 2 is determined by the following formula.

$$accum-\text{cost}_2 = (\text{cost}_1 + \text{cost}_2) \times \sqrt{2}$$

After we get the cost map, we introduce the source and destination points. As shown in Figure 8, points 1 and 2 are the source and destination points, respectively.

The general formula for calculating cumulative cost using the COST function (Fig. 9):



1.0	0.0	0.0	4.0	7.0	9.0
5.0	6.0	0.0	3.0	10.0	15.0
10.0	11.3	7.0	7.0	11.5	15.2
5.0	9.0	12.0	-1.0	12.8	9.2
4.0	9.0	9.0	-1.0	7.8	13.8
0.0	2.0	4.0	5.0	8.0	12.0

Figure 9: Costing the level

$$accum-\text{cost}_{ij} = accum-\text{cost}_{(i-a)(j-b)} + \sqrt{\alpha^2+\beta^2} \times \text{cost}_{ij}$$

$accum-\text{cost}_{ij}$ is The cumulative cost of movement from the source cell to cell ii.
α, β displays the direction of the path (Fig 10).

$$\begin{cases} \alpha = \pm 1 \ , \ 0 \\ \beta = \pm 1 \ , \ 0 \end{cases}$$

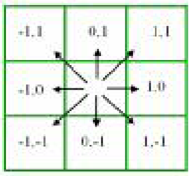
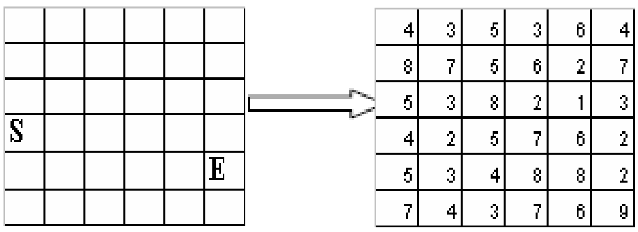


Figure 10: eight-directional directions and values

Creating a cumulative cost level using the cost function is, in fact, an attempt to identify the cell at the lowest cost. This is a repetitive process that starts from the starting point and aims at valuing the cells of surface based on the cost of moving from the start point.
This will continue until all cells are passed (Fig. 11).



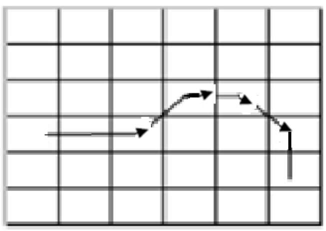


Figure 11: Determine the optimal route

The basis of this step is to determine the optimal route to all points on the cost surface.
In this method, a search function is used, which performs a function based on a special rule of step-by-step direct search operation. To determine the optimal route, the search function performs the following way. Starting from a cell that shows the position of the destination on the cumulative cost level, it starts with neighboring cells with the lowest cumulative expense. This operation is carried out until we reach the reference point [55]. The general trend of the path is indicated in the Figure 11.
In this way, after generating a cumulative cost image, the optimal route from the destination point to the origin point is determined. At each step, the cumulative cost of the neighboring olives (eight adjacent pixels) is considered (Fig. 12).

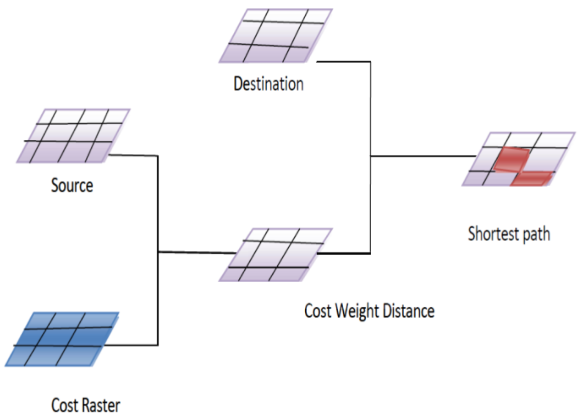


Figure 12: Lowest cumulative cost is chosen as the direction of movement.

$$M_d = \min(NN_{accum\_cost})_{ij}$$

$$\text{Move Direction} = M_d$$

$$\text{Cumulative cost of the first neighbor} = NN_{accum\_cost}$$

Analysis of the raster data
The last step is to find the path that generates the minimum cost of the pipeline route, which is the optimal route.
Implementing levels in the LCPA are as follows [60]:
- Create a discrete cost level that represents relative preferences for routing in any location in the project area.
- Creating an accumulated cost level identifying the optimal connection from a starting location (point, line, level) to all other locations, based on the intervention of relative preferences Identify the path with the lowest tilt of the desired location from the accumulated level.

Implementation of the overlapping index model
This model was implemented in three stages. In the first step, the layers in a class were classified according to their importance. In the second step, the class invoice maps were combined with the weight determined by the AHP method. Output maps are in the range of zero to one, and points with higher values are more appropriate. After this step, we came up with the cost plan. Then we applied the absolute limits that are not allowed to pass through them in the cost plan as a filter, and we allocated a very high cost for it, which does not pass through any of these points (Fig. 13).

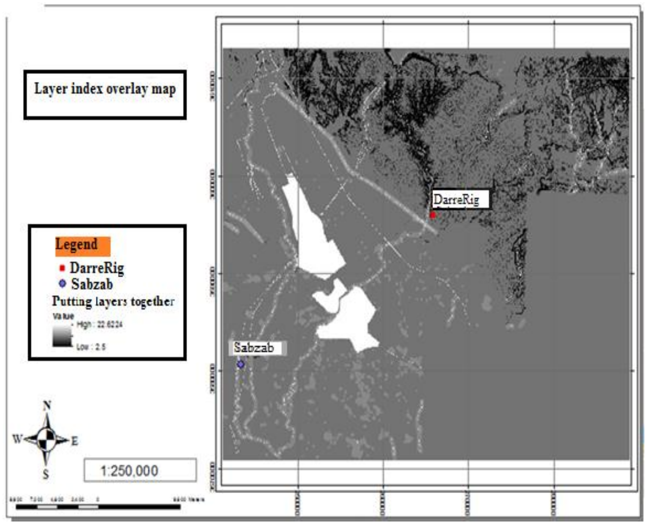


Figure 13: Mapping overlay index of layers

As shown in the figure, points with higher value are more capable. The route created does not interrupt the highway at all, and reaches the destination with the necessary protection of the river and the prohibited areas.
After obtaining the map of the area by applying the absolute limits of the area in question, which is not restricted to the prohibited areas and is not permitted to use them, the map is deleted. Then, by introducing the origin and destination points of the map, using the direction map and the cost, the final cost is obtained (Fig. 14). The cost level is the cost of moving from one cell to another according to the fittest.

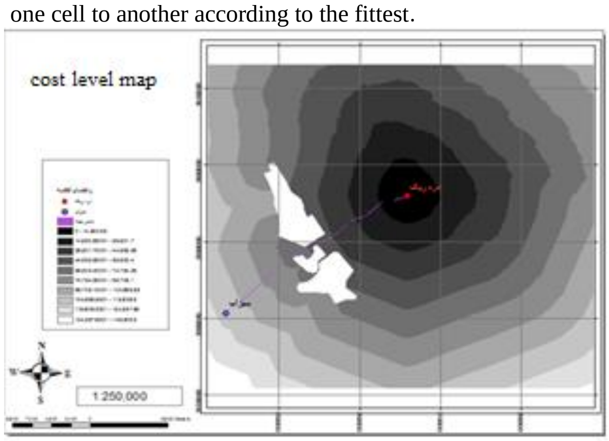


Figure 14: Mapping overlay index of layers

This is in fact an attempt to determine the cell with the lowest cost. This is a repetitive process starting at the starting point and aiming at valuing the cells of surface based on the cost of moving from the starting point. This work continues until all cells be cost-effective. To determine the optimal route, the search function starts from a cell that shows the position of the destination on the cumulative cost level and moves to the neighboring cells with the smallest cumulative cost. This operation continues until we reach the reference point. At each step, the cumulative cost of moving the neighboring olives (eight pixels adjacent) is targeted, and the pixel with the lowest cumulative cost will be selected as the direction of movement (Fig. 14).

The process for developing an integrated and comprehensive scenario is also evolving and the results are evident in the following map. The results of these maps are as follows (Table 3).

It needs to redirect 14.56 kilometers from the northern part of the area specified by the oil company. Therefore, the lands of the northern parts as shown in the map, are four ecological zones and their rating relate to the oil company. It was selected as a specific area for the pipeline crossing, so that we could examine three scenarios separately in that area (Fig. 15).

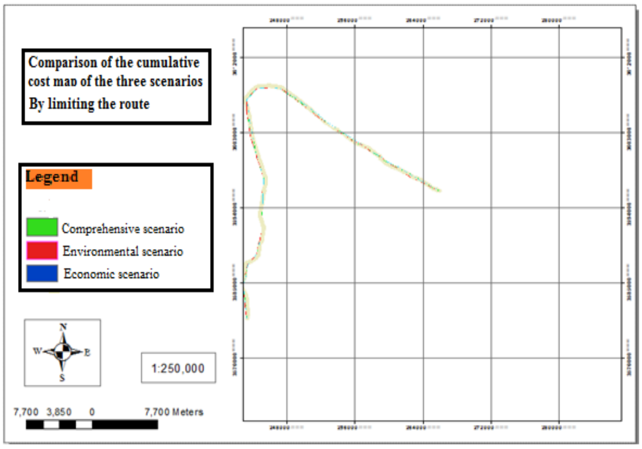


Figure 15: Comparison of Cumulative Map of Three Scenario Constraints

According to the study, the economic scenario with a length of 55,206 km, an environmental scenario with a length of 55,512 and a comprehensive scenario with a length of 55,561 km, differences with accordance with the designed line in the traditional way are 56,147 km, revealing a shorter route. Within the specified limits of the oil company, it could indicate the superiority of the Fuzzy AHP in combination with GIS than traditional design.

Table 3: The results of three scenarios in the specified range

Length(Km)	Scenario name
55.206	Economic scenario
55.512	Environmental scenario
55.561	Comprehensive scenario

Conclusion:

1. The AHP method uses a number of routing factors and tries to weigh them according to their impact on routing.
2. In the context of data integration, various models were evaluated that the model of overlapping index with weighting parameters selected based on Fuzzy AHP method as appropriate models.
3. In order to select the appropriate model, three parameters of the path length, the degree of adaptation of the selected routes with the route between the two sides and compliance with the standards, according to the expert opinion, were considered as the parameters for evaluating each route.
4. Since the AHP method is a baccalaureate method, criticisms of the general methods of knowledge base are also known to this method. But this method facilitates judgments and calculations due to the use of paired comparisons and fewer failures.
5. The method of AHP is based on the principle of hierarchical formulation of the problem and the possibility of considering different quantitative and qualitative criteria, and has a strong theoretical structure, therefore, it should be added to the methods chosen for weighting in this research.
6. Bowline's model was not recognized by the low flexibility in influencing various parameters in routing of lines and due to the fact that the region's cohesion is eliminated.

The combination of fuzzy models and AHP can determine the appropriate route for transmission lines. Using GIS, it can be possible to increase the accuracy of routing and reduce costs. Studies have shown that by routing through GIS, the shortest route can be designed with respect to environmental issues ,legal constraints and technical and engineering issues. Choosing short and efficient paths which reduces costs and reduces power loss.

suggestions

1. One of the major shortcomings of different organizations for managing various departments is the lack of a complete and timely database. This database can, in addition to the required analyzes, create an information link between the various departments of an organization. A spatial database is a very suitable option for implementing the needs of an organization.
2. Given the breadth and applications of GIS, it is considered necessary and appropriate for the system to be considered and used by the planning and execution systems in the country.
3. Allocate funds to support research on the development of GIS applications.

4. If routing of the oil lines takes into account new factors and their role in routing, it is expected that they will achieve better results.
5. In the next research, the researchers expanded the details of the factors involved in routing and determined their value according to the situation in the region.

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DETERMINATION OF LOCAL QUASI-GEOID IN CENTRAL ANATOLIA FOR ENGINEERING AND GIS PURPOSES

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ABSTRACT:

Requirement for a high resolution geoid model has increased substantially during the last few decades especially with the advent of Global Positioning System (GPS). Many countries across the world have already developed their own geoidal model which serve as the means of deriving orthometric heights from GNSS observations. On the other hand, the need for transformation of the ellipsoidal heights derived from GNSS observations to the physical orthometric heights has forced geodesists to determine the high precision local geoid heights. Besides, because orthometric heights are used in engineering and GIS applications, local quasi-geoid determination studies have become especially important.
As it is well known, Turkey is situated on a tectonically very active region and earthquakes occurring in different times cause deformations in heights of levelling points of Turkish National Vertical Network. On the other hand, National Mapping Agency of Turkey (GDM: General Directorate of Mapping) which is responsible for the establishment and maintenance of national geodetic networks compute geoid models for whole Turkey and release them for public use in different periods. These GDM-computed geoid models are called “hybrid geoid” models. Hybrid geoid models are computed with the combination of gravimetric geoid models and geoid heights on the GPS_levelling points. And it is also known that the absolute accuracies of these geoid models are nearly at the 10 cm level or even worse. But, the requested accuracy is about better than 5 cm. Hence, in order to prove that the required accuracy levels can be achieved, A local gravimertric and quasi-geoid determination project using the resources of Selçuk University was initiated. Project area has been planned to cover a limited part of Central Anatolia including Konya.
Necessary basic data (gravity, levelling etc.) for this Project have been obtained in the field by performing observations/measurements. Some other necessary data such as absolute gravity values have been obtained from GDM. And as the next phase, high accuracy (better than 5 cm) local gravimetric and quasi-geoid models will be computed for the limited part of Central Anatolia using the above mentioned data. In order to be able to reach this goal suitable geoid computations softwares must be used. In this project, we will use DFHRS developed by the Karlsruhe Applied Sciences and GRAVSOFT softwares.
According to the results to be obtained from this Project, a more comprehensive project will be launched and the project area will be expanded. Thus, additional gravity, levelling and GNSS measurements will be carried out in the new Project area for the determination of a high accuracy regional gravimetric geoid.

KEY WORDS: GNSS, GIS, Gravitmeric geoid, quasi geoid, ellipsoidal height, orthometric height

1. INTRODUCTION

With the advent of GPS, conventional terrestrial positioning techniques have been replaced by real-time GNSS services in practice and thus agencies now provide heights almost effortlessly to the users. Almost all countries have their own Continously Operating Reference Stations (CORS) Networks. And many corrections are being disseminated via RTCM messages through these CORS networks. For example, in Turkey CORS-TR (TUSAGA-Aktif) is in use which provides real-time 3D coordinate corrections in ITRF96 (International Terrestrial Reference Frame-1996). In Turkey, there are also some other local CORS networks operated by local municipalities such as Istanbul, Ankara and Konya. These services can provide the end user with highly accurate real time positions at a relatively low cost. In corresponding GNSS online processing, the positioning problem is divided into two parts: horizontal positioning and vertical positioning. The horizontal position is transformed to the local coordinate systems through a datum transformation. In this way the horizontal positions can easily be integrated with other traditional horizontal positioning techniques

But for the height component the situation is different. Heights are a necessary component of surveying and mapping applications. As it is well-known, the GNSS-derived height is the ellipsoidal height. On the other hand, in engineering projects and GIS applications orthometric height (H:sea-level heights referring to Earth gravity field) is used. In practice orthometric heights refer to Mean Sea Level (MSL) as their (vertical) datum thus called practical heights. Practical heights must be physically meaningful Thus, the GNSS-based determination of orthometric heights “H” requires the transformation of the GNSS-derived ellipsoidal heights to the respective geoid model (i.e. physically defined height reference surface). Requirement for a high resolution geoid model has

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increased substantially during the last few decades especially with the advent of Global Positioning System (GPS). Many countries across the world have already developed their own geoidal model which serve as the means of deriving orthometric heights from GNSS observations. On the other hand, the need for transformation of the ellipsoidal heights derived from GNSS observations to the physical orthometric heights has forced geodesists to determine the high precision local geoid heights. Consequently, GNSS positioning services such as CORS-TR serving also for navigation, mobile GIS and mobile IT applications require the establishment and maintenance of a geodetic infrastructure for GNSS positioning services.

Turkey is situated on a tectonically very active region and earthquakes cause deformations in heights of levelling points of Turkish National Vertical Network. On the other hand, National Mapping Agency of Turkey (GDM: General Directorate of Mapping) is responsible for the establishment and maintenance of national geodetic networks compute geoid models for whole Turkey and release them for public use in different periods. These GDM-computed geoid models are called “hybrid geoid” models. Hybrid geoid models are computed with the combination of gravimetric geoid models and geoid heights on the GPS_levelling points. And it is known that the absolute accuracies of these geoid models are nearly at the 10 cm level or even worse. But, the requested accuracy is about better than 5 cm for engineering works. Hence, in order to prove that the required accuracy levels can be achieved, a local gravimetric and quasi-geoid determination project using the resources of Konya Selçuk University was initiated. Project area has been planned to cover a limited part of Central Anatolia including Konya.

Necessary basic data (gravity, levelling etc.) for this Project have been obtained in the field by performing GPS and gravity observations/measurements. Some other necessary data such as absolute gravity values have been obtained from GDM. And as the next phase, high accuracy (better than 5 cm) local gravimetric and quasi-geoid models will be computed for the limited part of Central Anatolia using the above mentioned data. In order to be able to reach this goal suitable geoid computations softwares must be used. In this project, we will use DFHRS (The digital finite-element height reference surface) which applies a geometric approach and developed by the Karlsruhe Applied Sciences and GRAVSOFT softwares. The principle of the DFHRS software is based on the parametric model of N(φ, λ, h) as a continuous polynomial height reference surface (HRS). Following the quasi-geoid computation, when we reach the requested accuracy level, namely better than 5 cm, then it will have been shown that the GNSS based determination of orthometric heights (H) is much faster, easier to handle and much more economic, in comparison to classical geodetic levelling (DFHRS 2018). On the other hand, GRAVSOFT is a package of FORTRAN programs for gravity field modelling. Using the program empirical covariance function and its analytic modelling is determined and thus geoid determination using least-squares collocation is performed (Sanso et al. 2009).

It can generally be said that it is possible to obtain a gravimetric geoid better than 10 cm accuracy by using global models and gravity data with 1-2 mGal accuracy. And you can only check such geoid only with GNSS/Levelling heights which provide better accuracies. Thus, according to the results to be obtained from this Project, a more comprehensive project will be launched and the project area will be expanded. Thus, additional gravity, levelling and GNSS measurements will be carried out in the new Project area for the determination of a high accuracy regional gravimetric geoid.

Consequently, in this paper, all works carried out within the framework of this project and the reached preliminary results will be presented. Because this projects has just initiated, here only the preliminary results obtained by DFHRS software are presented.

2. GEOID AND THE DFHRS SOFTWARE

As it has been stated above heights are a necessary component of surveying and mapping (including GIS) applications particularly if the projects require a 3 dimensional work. In practice, we use practical heights (H:orthometric heights) which refer to mean sea level (MSL) as our vertical datum. Practical heights are defined by means of real gravity observed at the Earth’s surface. On the other hand, if we need a very precise vertical datum for our practical heights then MSL is no longer a vertical datum particularly for scientific studies and national datums. In this case an equipotential surface of the Earth’s gravity field, the geoid, must be determined. Hence, Practical heights are defined by means of real gravity observed at the Earth’s surface.

Due to the non-parallelism of equipotential surfaces levelling loops do not close (impossible to adjust) and there is no uniqueness in heights. Thus, we must use properly defined heights instead of leveled heights (Vanicek, 2009), (Fig.-1).

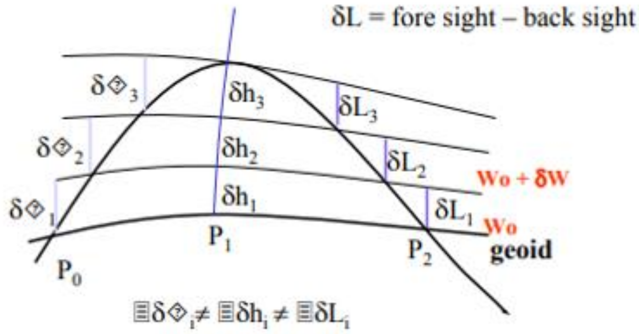

Figure-1. Geodetic levelling: Levelling is affected by the Earth Gravity Field

There are three types of geoid-referenced height, namely, dynamic height, orthometric height and the normal height in geodesy. Each of these heights basically refers to the difference in gravity potential between the geoid and the point in question. This potential difference is known as the geopotential number (Christopher Jekeli 2000). Different height systems can be related to each other by the geopotential number (Cp). Hence, geopotential numbers create the most natural height system but they are impractical.

Dynamic heights: Any point has a unique geopotential number (with respect to the defined local geoid), scaled by a reference gravity " γ_0 ", can be used as a height coordinate of the point and computed by the following equation.

$$H_P^{dyn(j)} = \frac{C_P^{(j)}}{\gamma_0}$$

Here, $\gamma_0 = 9.806199203\ m/s^2$ and called normal gravity for GRS80 ellipsoid. In above equation, $H_P^{dyn(j)}$ is the dynamic height of P (with respect to vertical datum) and has a physical meaning (i.e. water always flows downward) and thus the dynamic heights are unique. $H_P^{dyn(j)} = 0$ for all points on the geoid.

Orthometric heights: The orthometric height of a point on the Earth Surface is the distance Ho from the point to the geoid, measured along the plumb line of P, and given as below (Figure-2):

$$H_P^j = \frac{C_P^{(j)}}{\bar{g}_P^j}$$

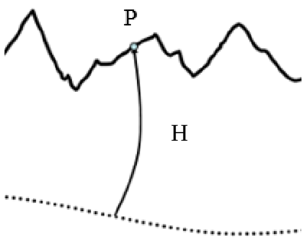

Figure-2. Orthometric Height (H)

Here, $\bar{g}_P^j$ is the mean gravity along the plumb line of P.
Normal height: It is possible to define a similar geometrically interpretable height that avoids a density hypothesis for the crust. This is accomplished by introducing the normal gravity field. Normal gravity field is defined as the gravity field generated by an Earth-fitting ellipsoid, (Jekeli 2000). Normal height describes height above the quasigeoid, Figure-3. Geoid and quasigeoid coincide along the mean shoreline and at sea.

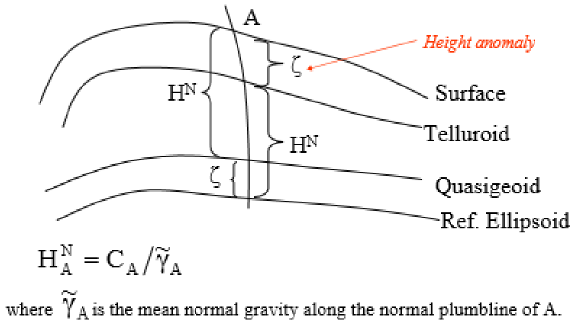

Figure-3: Normal Height and Quasi-geoid

3. PROJECT PLANNING AND FIELD WORK

Requirement for a high resolution geoid model has increased substantially during the last few decades especially after advent of Global Positioning System (GPS). Many countries across the world have already developed their own geoidal model which serve as the means of deriving orthometric heights from GNSS observations. On the other hand, the need for transformation of the ellipsoidal heights obtained from GNSS technique to the orthometric heights has forced geodesists to determine the high precision geoid heights.

Thus, all these developments in other countries have also affected Turkey, which means determination of a geoid model and computation of orthometric heights are also a necessity in Turkey. As well known, Turkey is situated on a tectonically very active region and earthquakes occurring in different times cause deformations in heights of levelling points of Turkish Vertical Datum. On the other hand, National Mapping Agency of Turkey (GDM:General Directorate of Mapping) which is responsible for the establishment and maintenance of national Geodetic Networks compute geoid models for whole Turkey and release them for public use in different periods. These GDM-computed geoid models are called "hybrid geoid" models. Hybrid geoid models are computed with the combination of gravimetric geoid models and geoid heights on the GPS_levelling points. And it is also known that the absolute accuracies of these geoid models are worse than 10 cm. But, the requested accuracy is about 2-3 cm. Hence, in order to reach the required accuracy levels, it is aimed to realize a pilot Gravimetric Geoid Project with the resources of Selçuk (and Konya Technical) University. Project region is anticipated to cover some parts of Central Anatolia including Konya.

Necessary basic data (absolute gravity values and heights) for this Project have mainly been obtained from GDM's archive. And following the necessary investigation on topographic maps, and using the obtained data a high accuracy gravimetric geoid will have been determined for the Project area in which

Konya will be center. For this purpose a 140 km-long line has been determined between Ankara and Yozgat. And along this line relative gravity, GPS and levelling measurements were performed at 21 points. Project area is seen on Figure-4. Gravity measurements were performed using Scintrex CG-5 AUTOGRAV device obtained from Dokuz Eylül University (Izmir). Absolute gravity measurements at Ankara and Yozgat points were obtained from GDM.

Project team consists of Konya Technical University academicians and MSc/PhD students. And it is anticipated to complete the Project within 24 months including the training issues.

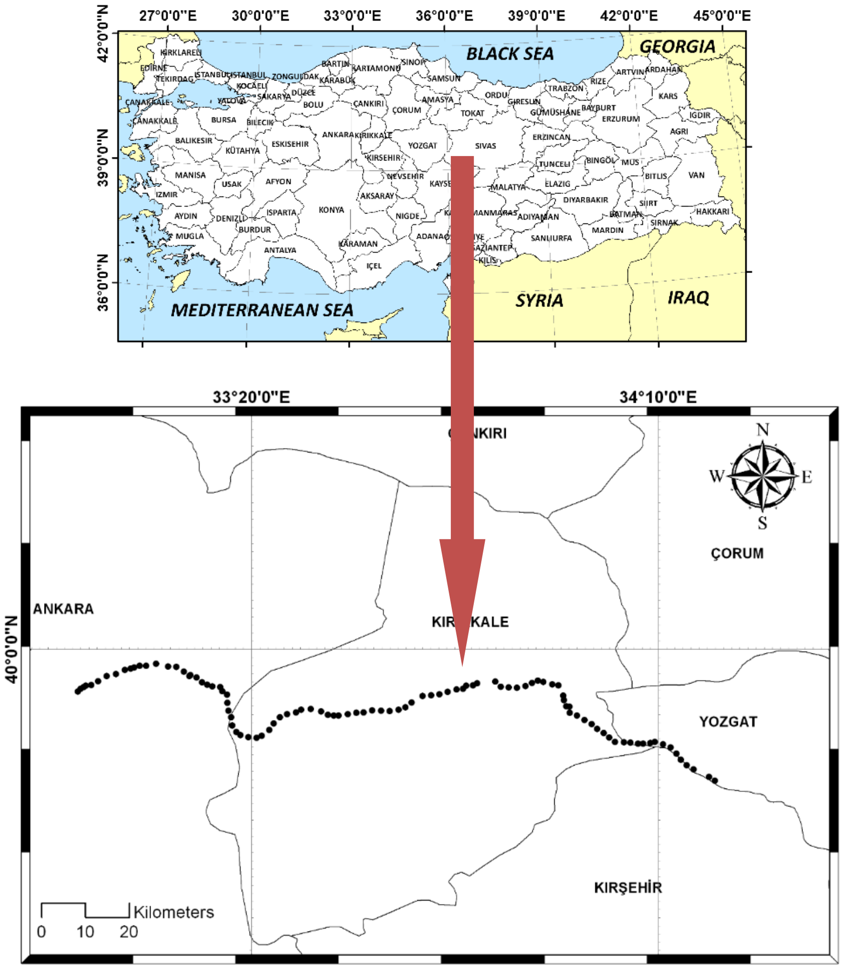

Figure-4: Project Area

4. CONCLUSIONS

Requirement for a high resolution geoid model has increased substantially during the last few decades especially after advent of Global Positioning System (GPS). Thus, the need for transformation of the ellipsoidal heights obtained from GNSS technique to the orthometric heights has forced geodesists to determine the high precision geoid heights. Today, it is possible to obtain a gravimetric geoid better than 10 cm accuracy by using global models and gravity data with 1-2 mGal accuracy. And you can only check such geoid only with GPS/Levelling heights which provide better accuracies.

In this project it has been aimed to obtain a geoid model better than 5 cm in local areas in Turkey. In order to reach this aim, a pilot project has been launched in Central Anatolia. A 140 km-long line has been chosen and along this line relative gravity, GPS and levelling measurements have been performed. It is anticipated to complete the gravimetric geoid and quasi-geoid (geometric) computations using GRAVSOFT and DFHRS softwares, respectively. And, according to the results to be obtained from this Project, the project area will be enlarged and thus additional densification data will be collected by carrying out relative gravity, levelling and GPS measurements for the determination of a high accuracy gravimetric geoid. And as a last step, a geoid determination project will be initiated for whole Turkey to reach a geoid model better than 5 cm.

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DESIGNING A REAL ESTATE VALUATION MODEL FOR TURKEY BY USING NATIONAL GDI

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ABSTRACT:

For effective land management, key component is to provide sustainable, reliable and definitive information about real property, land and all related factors. Standardised and interoperable land and real property related data helps to promote geographic enablement and sustainable land development in both rural and urban areas. In Turkey, the demand for reliable and affordable real estate valuations has increased in the sector especially with the densely performed urban transformation applications. Because of these reasons, in order to perform objective and accurate value estimation, different datasets used in the valuation process produced from different sources should be interoperable. For the solution of the interoperability issues, Geographic Data Infrastructures (GDI) concept has emerged with the purpose of developing geographic data standards and ensuring data interoperability. In this study, a real estate valuation model will be designed as an extension model to the Turkish national GDI (TUCBS) for performing reliable real estate valuation by using standardised and interoperable data sets that are produced by public institutions. With this purpose, national and international standards will be examined and legal, physical and environmental factors effecting the real estate value will be determined. TUCBS, Infrastructure for spatial information in Europe (INSPIRE) and ISO/TC211 standards, such as ISO 19103 – Conceptual Schema Language, 19109 – Rules for Application Schema, 19110 – Feature Cataloguing and 19118 – Encoding will be taken into consideration in the model design. In addition, a country profile of real estate valuation process in Turkey will be presented with the proposed valuation model.

KEY WORDS: Real Estate Valuation, Geographical Data Infrastructures (GDI), Data Modelling, Interoperability, Data Standards.

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1. INTRODUCTION

Management of land information effectively is a quite important issue for the governments in order to success sustainable and successful land development. Effective land administration and land governance with comprehensive land policies helps to promote the geographic enablement and sustainable land development in both urban and rural areas (FIG, 2002; Williamson, 2005). In compliance with today's land management and development concepts, mapping, registration, and valuation functions of land should be the parts of land administration policy for sustainable implementations (Kalantari et al., 2005). Primary needs are definite and standardised data about topography and property for sustainable management of land and all related sectors. In this point of view, applications like real estate valuation, rural-urban transformation, expropriation, land consolidation can effectively be performed throughout the government agencies with the presence of the standardised and interoperable data.

Data interoperability in different thematic applications between public institutions has significant importance for successful and sustainable land management. Therefore, governments and organizations put more emphasis on producing and sharing interoperable geographic datasets in recent years (EIF, 2010; Republic of Turkey – Ministry of Development, 2012). Because only with the existence of the up-to-date and interoperable geographic data, governments can manage the land effectively and provide the opportunity of data sharing between various public institution and private sector applications (Aydinoglu and Bovkir, 2017). For the solution of the interoperability issues with the purpose of developing geographic data production and sharing standards, the concept of Geographic Data Infrastructures (GDI) has emerged (Budic et al., 2004; Aydinoglu, 2009). Governments and geographic data organizations developed their own GDI that helps the sustainable land development and effective data manipulation throughout the different thematic applications. In national level Turkish National GDI (TUCBS in Turkish), Geospatial Data Infrastructure for Germany (GDI-DE), and the Dutch National GDI; in continental level Infrastructure for spatial information in Europe (INSPIRE) can be good examples for GDI.

GDI promotes land administration and real estate management by providing reliable, definite and interoperable geographic data (Osei, 2006; Williamson et al., 2006). With the existence of interoperable and standardised land and real estate related data provided from the national GDI, successful land related implementations such as real estate valuation, expropriation, taxation, rural-urban transformation and land consolidation can be performed. Accessing land and real estate datasets easily increase regional development, structural harmonisation and provide effective policy implementation (Dawidowicz et al., 2014). That's why if real estate related datasets can be obtained from national GDI, data access and harmonisation problem can be solved and these data sets can be easily used in land administration.

In this study, main purpose is to provide real estate related information to users by using national GDI. In this way, reliable information can be obtained from e-government services without using commercial applications. For this purpose, a real estate valuation model will be designed an extension model to the Turkish national GDI (TUCBS) for performing reliable real estate valuation by using standardised and interoperable data sets that are produced by public institutions. In addition, national and international standards will be examined and legal, physical and environmental factors effecting the real estate value will be determined. In model design of TUCBS, Infrastructure for Spatial Information in Europe (INSPIRE) and ISO/TC211 standards, such as ISO 19103 – Conceptual Schema Language, 19109 – Rules for Application Schema, 19110 – Feature Cataloguing and 19118 – Encoding will be taken into consideration. In addition, a country profile of real estate valuation process in Turkey will be presented with the proposed valuation model. Because the model will be designed in order to provide a base model for managing data concerning the main objects of real estate valuation process.

2. METHODOLOGY

2.1 Real Estate Related Data Requirements

Real Estate is the immobile and tangible land with all natural and unmanned equipment affixed to land that are both below or above the ground like buildings, site improvements and natural resources (Appraisal Institute, 2001; IVSC, 2011; RICS, 2014). Value of an object or service is determined by its benefits, quality and abundance or scarcity (CMB, 2006; IVSC, 2011). The word "valuation" can be used to refer to the estimated value or to refer to the preparation of the estimated value (the act of valuing) (IVSC, 2011).

There are several national and international standards related to the real estate valuation process. These standards can be listed as International Valuation Standards (IVSC, 2011); European Valuation Standards (TEGoVA, 2016); Turkey Valuation Standards (TDUB, 2011); Professional Valuation Standards (RICS, 2014) and Mass Appraisal of Real Property (IAAO, 2013). Despite these existent standards, there is no internationally accepted standard model for defining the real estate valuation process will all related data and criterias. ISO 19152: 2012 - Land Administration Domain Model (LADM) and Cadastral Parcels data theme of the INSPIRE can be accepted the most related data standards; however, they focus on legal and geometric requirements of land parcels. Therefore, this study focuses on proposing a model for explaining requirements of the real estate valuation process within the national GDI.

In real terms, it is difficult to determine the exact value of real estate because value is a subjective term and differs from person to person in terms of various location and utility factors (Yomralioglu and Nisanci, 2004). According to the application needs or personal subjective expectations, different thematic factors may need to be examined. In this way, commonly used factors in real estate valuation process are analysed and determined in Table 1, according to the academic researches, nationally and internationally accepted standard documents (CMB, 2006; TDUB, 2011; IVSC, 2011, TKGM, 2011; RICS, 2014; TEGoVA, 2016; Yomralioglu 1993; Nisanci, 2005; Candas 2012; Yalpir and Bunyan Unel, 2016).

2.2 Model Design

According to determined factors in Table 1, a real estate valuation model was designed as an extension of Turkish National GIS (TUCBS). TUCBS is an e-government project initiated with the purpose to establish a national GDI for Turkey under the responsibility of General Directorate of GIS in Ministry of Urbanization as a part of e-Transformation Turkey (TKGM 2005; TKGM, 2006). TUCBS corresponds to national level user requirements in accordance with INSPIRE specifications with base geographic and thematic data themes (GD-GIS, 2012; Aydinoglu and Bovkir, 2017). These data specifications were designed to enable geographic data interoperability and effective data management between different data providers and users (GD-GIS, 2012; Aydinoglu and Bilgin, 2015).

Table 1. Commonly used factors in valuation process

Parcel Characteristics	Area
	Position (Corner, Middle, Front)
	Use Type
	Zoning Status
	Legal Right/Restriction/Responsibilities
	Ownership Status
	Topographic Characteristics
Location Characteristics	Neighbourhood Status
	Noise Nuisance
	Landscape
	Population Density
	Education Level
	Distances to Point of Interests
	Distance to Deleterious Areas
	Distance to Green Spaces
Improvement Characteristics	Living Area
	Age
	Number of Floors
	Number of Rooms
	Heating System
	Energy Efficiency
	Use Type
	Available utilities (elevator, balcony, garage, pool etc.)
	Construction Material
	Construction Type

TUCBS follows the ISO/TC211 and OGC standards for the interoperability of the geographic datasets and services. However, data models have not been put into practice yet and stakeholders have encountered problems about producing and using the data sets and models (GD-GIS, 2012). Therefore, data standardisation and interoperability are required between land administration applications for performing effective real-world practices. Geographic data contents like topography, land cover, buildings, and transportation are also defined as real estate related information from different data themes.

Proposed real estate valuation model was designed within the Turkish National GIS (TUCBS) in relation to the land registry and cadastre data model (TUCBS.TK) as an extension because real estate is a kind of spatial unit inside the cadastre concept. Land parcels, buildings and condominium units can be accepted as the main objects of the valuation process. With proposed valuation model it is aimed to serve all real estate related information with assessed value within the national GDI by using reliable public databases.

In the valuation extension, TD_TasinmazDeger (valuation) feature class represents the main valuation process and defines land values for each valuation unit and TD_TasinmazDegerBirimi (valuation unit) feature class represents the spatial units in subject of the valuation process and related to the main objects represented with TK_Parsel (parcel), Bina (building) and BagimsizBolum (condominium unit) (Figure 1).

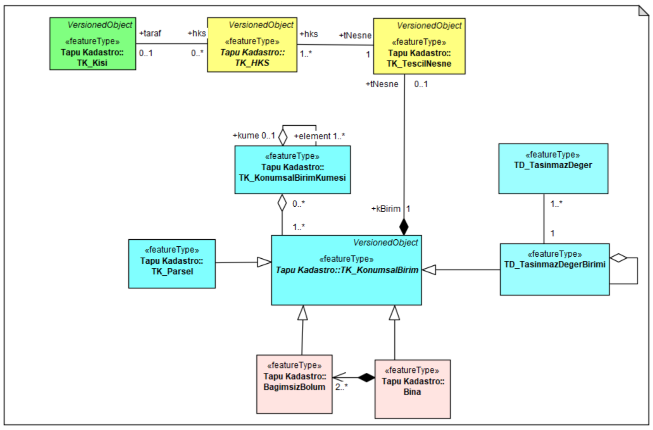

Figure 1. TUCBS.TK with valuation extension

In parcel-based valuation, TK_Parsel (parcel) as a spatial unit (TK_KonumsalBirim) from TUCBS.TK with all related attributes are used. For valuation of buildings and single spaces, OzetBina (abstract building) and BagimsizBolum (condominium unit) from building data theme of TUCBS (TUCBS.BI) with their attributes are used. In addition, to calculate the values of condominium units or buildings BinaBagimsizBolumOzellikleri feature type which indicates the specific factors effecting the value was added to the model (Figure 2). These factors were determined according to the Table 1.

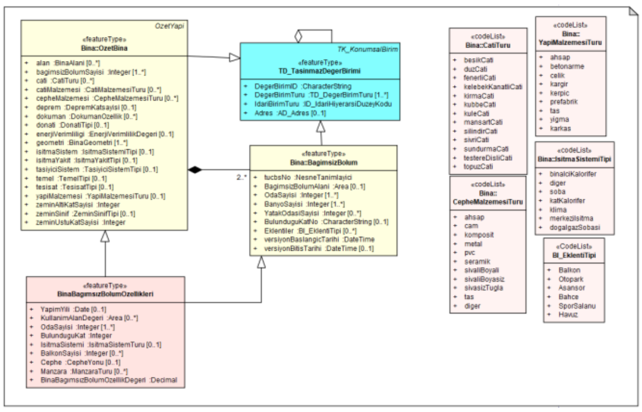

Figure 2. Feature classes with their relations of Buildings and Condominium units

TD_TasinmazDeger class is related to TD_TasinmazDegerBirimi. DegerID (value ID) and DegerRaporID (appraisal report ID) represent the single identification number of value and appraisal report. DegerTuru (value type) is defined with the TD_DegerTuru codelist which includes value types such as market value, tax value, use value, fair value, commercial value. Deger (value) represents the final assessed value after the valuation process and DegerlemeYontemi (valuation type) is defined with TD_DegerlemeTuru (valuation method) data type which includes valuation methods such as TopluDegerleme (mass valuation), MaliyetYontemi (cost approach), GelirYontemi (income approach), and EmsalYontemi (sales comparison approach) (Figure 3).

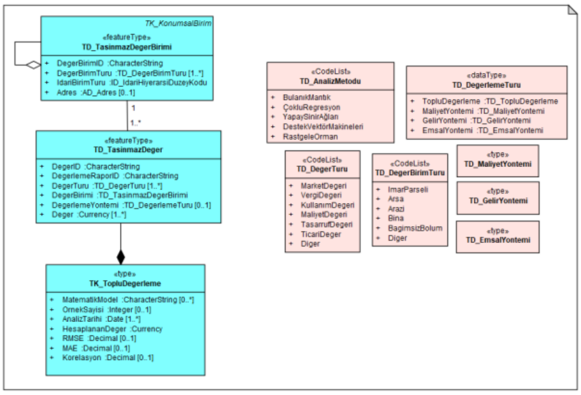

Figure 3. TD_Valuation with its related classes

Designed model uses related necessary base and thematic data themes of TUCBS and performs the appraisal with reliable data produced by public institutions. In this perspective, TD_TasinmazDeger classs is related to legal and thematic classes as parcel characteristics, legal factors, transportation, socio-cultural factors, public services, improvement characteristics of building/condominium unit, locational factors and utilization. Each class defining factor groups uses the datasets obtained from different geographic data themes in the TUCBS. A detailed representation of TD_TasinmazDeger with its relations of TUCBS data themes is illustrated in Figure 4.

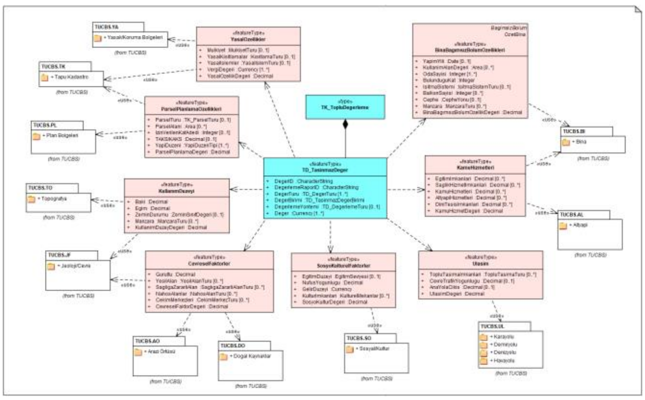

Figure 4. Detailed representation of TD_TasinmazDeger

- YasalOzellikler (Legal Factors) includes data regarding the legal characteristics of the property.
- ParselPlanlamaOzellikleri (Parcel Characteristics) includes data about parcel status and its planning conditions.
- KullanimDuzeyi (Utilization) includes data affecting the utilization such as slope, aspect and visibility.
- CevreselFaktorler (Locational Factors) includes data about environmental conditions of real estate such as existence of green space, distance to deleterious and unpleasant areas.
- SosyoKulturelFaktorler (Socio-Cultural Factors) includes data about the socio-cultural status of real estate owners and neighbourhoods.
- Ulasim (Transportation) includes data about transportation facilities such as existence and type of the public transportation, density, distance to main roads.
- KamuHizmetleri (Public Services) includes data about proximity to public services and public facilities such as administrative facilities, education facilities, healthcare facilities, religious facilities and infrastructure opportunities.
- BinaBagimsizBolumOzellikleri (Improvement Characteristics) includes data about the improvements qualifications of buildings or single building parts.

3. DISCUSSION AND CONCLUSION

In sustainable land management and development concept, primary needs are reliable and standardised data about topography and property. In this point of view, applications like real estate valuation, rural-urban transformation, expropriation, land consolidation can effectively be performed throughout the government agencies with the presence of the standardised and interoperable data. That's why in this study it is aimed to design a real estate valuation model in compatible with the TUCBS data themes in order to propose a standardised real estate valuation process by using interoperable geographic dataset produced by public institutions.

In recent years, governments put a deep interest on real estate valuation process for taxation, market capitalization and economic activity purposes. In addition, because of the intensively performed urban transformation applications, real estate valuation has increased its importance within the sector in Turkey as such in many other countries. Since the real estate valuation has become one of the most important economic and socio-cultural issue nowadays, there is a need for providing real estate related data from reliable and updated databases. Once data interoperability is provided, stakeholder needs for different thematic applications like expropriation, real estate valuation, taxation, rural-urban transformation, land consolidation are supposed to be met.

For that purpose, a valuation model compatible with ISO/TC 211 standards was designed within the TUCBS for providing real estate related information to the users by using national databases. In this way, high quality and creditable information that contributes to the efficiency of the real estate market and economic growth can be obtained easily. Also, UML schemas of the data model gives the user opportunities to overcome the challenges such as integrating independent information systems, eliminating duplicated information and enhancing the quality of systems.

In this study, main purpose was to provide real estate related information by analysing all related factors affecting the value by using standardised geographic data within the national GDI. Because extracting data from complex data models is difficult and challenging, using public databases and models for real estate evaluations prevents time and cost loss. If required data can be obtained at the same standard, not only real estate evaluation application but also many land related applications can be performed easily.

ACKNOWLEDGEMENTS

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ANALYSING THE IMPACT OF VEGETATED AREAS ON LAND SURFACE TEMPERATURE USING REMOTELY SENSED DATA

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ABSTRACT:

Industrial areas, high-rise buildings, anthropogenic activities, settlements and artificial surfaces have been associated with Urban Heat Island (UHI) phenomena. This phoneme has negative impact on air quality, heat stress and it is related with heat related mortality and morbidity. Thermal Infrared (TIR) remote sensing have been widely used in global and regional scale climate and climate change studies. Land Surface Temperature (LST) calculated from remotely sensed data, is a key parameter for UHI studies. The aim of this study is to investigate and evaluate the impacts of vegetated areas on land surface temperature of Istanbul, Turkey using freely available 2017 dated Landsat 8 OLI & TIRs data. Istanbul is a huge metropolitan city where the population and artificial surfaces increases rapidly every year. Land surface temperature (LST) distribution was derived from Landsat 8 OLI&TIRs images using a mono-window algorithm. To determine the vegetated areas of İstanbul, Normalized Difference Vegetation Index was calculated and various transects were selected. Different regression analysis was conducted to analyse the relationship between LST and NDVI transects. The relationship between NDVI and LST indicates that the vegetated areas have an ability to decrease the land surface temperature.

KEY WORDS: land surface temperature, NDVI, Landsat 8 OLI&TIRs, İstanbul

1. INTRODUCTION

Urbanization and the rapid development of cities lead to fast and repeat expansion of urban areas (Yang et al., 2018). Especially, land use land cover changes (LCLU) and transformations affect land surface temperature in urban areas significantly (Fu and Weng, 2016). Dense and mega construction zones, industrial areas, high-rise buildings, anthropogenic activities, asphalt and concrete surfaces have been associated with Urban Heat Island phenomena (Arısoy, 2018). Urban heat islands have huge impacts on microclimate, air quality, heat stress, natural resources, urban public health and vegetation phenology in urban areas (Bektaş Balçık, 2014).

Many studies have been conducted to determine land surface temperature using thermal infrared remote sensing using different methods such as mono-window, single channel algorithm, split window method, radiative transfer equation method (Quin et al., 2001, Bektaş Balçık, 2014., Weng et al., 2015). Qualitative studies on the relation between land use or cover pattern on LST are used for sustainable land use planning. Many studies related about the impact of different urban components on land surface temperature have been conducted (Bektaş Balçık, 2014; Wang et al., 2014; Chen and Yu, 2017).

The main aims of the study are 1) to derive land surface temperature from the Landsat OLI & TIRs thermal band for the year of 2017 using mono-window algorithm based on Qin et al. (2001); (2) to produce the NDVI index to examine the spatial pattern of the green areas; (3) to investigate the statistical relationship between land surface temperature and green areas in Istanbul using NDVI. The results showed that correlation coefficient between LST & NDVI was negative therefore this relationship shows that vegetation areas have cooling effect so decrease urban heat island effect.

2. MATERIAL AND METHOD

2.1 Study Area

Istanbul is one of the most attractive city in the world due to its historical, cultural, and industrial importance (Figure 1). İstanbul lies between the continents of Europe and Asia and has an area of approximately 5313 km^2 with the population over 15 million.

Figure 1. Study Area (İstanbul/ Selected Test Sites)

* Corresponding author. This is useful to know for communication with the appropriate person in cases with more than one author.

In this study, two test regions were selected from the European and Asian side of the Istanbul. First site belongs to construction site of 3 rd airport of İstanbul, located at the north of the European side covered by forest, agricultural fields and wetlands. Second test site belongs to Yavuz Sultan Selim Bridge with its access highways at the northern Istanbul. Figure 2 shows two selected test sites for the study.

Figure 2. Test sites 1 and Test sites 2

2.2 Material

In this study, freely available Landsat 8 OLI & TIRs image provided by USGS were used to determine the relationship between LST and vegetated area (Table 1). The Landsat-8 OLI has narrower spectral bands, improved calibration and signal to noise characteristics, higher 12-bit radiometric resolution, and more precise geometry, compared to the Landsat 5 TM and Landsat-7 ETM+ (Irons et al., 2012). It acquires data in nine spectral bands covering a wavelength range of 430–2,290 nm with a spatial resolution of 30 m. The OLI has two new reflective wavelength bands, a shorter wavelength blue band (430–450 nm) and a shortwave infrared cirrus band (1,360–1,390 nm). Land surface temperature information was derived from Landsat 8 TIRS image thermal band (Band 10) with resampled 30 m spatial resolution.

Landsat 8 OLI & TIRS Launched February 11, 2013		
Bands	Wavelength (micrometers)	Resolution (meters)
Band 1 - Coastal aerosol	0.43 - 0.45	30
Band 2 - Blue	0.45 - 0.51	30
Band 3 - Green	0.53 - 0.59	30
Band 4 - Red	0.64 - 0.67	30
Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
Band 6 - SWIR 1	1.57 - 1.65	30
Band 7 - SWIR 2	2.11 - 2.29	30
Band 8 - Panchromatic	0.50 - 0.68	15
Band 9 - Cirrus	1.36 - 1.38	30
Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100*30
Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51	100*30

Table 1. Spatial and spectral resolution of Landsat 8 OLI & TIRs

Meteorological data used in the study include near- surface temperature and relative humidity from 16 meteorological stations in Istanbul for the same date and hour of the Landsat 8 OLI & TIRs image provided (July 16, 10:30 am). The meteorological stations belong to the Turkish State Meteorological Service, and the Automatic Weather Observation Stations belong to the Istanbul Metropolitan Municipality. These meteorological data were integrated with the mono-window method to retrieve LST from Landsat 8 OLI&TIRs data.

2.3 Method

This study includes four main steps. First of all, image pre-processing was done, secondly land surface temperature was calculated using mono-window algorithm then remote sensing index including NDVI was calculated and finally, regression analysis between LST & NDVI, was done. Figure 3 indicates the flowchart of the study.

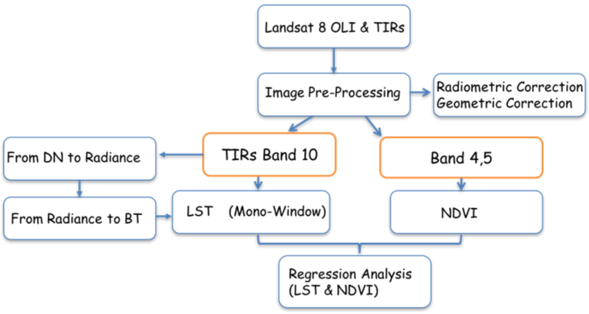

Figure 3. Flowchart of the study

2.3.1 Image Pre-Processing

The original digital numbers (DN) of Landsat 8 OLI images were converted into Top of Atmosphere spectral radiance based on the methods provided by Landsat 8 Data User Hand Book using equation 1 [10].

$$L_\lambda = M_L Qcal + A_L \qquad (1)$$

Where L_λ = TOA spectral radiance (watts/mm^2*srad*µm)

M_L = Radiance_Mult_B10

A_L = Radiance_Add_B10

Qcal = Quantized and calibrated standard product pixel values (DN)

2.3.2 LST calculation using Mono-Window

Variety of algorithm have been developed to calculate land surface temperature from remotely sensed data (Bektaş Balçık, 2014). In this study, mono-window algorithm was selected to derive LST map of İstanbul using Landsat 8 OLI& TIRs data. In order to determine LST with Mono-window Algorithm, four parameters are need to be known. These are brightness temperature, effective mean temperature, atmospheric transmittance and ground emissivity. A summary of the methodology used in mono-window method is illustrated in Figure 4 and the image processing details are given in the following sections.

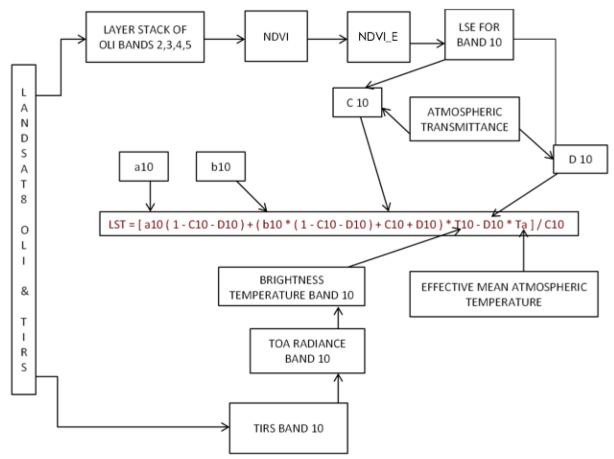

Figure 4. Flowchart of Mono-Window method

In the first step of Mono-Window process, brightness temperature values were calculated by using TOA spectral radiance and equation 2.

$$T = K_2/\ln((K_1/L_\lambda)+1) \quad (2)$$

T = Brightness Temperature (K) (B10)
L_λ= TOA spectral radiance (watts/mm2*srad*μm)
K_1 = K_1_constant_B_{10} = 1321,08
K_2 = K_2_constant_B_{10} =777,89

Band specific thermal conversion constants (K_1 and K_2) and band-specific multiplicative rescaling factor (M_L) and additive rescaling factor (A_L) were obtained from the metadata file of Landsat 8 image.

In the second stage, emissivity values were calculated based on NDVI threshold method. Normalized Difference Vegetation Index (NDVI) was calculated using equation 3. Figure 5 indicates the created NDVI image.

$$NDVI= (Band\ 5-Band\ 4) / (Band\ 5+ Band\ 4) \quad (3)$$

In the equation 3, Band 5 corresponds near infrared band and Band 4 corresponds red band of Landsat 8 OLI data.

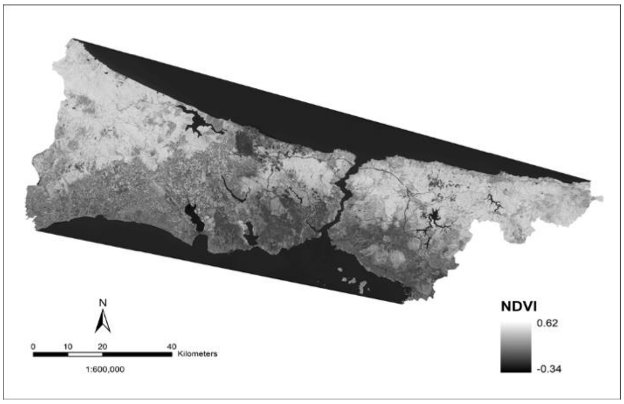

Figure 5. Normalized Difference Vegetation Index (NDVI) image

The equations in Table 2 were used to calculate emissivity values for Istanbul. The emissivity values for different land-cover types were integrated with mono-window algorithm to derive the LST of Istanbul.

NDVI	Land Surface Emissivity
NDVI<-0.185	0.995
-0.185 ≤NDVI≤	0.970
0.157≤NDVI≤0.727	1.0094+0.047 ln (NDVI)
NDVI>0.727	0.990

Table 2. Estimation of emissivity using NDVI

One of the parameter that calculated for LST is atmospheric transmittance that obtained from lots of factors, such as water vapour, ozone, aerosol etc. Atmospheric water vapour is most important to determine change of atmospheric transmittance in the thermal range of the electromagnetic spectrum. Atmospheric water vapour content was calculated with meteorological station collected near surface air temperature (T_0) in Kelvin and Relative Humidity (RH) by using equation (4). According to these values near surface temperature was 32.44 ℃ (304.59 Kelvin), and RH value was %38.32. Therefore, water vapour (ωi) was calculated as 1.5309 g/cm^2 (grams per square centimetre).

$$\omega_i = 0.0981*\left\{10*0.6108*\exp\left[\frac{17.27*(T_0-273.15)}{273.3+(T_0-273.15)}\right] RH\right\} + 0.1697 \quad (4)$$

With the help of the calculated water vapour value, the atmospheric transmittance was calculated using Mid-latitude summer equation from Table 3.

Atmospheres	Water Vapour Content (g/cm^2)	Transmittance Estimation Equation
Mid- latitude summer	0.2-1.6	τ_{10}=0.9184-0.0725ω_i
	1.6-4.4	τ_{10}=1.0163-0.1330ω_i
	4.4-5.4	τ_{10}=0.7029-0.0620ω_i
Tropical model	0.2-2.0	τ_{10}=0.9220-0.0780ω_i
	2.0-5.6	τ_{10}=1.0222-0.1310ω_i
	5.6-6.8	τ_{10}=0.5422-0.0440ω_i
Mid- latitude winter	0.2-1.4	τ_{10}=0.9228-0.0735ω_i

Table 3. Derivation of atmospheric transmittance for Landsat 8 TIRS band

Effective mean atmospheric temperature (T_a) is generally used to estimate the upwelling atmospheric radiance. Near surface air temperature (T_0) is gathered from 16 local meteorological stations data. After that Near surface air temperature is used to obtain effective mean atmospheric temperature from mid-latitude summer equation is shown Table 4.

Atmospheres	Linear Relation Equation
Tropical model	T_a = 17.9769 + 0.9172T_0
Mid-latitude summer	T_a = 16.0110 + 0.9262T_0
Mid-latitude winter	T_a = 19.2704 + 0.9112T_0

Table 4. Effective mean atmospheric temperature

Mono-Window algorithm is proposed to retrieve the LST from remotely sensed data (Qin et al. 2001) and it is expressed in Eqs. 6–7. In this model, only three variables, *emissivity*, *transmittance*, and *effective mean atmospheric temperature*, are required as given below:

$$T_s=\{a*(1-C-D) + [b*(1-C-D)+C+D]*T_i-D*T_a\}/C \quad (5)$$

Determination Coefficients were a=-62.7182 and b = 0.4339 for equation 5.

$$C = \varepsilon * \tau \quad (6)$$

$$D = (1- \tau)[1 + (1- \varepsilon) \tau \quad (7)$$

ε indicates emissivity that calculated using NDVI based method. τ is the atmospheric transmittance that calculated from Table 3. T_i indicates brightness temperature and T_a indicates mean atmospheric temperature that gathered from 16 meteorological station in İstanbul. The ERDAS image processing software was used to design a model using the Spatial Model tool. Figure 6 shows the LST results of Istanbul in 2017 using the mono-window algorithm.

3. RESULTS AND DISCUSSION

Determination of the impact of different urban components such as vegetated areas, artificial surfaces and water surfaces on land surface temperature has huge importance for management of the area. Based on LST map, Istanbul is facing a severe urban heat effect because of high rate of urbanization. It can be seen from Figure 6 that most areas especially the urban areas mainly covered with artificial surfaces and industrial areas in İstanbul have high LST . The forest areas of the city have lower surface temperature values than the urban areas. Bare lands and agricultural fields (ploughed and harvested) have high temperature values.

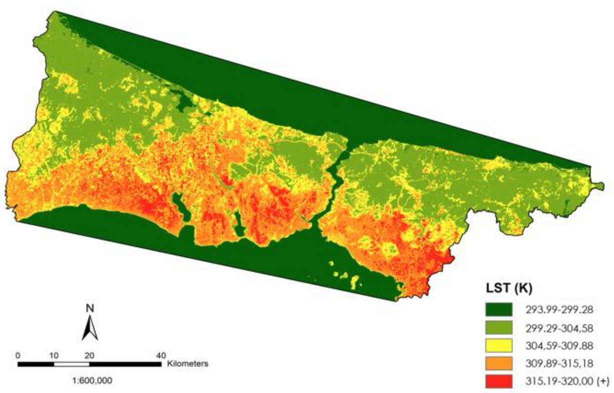

Figure 6. LST map of İstanbul

In this study, the relationship between vegetated areas and land surface temperature was analyzed in detail by using the NDVI index. Before the analysis, NDVI was normalized since indices contains negative values. Various transects were selected across the test sites of image. LST, and NDVI values were extracted from transects. The pixel value of each 30 m was extracted from different index images for each transect. Linear regression model was then conducted to examine the statistical relationship using the LST image (representing temperature), and NDVI image (representing vegetation) (Figure 7).

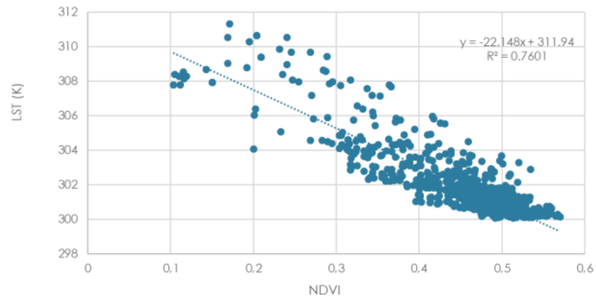

Figure 7. Regression analysis of the relationship between the IBI and LST

Correlation coefficients were calculated between LST and indices. Correlation coefficient between LST & NDVI was negative (-0.87) therefore this relationship shows that vegetation areas have cooling effect so decrease urban heat island effect. On vegetated areas NDVI values is observed higher than other features at the same time LST values is lower on same areas with NDVI. Based on correlation results, it is clear that vegetated areas have important roles in the prevention of increased LST in the city.

4. CONCLUSION

The aim of this study is to determine the impact of vegetated areas on land surface temperature in İstanbul using two selected test sites that includes mega construction sites, projects and natural areas. The results of this study indicate that İstanbul is experiencing a negative Land Surface Temperature effect. The study showed that there is a linear relationship between NDVI and LST and this is linearly decreasing (negative) relation.

Urban management models have huge important effects on urban temperature. The effects of vegetated regions on the urban surface temperature in the city should contribute to healthier construction strategies. Especially, urban green areas should be planned and managed more carefully for the sustainable management of the urban areas.

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EVALUATION OF SENTINEL-2 MSI DATA FOR LAND USE / LAND COVER CLASSIFICATION USING DIFFERENT VEGETATION INDICES

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ABSTRACT:

Accurate determination of Land Use/Land Cover (LULC) categories has very important role for environmental monitoring and management applications. Classification of remotely sensed data is one of the popular method to determine LULC information in different scale. Many methods have been developed and applied to classify satellite images. Freely available Sentinel-2 MSI data is new generation remotely sensed data which can be used efficiently to determine the land use and land cover categories for environmental monitoring applications. In this study, Sentinel-2A level 1C data acquired in July 2018 were downloaded from Earth Explorer web page. A test site from Çatalca District of İstanbul, Turkey was selected as the study area. Çatalca is very important district for İstanbul because of its valuable agricultural fields. Different land use/cover types have been defined in the selected study area such as; water surfaces, forest areas, agricultural fields (sunflowers), open mining area, settlements, and road. Sentinel-2 data four bands with 10 m spatial resolution was classified by maximum likelihood classification (MLC) method to investigate the potential of the data to determine the LULC types in selected region, as the first data set. Beside the original bands, different vegetation indices such as Normalized Difference Vegetation Index (NDVI), Green–red normalized difference vegetation index (GRNDVI), were calculated for Sentinel-2 data. These calculated indices and red-edge band were added to the original bands, and classified as the other data sets. The results of these 4 data sets of Sentinel-2 image were compared based on the field collected ground control data and error matrix. Sentinel-2 data had a satisfactory performance in land cover classification; (the overall classification accuracy using the MLC classifier applied data set 2 data was higher than the other three data set).

KEY WORDS: Sentinel-2 MSI, LULC, MLC, NDVI, GRNDVI, Red-Edge Band

1. INTRODUCTION

Reliable and accurate and up-to date determination of Land Use/Land Cover (LULC) categories has significant role for sustainable urban and rural planning, crop types mapping, agricultural activities, soil management, environmental monitoring and management, climate change modelling, natural hazard management, air quality monitoring (Bektaş Balçık, 2014; Kahya et al., 2017).

Remote sensing is an important tool for LULC applications due to its ability to acquire measurements of land surfaces cost effectively at various spatial and temporal scales (Esetlili et al., 2018). The classification is one of the widely used approaches to extract LULC information from remotely sensed data. Variety of classification methods have been developed and applied to get accurate and reliable LULC categories such as supervised and unsupervised classification, support vector machine classification, artificial neural network classification, and sub-pixel mapping (Lu and Weng, 2007; Esetlili et al., 2018). Therefore, different remote sensing indices (vegetation, built-up, water, soil), image transformation methods, and image fusion methods have been conducted to improve the accuracy of classification (Bektaş Balçık, 2014; Bektaş Balçık and Kuzucu, 2016).

Classification of remotely sensed data which have different spatial, spectral and temporal resolution is one of the common method to determine LULC information in different scale. However, land use/cover classification with high classification accuracy is a difficult image processing step. Especially, the classification of heterogeneous areas that have rural and urban LULC categories together is still faced with mixed pixel problems.

In this study, Maximum Likelihood supervised classification was applied to freely available, new generation Sentinel-2 MSI data. A heterogeneous test site in Çatalca, İstanbul was selected for the study. Sentinel-2 data four bands with 10 m spatial resolution was classified by maximum likelihood classification (MLC) method to investigate the potential of the data to determine the LULC types in selected region, as the first data set. Beside the original bands, different vegetation indices such as Normalized Difference Vegetation Index (NDVI), Green–red normalized difference vegetation index (GRNDVI), were calculated for Sentinel-2 data. These calculated indices and red-edge band were added to the original bands, and classified as the other data sets. The results of these 4 data sets of Sentinel-2 image were compared based on the field collected ground control data and error matrix.

2. MATERIAL AND METHOD

2.1 Study Area

Istanbul is one of the most important cities in the world due to its historical, cultural, and industrial importance (Figure 1). İstanbul lies between the continents of Europe and Asia and has an area of approximately 5313 km^2 with the population over 15 million.

For the past 65 years, Istanbul has been experiencing an accelerated urban expansion because of high population rate. It has huge importance to determine land cover/use categories and

* Corresponding author. This is useful to know for communication with the appropriate person in cases with more than one author.

its' changes of the region for sustainable management and monitoring activities.

Figure 1. Study Area (İstanbul/Çatalca Test Site)

In this study, one heterogeneous test region was selected from the European side of the Istanbul. The region includes one of the valuable agricultural areas of mega city İstanbul. Çatalca test site covers the land cover categories of water surfaces, green area, bare lands, agricultural fields, mining areas, road, and artificial surfaces. Figure 2 show three field study photos that belong to agricultural field samples in the region (From July, 2018).

Figure 2. Agricultural fields A) ploughed B) harvested C) cultivated (sun flower)

2.2 Material

New generation high resolution Sentinel-2 MSI image was used in the study. The sensors, designed to perform continuous measurements for the next 20+ years, have global coverage and provide free data in both the optical (Sentinels-2 and 3) and microwave (Sentinel-1) sections of the electromagnetic spectrum (EM) (Topaloglu et al., 2016). The ability of accessing freely available high-resolution satellite images will enhance scientific investigations, open up new application areas, and improve decision-making and policy formulation.

Sentinel-2A (S-2) satellite, launched in June 2015, has a swath width of 290 km and provides multi-spectral images in 13 spectral bands at different spatial resolutions. These are four visible and near-infrared (NIR) bands at 10 m resolution, six red-edge and shortwave infrared (SWIR) bands at 20 m resolution, and three atmospheric correction bands at 60 m resolution (Drusch et al. 2012; İrfanoğlu and Bektaş Balçık, 2018) (Table 1). Freely available Sentinel-2 multispectral space borne imagery has a 5-day revisit temporal resolution. Sentinel-2 also features those traditional bands, alongside additional bands in the red-edge region that is very sensitive to crop characteristics. Moreover, an acceptable compromise between the revisit time and spatial resolution, with increased spectral abilities for vegetation monitoring compared to previous public domain space-borne imagery. Sentinel-2 provides for compatibility with the historical Landsat data, while also improving measurement capabilities.

Band	Resolution	Central Wavelength	Description
B2	10 m	490 nm	Blue
B3	10 m	560 nm	Green
B4	10 m	665 nm	Red
B9	60 m	940 nm	Short Wave Infrared (SWIR)
B10	60 m	1375 nm	Short Wave Infrared (SWIR)
B11	20 m	1610 nm	Short Wave Infrared (SWIR)
B12	20 m	2190 nm	Short Wave Infrared (SWIR)
B1	60 m	443 nm	Ultra blue (Coastal and Aerosol)
B5	20 m	705 nm	Visible and Near Infrared (VNIR)
B6	20 m	740 nm	Visible and Near Infrared (VNIR)
B7	20 m	783 nm	Visible and Near Infrared (VNIR)
B8	10 m	842 nm	Visible and Near Infrared (VNIR)
B8a	20 m	865 nm	Visible and Near Infrared (VNIR)

Table 1. Spatial and spectral resolution of Sentinel 2A

In this study, ground truth data were collected in the test site field study. Especially different crop fields were visited and coordinates collected for classification purposes. Field works were done to determine location of different crop pattern and other land cover types. And also, spatial properties of objects that classified were observed during the fieldwork. Approximately 200 field points were visited and data gathered.

2.3 Method

Main aim of the study is to test the potential of Sentinel-2 MSI data for LULC classification. A summary of the methodology used in the study is illustrated in Figure 3 and the image processing details are given in the following sections.

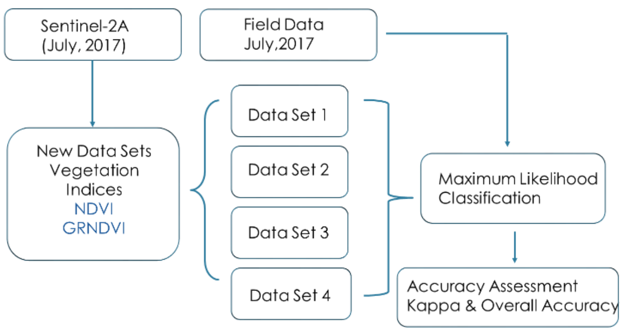

Figure 3. Flowchart of the study

In the first step, four different data set were created by using original bands with 10 m spatial resolution, two vegetation indices and red-edge band (Band 8A).

Data set 1: Sentinel-2 MSI with 4 bands (A)

Data set 2: Sentinel-2 MSI data (4 bands) + NDVI (B)

Data set 3: Sentinel-2 MSI data (4 bands) + GRNDVI (C)

Data set 4: Sentinel-2 MSI data (4 bands) + Red-Edge Band (D)

In this study, Band 2, Band 3, Band 4 and Band 8 were selected as four original bands to create different data set. Two different vegetation indices such as Normalized Difference Vegetation Index (NDVI) and Green Red Normalized Difference Vegetation Index (GRNDVI) were selected four different data set were classified using MLC classification method. Related equations and used bands were given in Table 2.

Vegetation Indices	Equation
Normalized Difference Vegetation Index	$(Band8{-}Band4)/(Band\ 8{+}Band\ 4)$ Band 4= Red Band 8= Near Infrared
Green-Red Normalized Difference Vegetation Index	$(Band8{-}(\mathrm{Band3}{+}Band4))/(Band\ 8{+}(\mathrm{Band\ 3}{+}\ Band\ 4))$ Band 3=Green Band 4= Red Band 8= Near Infrared

Table 2. Selected vegetation indices

Supervised classification is a technique that based on the statistics of training areas representing different earth surface objects selected subjectively by users on the basis of their own knowledge or experience (Liu and Mason, 2009). In this study, Maximum Likelihood Classification (MLC), which is the most common supervised classification method in remote sensing, was used to derive land use/cover categories. In this method, each pixel is assigned to the class-category for which the probability of pixel belonging is the highest (Gong, 2002).

For the classification same signature files were used for four data set. Field work synchronized with the remotely sensed data and 200 field data collected during field study using handhold GPS for classification process. Nine general LULC classes including Water Surfaces, Road, Artificial Surfaces, Green Areas, Mining Area, Crop 1, Crop 2, Agricultural Field 1, Agricultural Field 2 were utilized in this case study.

There are a number of equations that can show the level of error statistically, such as producer accuracy, user accuracy, overall accuracy, and Kappa, which can be calculated using the error matrix to determine the accuracy of thematic maps (Foody, 2002). An accuracy assessment was performed using field collected ground-truth data for classification using a standard error matrix. Kappa statistics and overall accuracy were used to determine the performance of the created data set for the selected heterogeneous region (Table 3).

3. RESULTS AND DISCUSSION

In order to determine the performance of Sentinel-2 MSI data for selected test site, maximum likelihood supervised classification method applied 4 different data set by using field collected ground truth data. Same reference field points were used in classification process for all of the data set. Figure 4 indicates the MLC classification results for 4 data set.

A

B

C

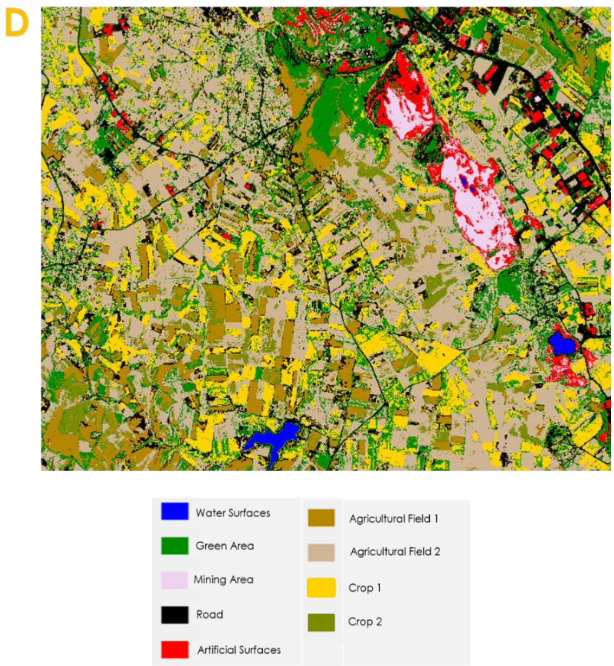

Figure 4. Maximum Likelihood Classification Results A) Data set 1 B) Data set 2 C) Data Set 3 D) Data Set 4

LULC images were obtained from Sentinel-2 data sets using pixel based MLC method, and the results were evaluated using accuracy assessment by same test points. Overall accuracy and Kappa statistics were given for 4 different data set in Table 3.

Data	Overall Accuracy	Kappa
Data Set 1	86.10 %	0.83
Data Set 2	89.24 %	0.87
Data Set 3	87.82 %	0.86
Data Set 4	86.83 %	0.84

Table 3. Accuracy Assessment Results

The overall accuracy of the Data Set-2 data was slightly higher than for Data Set -3 data, 89.24% versus 87.82 %, respectively. The approach that yielded the highest value of Kappa coefficient was the Data Set 2 data with 0.87, followed by Data Set 3 with 0.86. From Table 3, it can be observed that the Data Set 1 data had low overall accuracy (86.10%) and kappa coefficient (0.83).

Data Set 2 and Data Set 3 data set created by using NDVI and GRNDVI vegetation indices, respectively. Index added data sets in this paper provided results with higher accuracies than the four original band of Sentinel 2A-MSI (Data Set 1). This result suggests that vegetation indices have potential as an alternative method (over original bands) to extract LULC information from freely available high resolution satellite imagery captured over agricultural lands in Çatalca, Turkey.

4. CONCLUSION

The aim of this study is to generate LULC images from Sentinel-2 MSI data sets that created by using original bands and vegetation indices using pixel-based MLC supervised classification method, and to reveal which LULC image presents better accuracy results. The results of this study indicate differences in the classification accuracy between four different data set that created using original four bands of Sentinel-2 A, selected vegetation indices and red-edge band for mapping LULC types using pixel based Maximum Likelihood Supervised classification method. The results highlighted that all created data set as highly useful (over 85 %) in mapping of LULC types in the study region. The success of created data set also underlines the potential of Sentinel-2A MSI data for mapping LULC in heterogeneous test site.

Future work would test the classification potential of using the different band composites of Sentinel-2 images for whole Çatalca Region in İstanbul. Different transformation methods and remote sensing indices and pan sharpening methods would test with advance classification methods such as random forest, SVM and object based classification.

ACKNOWLEDGEMENTS

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GEOSTATISTICS ANALYSIS TO DETERMINE THE USER PROFILE OF A SOCIAL MEDIA PLATFORM

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ABSTRACT:

Social media platforms have started to be used in various social and working disciplines. Defining any activity with location in social media means that the distribution of social media users can be analysed geographically to determine user profiles. This study determines user profiles of social media platforms with the example of an online dating site. Data about active users of this platform was retrieved and analyzed in GIS environment using geostatistics techniques. The distribution and outliers of the data were determined by using exploratory spatial data analysis tools. Focusing on Istanbul province of Turkey, user profiles were analysed by examining socio-demographic relationships. Target areas were determined by using cluster analysis. Results give a perspective of user profiles by using geostatistics approaches.

KEY WORDS: Geographic Information Systems (GIS); geostatistics; social media.

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1. INTRODUCTION

Social media platforms have started to be used in various different social and working discipline. Social networking sites allow individuals to construct a public profile within the system and to view and communicate with other profiles (Boyd and Ellison, 2007). The social media develops as technological progress and introduces a new bottom-up nature of communication and information sharing (Park and Nicolau, 2015). Web and mobile platforms provide new opportunities for geographic science (Sui and Goodchild, 2011) by giving location data attached to the social media data in the form of longitude and latitude coordinates.

Geographic Information Systems (GIS) were rapidly becoming part of the mass media and social media, because the media has become increasingly location-based (Sui and Goodchild, 2011). Participatory mapping methods described as public participation GIS (PPGIS) and volunteered geographic information (VGI) provide a means to capture location-based social data for integration with other data layers in GIS (Brown, et.al. 2015; Brown and Kytta, 2014; Tsou, 2015). While geographic analysis includes simple GIS operations such as buffering, querying, etc., geographic data analysis is the discipline of the geostatistics and requires statistical theory that provides the main tools for addressing complex problems (Bailey and Gatrell, 1995). Geostatistics analyses distributions, patterns, processes and relationships in a GIS environment (Scott and Getis 2008). Cluster analysis and density map facilitate the involvement of domain knowledge in analysis and support visual cluster detection in the emerging large geospatial data sets (Du et.al., 2015).

In this study, to determine user profiles of social media platforms with the examples of online dating site, active users were determined for selecting study area. The distribution and outliers of the data were determined by using Exploratory Spatial Data Analysis (ESDA) tools in the section of exploring the distribution of patterns. User profiles were analysed by using statistical data to examine socio-demographic relationships. In the section of identifying clusters, the hot-spot analysis was used to find the clustered area of social media users. Results were discussed in the last sections.

2. METHODOLOGY

Geographic data sets are captured, queried, analysed, and visualized on GIS environment. Statistics techniques help to identify the spatial patterns and relationships in the data.

2.1 Collecting data for Study Area

In this study, an online dating platform (www.pembepanjur.com) was selected as an example of social media site. Active users entering the platform twice a week at least was extracted from the database to analyse user profiles of this platform. Detailed analysis was focused on Istanbul Metropolitan Area, the most populated province of Turkey, with 3401 active users. The datasets were organized and eliminated for Istanbul district as regional area, not only for social media data but also for statistics data taken from address-based information system including demographic information about population, gender, age, status, education, and income.

2.2 Examining Thematic Data

Thematic analysis aims to create meaningful patterns that represent the main idea of the data better than reading many transcripts of the data. Demographic analysis is a method to build an understanding of the age, sex, and racial property of a population and how it affects through the demographic processes of birth, death, and migration (Parker and Asencio, 2009). According to Karlsdotter et al (2012), the individual independent variables correspond to sociodemographic (age, sex, marital status, and nationality) and socioeconomic (educational level, personal income, and unemployment) dimensions. Demographic statistics and social media data were analysed to examine thematic information on Figure 4. The idea behind that people living in the same region may show similar characteristics. It is important to note that this study informs about sociodemographic and socioeconomic situation in Istanbul.

2.3 Exploring Distribution of Pattern

Patterns, clusters, and distributions are determined to explore geographic data. These analysis answer the questions; How features are distributed? Where the cluster located? What is the pattern? The techniques used for this study are mean center, median center, central feature, standard distance and directional distribution tools. These measuring techniques can be used to understand the distribution of the data. Figure 1 shows mean center and SDE of the platform users in Istanbul.

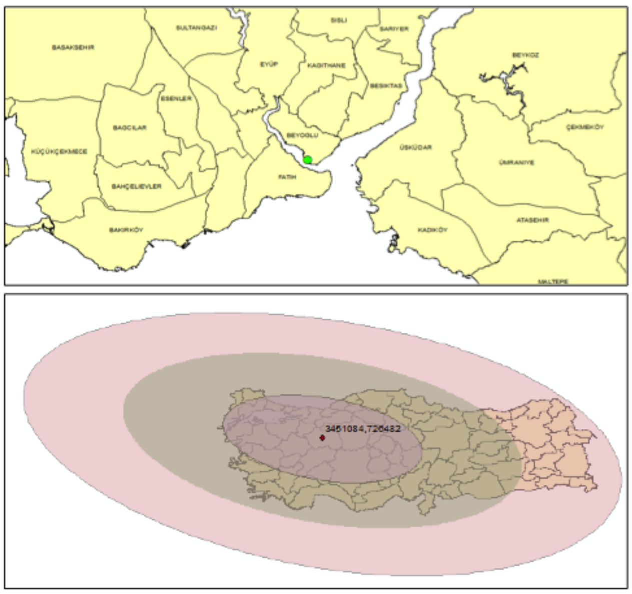

Figure 1. Mean center and SDE of the platform users in Istanbul

Normal QQ plot and General QQ plot check the relativity of the data by combining distribution graph and data graph as seen on Figure 2. Normal QQ plot uses cumulative distribution graph versus normal distribution graph. It has the same steps for general QQ plot but instead of using normal distribution as different data set. General QQ plot is used to understand similarity of distribution of the two different the data set.

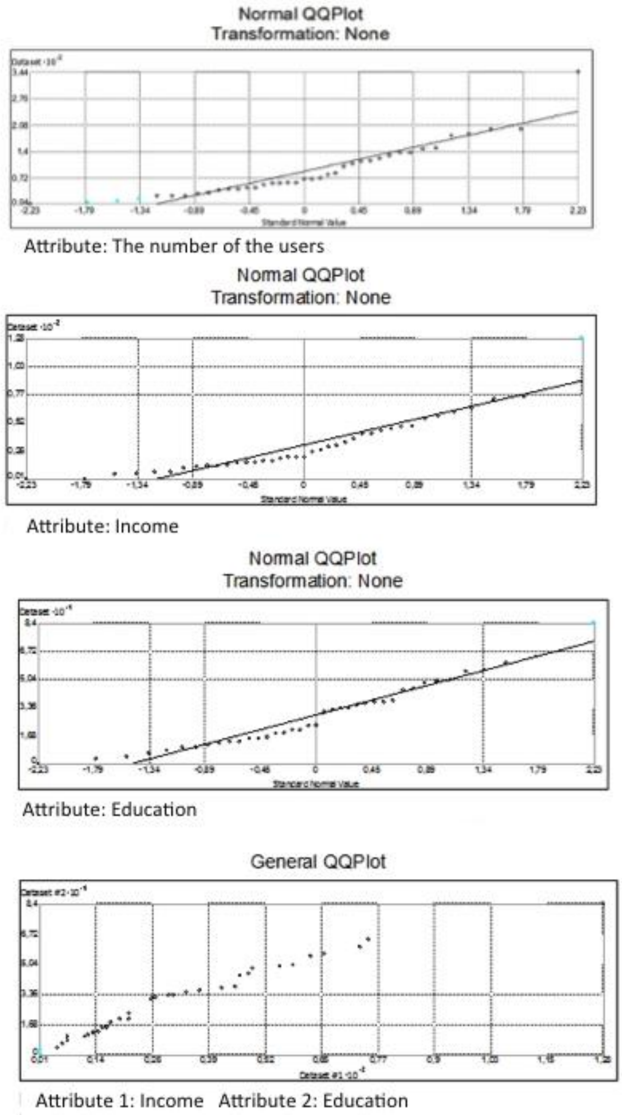

Figure 2. Normal and General QQ Plot of the platform users in Istanbul

2.4 Identifying Cluster

To identify clusters, Hot-Spot Analysis determines statistically significance by using Getis-Ord Gi* statistics. The hot-spot tools help to cluster the users geographically and to focus on the study area. A feature with a high value is interesting but may not be a statistically significant hot spot. Statistically significant means that the features have high values and be enclosed by other features with high values as well (Ilian, et.al., 2008; Krivoruchko, 2011). Figure 3 shows analysis result of social media users in Istanbul.

3. RESULTS

According to this platform example, 59% of the platform users is male and %41 of which is female, while the ratio of male population is 50.2% in Istanbul. It shows that male users prefer to use this platform rather than female users.

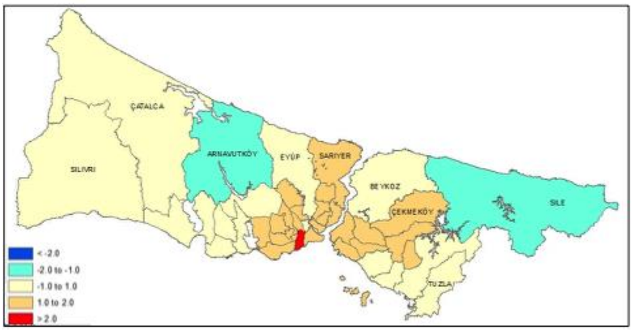

Figure 3. Hot-spot analysis of the platform users in Istanbul

Thematic maps were used to understand the distribution and the density of social media users as seen on Figure 4. Thematic maps show that most of social media users are living in Kadikoy, Bahcelievler, and Besiktas counties. There is a positive relation between demographic statistics and social media data. Futhermore, social media users prefer to live in urban areas more than in rural areas. Single social media users are low in Bagcilar or similar counties. The reason for this that economic level is too low and young people generally prefer to marriage in their earlier age.

Anatolian side of Istanbul has more woman user ratio and Europe side of Istanbul has more man ratio. Adalar, Kadıkoy, Bakırkoy, Besiktas, and Beylikduzu have more man and woman ratio rather than the others. Furthermore, the woman ratio is less and man ratio is high in Sile and Sancaktepe. The man ratio is less and woman ratio is high in Arnavutkoy and Catalca.

Demographic data such as age, education and income level was examined. According to age histogram, males have the highest population rate between 24 and 36 ages and distributed equally. Females have the highest population rate between 18 and 66 ages and not distributed equally. It is understood that the number of female users are less than male users and their age is not distributed equally. In addition, age histogram pointed out that the mean age of male users is 33 and of female users is 32. Thus, there is no huge gap between age groups. Median age is low in some counties such as Bagcilar and Esenler. The population of these counties is high but economical structure is low.

This study also looked into unemployment rate and education level relations. The number of social media users is close and the highest at high school and undergraduate program levels. As a result, social media users are living in Adalar, Bakirkoy, and Besiktas counties have high unemployment rate and high school education level. Besides, most of social media users were defined at low-income level, especially low and lower middle.

After examining thematic maps, spatial pattern was explored with ESDA tools. Firstly, mean center was determined as Beyoglu county for Istanbul. Directional distribution of the users was found as North-Weast and South-East direction. It gives an in idea about social media users where distributed in Turkey (Figure 1). Normal QQ plot shows huge differences between some counties. For example, Kadikoy has the maximum number and Catalca has the minimum number of social media users. General QQ plot comparing two data attributes shows that income and education level has a strong relation (Figure 2).

When hot-spot analysis was applied, high values were clustered in European sides of Istanbul rather than Anatolian sides in

Istanbul. When it was applied for Istanbul city, high values were clustered geographically in Zeytinburnu and Gungoren and low values were clustered in Catalca and Silivri (Figure 3). So, hot-spot analysis helps to answer how many and where questions (Erkus, 2014).

4. CONCLUSION

A variety of geostatistics techniques were used to identify the users' profile. The methodology utilized in this study can be accepted as general working steps. First of all, it is important to find the best analysis method for dataset.

The overall pattern of the results shows strong relations between user profiles. For this aim, ESDA tools help to identify the explanatory variables for regression analysis. These explanatory variables are educational level and income level in this study.

The managers of social media platforms can decide how the users should be encouraged and where initiatives should focus on. Various ways can be used to focus on target area, but in this study the number of the users with relating statistical data were considered to identify user profiles and meaningful results. These analysis approaches should be implemented in determining the platform's development policy.

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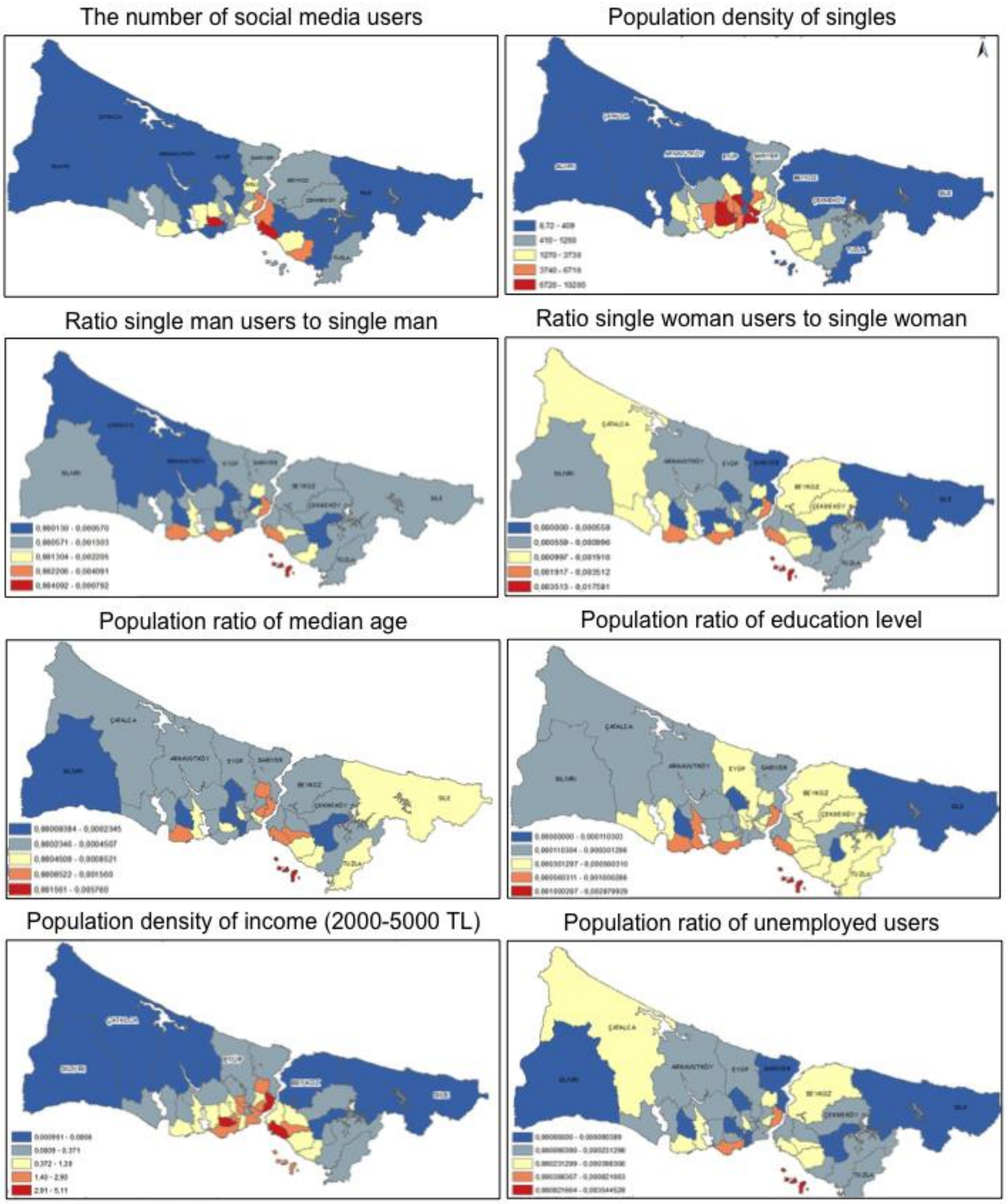

Figure 4. Thematic maps of demographics of the platform users in Istanbul

SIMULATION OF ACCUMULATED SOIL CONTAMINANTS IN THE IMPACT ZONE OF NOVOCHERKASSK POWER PLANT USING GIS TECHNOLOGIES

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ABSTRACT:

The indicator-factor model of pollutants accumulated in the soil due to air emissions is considered as a set of interacting in time and space models for the distribution (atmospheric transfer), precipitation, transformation, and removal of pollutants. The stage of pollutant accumulation in the surface soil layer is considered as interaction of the model for calculating the averaged concentration in the atmospheric air and the model of land topography. Algorithms are proposed for the implementation of the model for the raster presentation of local neighborhood in GIS using geomorphological analysis. Methods are reviewed for the geomorphological analysis and determination of morphometric parameters used in the development of indicator-factor model for predicting the transformation and removal of pollutants.

KEY WORDS: Geoinformation Technologies, Digital Soil Mapping and Simulation, Indicator-Factor Model, Accumulated Air Pollution, Geomorphological Analysis, Soil Survey Archives.

1. INTRODUCTION

Complex environmental models are frequently considered as a set of partial models for natural phenomena and their interactions (decomposition) (Gorstko, 1979). Calculation of pollutants accumulated on the soil due to atmospheric emissions of anthropogenic origin is one of such tasks. The calculation procedure proposed more than 30 years ago (Vazhenin, 1987) was based on models for the dispersion of pollutants in the atmosphere, their deposition onto the soil, transformation, and removal (horizontal and vertical). The general approach and the composition of indicator-factor model are based on the analysis of the conventional package of raster soil-landscape maps by local (point-neighborhood) methods of factor determination. However, the point (local) analysis alone is insufficient to describe mechanisms of sediment accumulation (runoff and transport) in the dynamic long-term prediction from incomplete soil information. The known approach to the calculation of indicator-factor model for missing soil parameters (factors) from regional indicator parameters (relative position of the point on the relief form) rather than local parameters (small neighborhood of the point) is applied in this case (Jenness, 2013; Florinskii, 2016).

2. MATERIALS AND METHODS

The distribution of pollutants is mainly affected by the direction and strength of wind in the surface layer of the atmosphere, its vertical distribution, variability, and other meteorological parameters. Models and mathematical tools used for this purpose are reviewed in literature (Berland, 1985). The Gaussian model of spatial distribution and the model of mass transfer in the form of turbulent diffusion equation are most popular and frequently implemented.

In Russia, procedure OND-86 is used for calculating the local contamination by atmospheric emissions from thermal power stations (TPSs), which is reduced to a series of analytical expressions solved by the difference approximation of the turbulent diffusion equation. Procedure OND-86 calculates the maximum possible distribution of emission concentrations at a distance of 2 m from the earth surface under moderately unstable atmospheric conditions averaged over a 20-min interval, but it takes no account of such factors as the stability class of the atmosphere and the heterogeneity of the underlying surface.

Conventional approaches to pollution mapping are based on the selection of a reference set of key objects, the registration of pollutant concentrations in these points, and the creation of pollution map by spatial-statistical methods using relief models. With low number of points the effect of relief (the position of the point on the relief) on the concentration of pollutants can be calculated by hand individually for each point. It is suggested that a schematic topographic map, e.g., in the form of isolines, is available for the area. In this case, it is sufficient to visually identify typical relief forms (slope, hollow, etc.) in the contamination zone and then perform calculations using ratio tables with consideration for regional features and landscape (mountains, plain, etc.).

The aim of this study is to develop an indicator-factor model for the accumulation of atmospheric pollutants in the impact zone of the Novocherkassk power plant (NPP) as a set of models for the distribution (atmospheric transfer), deposition, transformation, and removal of pollutants using GIS technologies.

3. RESULTS AND DISCUSSION

The indicator-factor model of atmospheric pollutant accumulation is developed by calculating the interaction of models for the atmospheric diffusion transport of pollutants from the four chimneys of the NPP. The data sources include materials of soil survey, vegetation maps, meteorological data, digital elevation models, and long-term monitoring data of the NPP impact zone.

A plot containing gentle slopes, an incline, a ridge, and a bench was selected according to the procedure of calculating the local pollution with atmospheric emissions from TPSs (Order of the RF Ministry of Natural Resources of January 1, 2018; Vazhenin, 1987).

The predicted accumulated pollutant concentration on the same area was calculated without consideration for land topography. Calculation was based on meteorological data for 2016–2017. The pollution map for this period agreed with the observations of preceding years, which points to steady emission rhythm and atmosphere behavior on average for the year (Fig. 1).

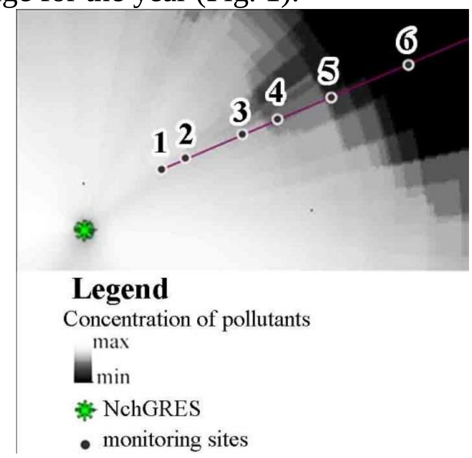

Fig. 1. Calculated pollutant concentrations in soils of monitoring plots during 2016–2017.

To study the vertical removal of pollutants depending on the texture and type of soil, monitoring plots 1–6 were established on different relief elements.

The experimental design included the analysis of area using Google Earth (Fig. 2). Thus, the elevation difference was estimated; a preliminary view of land profile with respect to the pollution source was obtained, and sampling points were selected.

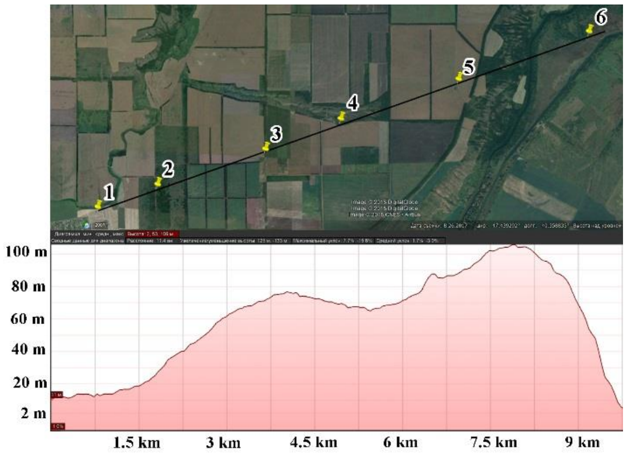

Fig. 2. Screenshot: experimental design in Google Earth.

The digital elevation model and the digital pollution map were transferred to the ArcGIS system together with the track and sampling points. To tabulate the profiles of the digital relief model and pollutants, the StackProfile (3D Analyst) tool was used (Hengl, 2008). The length ranges of the identified relief forms were also calculated: 6000–8000 m for the bench, 4000–6000 m for the ridge, and 0–4000 m for the incline.

The main results of the current stage of the study are the developed calculation scheme, the algorithm of automated calculation of geomorphometric parameters, and the calculation of their correcting impact on the level of pollutants determined from the diffusion transfer model. The high labor content and cost of soil (or plant) sampling and analysis complicate measurements in hundreds of thousands or millions of points, which are necessary for the development of the matrix of landscape parameters. In practice, a specific soil parameter is measured at about 200 sites, and the obtained results are statistically compared with the values of the digital elevation model calculated for the same sites on a large scale. About 10% of the sites are excluded from the calibration sets and are used for the validation of the developed pedotransfer functions.

Pedotransfer functions, which are related to the lateral transfer, uptake, and chemical decomposition of pollutants depending on the accumulative or denudation forms of relief, can be also calculated automatically using the described model. Then, the complete cycle of pollutant accumulation in the soil can be mapped within the framework of the indicator-factor model.

The vertical removal of pollutants depending on the texture and type of soil was calculated for the impact zone of NPP in ArcGIS using the indicator-factor model.

The filterability of soils and, hence, the migration and accumulation of technogenic pollutants are determined with consideration for the content of physical clay (particles <0.01 mm) in the soil. The filterability of soil is measured in Darcy units. This is a special permeability unit of porous media approximately equal to 1 μm^2.

Clay, heavy loam, and medium loam are the main particle size fractions in the area; therefore, the following filterability values were assigned: 1, 20, 40, and 1000, respectively. The extreme values in this series of soil filterability indicate the minimum (1, maximum accumulation of pollutants) and maximum (1000, minimum accumulation of pollutants) soil permeability.

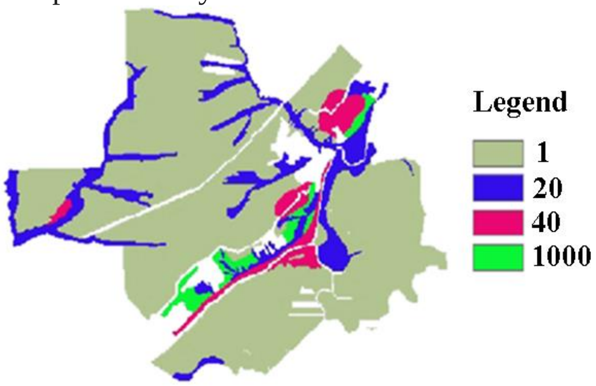

Fig. 3. Rasterized layer of the digital map of soil filterability for a fragment of the NPP impact zone.

After filterability determination, the vector layer of digital soil map was rasterized with respect to soil permeability for each texture value (Fig. 3). Elementary areas with homogeneous texture were identified on the soil map based on geomorphological parameters.

4. CONCLUSIONS

An indicator-factor model was developed for the accumulated atmospheric contamination of the NPP impact zone. The model was implemented in a GIS project composed of the following four groups of layers: accumulated atmospheric contamination; accumulation of pollutants depending on the form (hill, depression) and orientation of relief elements; transformation and filtration of pollutants depending on soil type and subtype; content of humus and texture of soil. The model can reveal regularities in the spatial distribution of technogenic emissions (including heavy metals) in the vicinity of the contaminating plants and predict the hazard of technogenic emissions for the environment (vegetation, wildlife, and humans).

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RELATIONSHIP BETWEEN CADASTRE VALUE OF LAND AND BONITET SCOREOF SOILS OF STAVROPOL TERRITORY

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ABSTRACT:

The soil cover of the Stavropol Territory is complex and diverse. The most common are chernozems, chestnut soils, solonetzes with solonetsous complexes. In the Stavropol territory there are 4 climatic zones: extremely arid with a hydrothermal coefficient (GTK) 0.4-0.7, arid (GTK 0.7-0.9), insufficient moistening (STC 0.9-1.1), and sufficient moisture (SCC 1.1-1.3). They compared the cadastral value of land, the soil quality score, the average productivity of winter wheat for the last 5 years, and determined the availability of 1 point of soil quality in the amount of winter wheat yield. It was established that the cadastral value of land does not always coincide with the soil quality score. Very often a higher cadastral value corresponds to a lower cadastral value. The average cadastral value of land and the average yield of winter wheat have a low correlation (0.31), which indicates a low level of interrelation between these factors. In an extremely dry climatic zone, 1 point of soil quality is provided by the production of winter wheat in 2 times higher than in the zone of sufficient moisture, which indicates the imperfection of the method of soil classification. In the territory, it is necessary to update the cadastral value of land and develop a more advanced methodology for soil classification.

KEY WORDS: Stavropol Territory, cadastral value, soil classification, winter wheat, correlation.

INTRODUCTION

Soil bonitizing is a qualitative assessment of soils by their fertility. The main indicators that are taken into account in bonitizing are the content of humus in the arable layer of soil (%), the reserves of humus in the soil (t / ha), the thickness of the soil (cm) and the content of physical clay (%). The average score of bonitet is corrected by the correction factors for salinity, solonetsousness, waterlogging, erosion, stony, etc. All these indicators are taken into account in the system of cadastral valuation of agricultural land. The cadastral valuation itself is the basis for taxation. (Truhachev, V.I. and other, 2003)

In recent years, judicial complaints from the agricultural enterprises of the region have become more frequent in the unreasonable overestimation of the cadastral value of land. As a result, the tax burden on the economy also increases (Zhukov, V.D. and Z.R. Sheudzhen 2015). The main purpose of the research was to discover the interconnection and interdependence between the indicators of cadastral value of land, the bonitet score and the yield of the main agricultural crop of the region - winter wheat. The yield of winter wheat was calculated as an average for 5 years from 2013 to 2017.

METHODS AND OBJECTS OF RESEARCH

The soil cover of the Stavropol Territory is complex and diverse. It is characterized by diversity, heterogeneity and significant complexity of combining zonal and intrazonal soils. More than 4500 soil differences are allocated at the level of species, variety and discharge.

The territory of the Stavropol Territory can be conditionally divided into two almost equal soil zones: western - chernozem, occupying 3136 thousand hectares (47.4%) and eastern - chestnut, occupying 3480 thousand hectares (52.6%).

The main soils are ordinary calcareous chernozems, distributed on an area of 1,254,000 ha (19.8%) and southern, occupying 658 thousand hectares (10.4%). Among the *chestnut* soils there are dark chestnut, chestnut and light chestnut soils. Dark chestnut carbonate soils occupy 1112 thousand hectares (17.7%). Introsonal*solonetzes* are common in both chestnut and chernozem zones. In the chestnut zone they are confined to the eastern and north-eastern part of the edge in the Manych depression and in the lower reaches of the Kalausriver, and in the chernozem zone, mainly in the Yankul and Sengileevskaya basins. Their area is 473 thousand hectares or 7.5% (Slyusarev V.N., and other. 2013).

Table 1 - Soil areas of the Stavropol Territory

Soilname	Area	
	th.h	%
Leached chernozems	55	0,9
Chernozems ordinary carbonate	1254	19,8
Common solonetzous chernozems	405	6,4
Southern Chernozems	658	10,4
Dark chestnut carbonate	1112	17,6
Dark chestnut solonetsous	154	2,3
Chestnut carbonate	316	5,0
Chestnut solonetsous	734	11,6
Light chestnut carbonate	246	3,9
Light chestnut solonetsous and solonchakous	162	2,6
Sands	239	3,8
Meadow	111	1,8
Alluvial soils	362	5,7
Solonetzes	473	0,7
Solonchaks	43	7,5
Total in the territory	6324,0	100,00

The region is divided into 4 climatic zones: 1. The zone is extremely arid - the amount of precipitation for the year is within 300-350mm, the hydrothermal coefficient (GTK) is 0.4-0.7, the soils are light chestnut and chestnut in a complex with solonetzes and alkaline soils; 2. Dry zone - total precipitation is 350-415 mm, GTK is 0.7-0.9, soils are chestnut and dark chestnut; 3. Inadequate humidification zone - the sum of precipitation is 450-530 mm, the SCC is 0.9-1.1, the chernozem soils are ordinary and southern in a complex with solonetsous soils; 4. The zone of sufficient moisture is the sum of precipitation 550-700mm, the SCC is 1.1-1.3, the soil is ordinary and leached chernozem (Tskhovrebov, V.S. and Faizova V.I. 2015).

RESULTS AND DISCUSSION

In general, if the quality of the soil is expressed in the Bonitet score, it can be concluded that the level of effective fertility varies greatly. The reason for this, first of all, is the huge climate differences across the regions of the region.

Regions	Average cadastral value of 1 ha of land, rub	Points of bonitet	Average yield q / ha	c / ha per 1 point of bonitet
Extremely arid zone (light chestnut, chestnut soils in the complex with solonetses)				
Apanasenkovsky	43900	23	38,9	1,7
Arzgirsky	50800	29	35,3	1,2
Neftekumsky	44000	19	37,5	2,0
Levokumsky	45400	24	32,5	1,4
The arid zone (chestnut and dark chestnut soils)				
Budennovskiy	64200	39	39,4	1,0
Blagodarnenskiy	63100	40	38,8	1,0
Ipatovsky	73000	42	37,4	0,9
Kursky	51600	33	31,1	0,9
Novoseletskiy	61300	50	41,7	0,8
Petrovsky	57700	48	35,0	0,7
Sovietsky	69300	43	43,4	1,0
Stepnovsky	56200	36	32,2	0,9
Turkmensky	52400	30	34,6	1,2
Zone of insufficient moisture (chernozems common, southern in complex with solonetsous)				
Aleksandrovsky	62600	52	39,5	0,8
Andropovsky	56400	42	29,6	0,7
Grachevsky	58500	48	35,3	0,7
Georgievsky	65200	55	39,7	0,7
Izobilnensky	73000	59	45,7	0,8
Kirovsky	64600	55	36,9	0,7
Kochubeyevsky	59800	49	54,4	1,1
Krasnogvardeysky	65900	58	46,5	0,8
Novoaleksandrivsky	79100	74	55,7	0,8
Trunovsky	65900	56	43,1	0,8
Zone of sufficient moistening (chernozems common and leached)				
Mineralavodsky	66700	51	38,2	0,7
Predgorny	61300	68	39,5	0,6
Shpakovsky	61100	46	37,0	0,8
In the region	55800	47	39	0,8

Table 2 - Bonitet score, cadastral value of land and productivity of winter wheat by districts

In determining the relationship of the factors studied, it was revealed that the lowest grade of bonitet is in the Neftekumsky district (19 points) and the largest in Novoaleksandrovsky (74 points). The difference is 55 points or 3.9 times. It would seem that one can expect a difference in the yield of winter wheat at the determining the relationship of the factors studied, it was revealed that the lowest grade of bonitet is in the Neftekumsky district (19 points) and the largest in Novoaleksandrovsky (74 points). The difference is 55 points or 3.9 times. It would seem that one can expect a difference in the yield of winter wheat at the same level. But this does not happen. The yield of the main culture of the region on average for 5 years in the Neftekumsk district was 37.5 c / ha versus 55.7 c / ha in Novoaleksandrovsky district. The difference is only 1.5 times.

The potential fertility of soils in the chestnut zone is very high. The yield of the crop, as can be seen from Table 2, was slightly different from the chernozem zone in some of the arid regions of the chestnut zone. So, for example, the wheat yield in the same Neftekumsk district was higher than the average for some areas of the chernozem zone, such as Andropov, Grachevsky, Kirovsky and Shpakovsky. In the Apanasenkovskoye region, the indicator studied was approximately at the same level as the Mineralovodsky District with a bonitet rating of 2.2 times lower. Consequently, the current assessment of soils is not objective and requires improvement. It is necessary to take into account the fact that in a very arid zone fertilizers are applied several times less than in the more humid zones. So in a very arid region fertilizers are applied in the range of 30-40 kg / ha in the active substance, and in the wet chernozem zone - 80-110 kg / ha. It should be noted that the extremely arid zone is represented by light chestnut and chestnut soils in combination with solonetzes, which are unfavorable soils by their water-physical characteristics.

The bonitet score does not always coincide with the cadastral value of land. In the arid zone in Budennovsky, Ipatovskoye, Sovetsky district, on light chestnut and chestnut soils, the bonitet score is in the range from 39 to 43, with an average cadastral value of 64200 to 73,000 rubles / ha. At the same time, in relatively well-humidified Grachevsky, Kochubeev, Mineralovodsky, Predgorny and Shpakovsky districts, which have predominantly chernozems, the usual powerful bonitet score is significantly higher, and the cadastral value is lower. So, for example, in the Ipatovskiy district, the bonitet score is 42, and the cadastral value is 73,000 rubles / ha. On the contrary, in the Predgorny district, the bonitet score is 16 points higher, and the cadastral value is lower by 8700 rubles / ha.

Such a factor as the location of land, which is taken into account in the cadastral valuation, also does not coincide with the cadastral value. So, for example, the lands of the Piedmont District, where the second highest score of bonitet (68) after Novoaleksandrovsky district, located in a favorable resort place and near economically developed zones, have a relatively small cadastral value, lower than in most areas of the arid zone, more remote from the regional center and resorts. This indicates a lack of cadastral valuation of land, or serious errors in the performance of calculations. In both cases, this is a subjective factor that can be easily eliminated with the joint effort of all stakeholders.

While carrying out the mathematical processing of the obtained data, it was found out, nevertheless, that there is a correlation between the average cadastral value and the bonitet score with a correlation coefficient of 0.80. Comparing the bonitet score and the average yield of winter wheat received a lower correlation coefficient of 0.58. But when we compared the average yield with the average cadastral value, then the correlation dependence was found to be below the average, only 0.31.

We calculated how many winter wheat products account for 1 point of bonitet in the regions of our region. It turned out that in an extremely arid zone 1 point of bonitetes falls from 1.2 to 2.0 c / ha of products, in the arid zone from 0.8 to 1.2 c / ha, in the zone of insufficient moisture from 0.7 to 1, 1 centner / ha, and in the zone of sufficient moisture only 0.6 to 0.8 centner / ha. Consequently, in a highly arid zone, 1 point of bonitet is provided with a product 2 times higher than in a zone of sufficient moisture. This indicates the imperfection of soil classification. It is more based on the content of humus (%) in the upper arable horizon and on the reserves of humus (t / ha) in the soil layer. Soil assessment does not take into account such important indicators as mineralogical composition, gross content of nutrients, the state of physical and water properties, etc.

CONCLUSION

Thus, the cadastral value of agricultural land Stavropol Territory does not always correspond to the real state of things and does not coincide with the score of soil quality. The main reason for this lies in the errors made in the cadastral valuation. The average cadastral value of land and average yield of winter wheat have a low degree of correlation (0.31), which indicates a low level of interrelation between these factors. In an extremely dry climatic zone, 1 point of bonitet is provided by the production of winter wheat in 2 times higher than in the zone of sufficient moisture, which indicates the imperfection of the method of soil classification. It is more based on the content of humus and its reserves in the soil layer and does not take into account such important indicators as the mineralogical composition, the total content of nutrients, the state of physical and water properties, etc. In the region, it is necessary to update the cadastral value of land and develop a more advanced method of soil classification.

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SEGMENTATION QUALITY ASSESSMENT FOR VARYING SPATIAL RESOLUTIONS OF VERY HIGH RESOLUTION SATELLITE IMAGERY

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ABSTRACT:

Due to the complex nature of remotely sensed imagery, it is difficult to construct meaningful image objects by segmenting a landscape features in an image. Because many factors including parameter selection, band weights, spectral resolution, spatial resolution and textural information affect the quality of the segments to be produced, a comprehensive analysis is required to assure high quality image objects. In this study, the influence of the spatial resolution on segmentation quality was analysed using Worldview-2 satellite image at five different spatial resolutions (0.5, 2, 4, 8, 16 meters). The multiresolution segmentation algorithm, the most widely used method and available in eCognition software, was utilized for the segmentation processes in this study. The effect of spatial resolution on the segmentation quality was investigated on three specific land use/cover types namely, building, pasture and road by using quality measures of shape index, area fit index and quality rate. It has been observed that resampling the image from 0.5 to 2, 4, 8, 16 meters remarkably reduced the quality of the segmentation results. For instance, when increasing the spatial resolution from 8 to 16 meters, the quality rate decreased by about 77% for road class. The results of this study revealed that the use of 4 meters or higher resolutions (i.e. 0.5 and 2 meters) would produce acceptable results in terms of segmentation quality metrics. When the lower resolution is preferred, the quality of the segments decreases considerably, thus the created image objects become too coarse, indicating an increase in under-segmentation.

KEY WORDS: Object-based image analysis, Segmentation quality, Spatial resolution, Multi-resolution segmentation

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1. INTRODUCTION

High spatial resolution remote sensing images provide more detailed spatial information than medium and coarse spatial resolution images in deriving information about the earth (Cheng et al., 2014). The widespread use of high-resolution images in remote sensing has greatly facilitated the creation and updating of land cover/use maps. Traditional pixel-based image analysis approaches, only use spectral information (pixel values) as a basis to analyse and classify remote-sensing images while disregarding spatial, textural, and contextual information (Cheng et al., 2014; Kavzoglu, 2017). Alternatively, object-based image analysis (OBIA) has recently become a more important trend in remote sensing. OBIA consists of two steps: image segmentation and classification. Segmentation, the first stage of OBIA, has a direct influence on the quality of final classification accuracy (Kavzoglu and Tonbul, 2018). Ideally, constructed segment boundaries should overlap perfectly with the real earth surface objects. The rate of mis-overlap indicates the segmentation quality, which considerably influences following image classification accuracy (Kim et al., 2009; Clinton et al., 2010). Therefore, quantitative methods should be applied to evaluate the segmentation results and efforts should be conducted to obtain the best results.

In remote sensing images, the image segmentation quality varies greatly depending on the different land use/cover classes and the image segmentation algorithm to be applied. In addition, the selection of segmentation parameters may also cause different image objects to be created (Johnson and Xie, 2011). There are many ways to evaluate the accuracy of image segmentation quality and they can generally be divided into two approaches: supervised (or empirical discrepancy methods) and unsupervised (or empirical goodness methods) approaches (Zhang 1996; Zhang et al., 2008). Supervised methods evaluate the segmentation result with quantitative or numerical analysis depending on the ground or reference objects. Unsupervised methods evaluate the image based on human perceptions and utilize certain quality criteria for matching the segmentation (Zhang 1996; Zhang et al., 2008). According to Zhang (1996), supervised methods can be objective and quantitative to evaluate segmentation results as long as reference objects can be obtained. Therefore, the authors preferred the supervised method to evaluate segmentation results.

While there are many studies in the literature investigating the effect of various factors on the segmentation quality, a limited number of studies exist about the effect of spatial resolution on the constructed segments (Mesner and Oštir, 2014; Lenarčič et al., 2015). The aim of this study is to evaluate the satellite image segmentation quality using different spatial resolutions, as well as different segmentation algorithm parameter settings. In this context, three specific land use/cover types namely, building, pasture and road were utilized to determine impact of spatial resolution on the segmentation quality.

2. STUDY AREA AND IMAGERY

In this study, a multispectral WorldView-2 high resolution satellite image with eight spectral bands at 2 m spatial resolution obtained on March 21, 2012 was used. The eight bands include blue (450-510 nm), green (510–580 nm), red (630–690 nm), near infrared-1 (770–900 nm, coastal blue (400–450 nm), yellow (590–630 nm), red edge (710–750 nm), near infrared-2 (860–1040 nm). The satellite also offers a panchromatic band (460–800 nm) having 0.5 m spatial resolution. The image has been acquired from the DigitalGlobe Inc. online data product sample. The study area is located in San Clemente, California, USA (3000 x 3000 pixels) is selected because it contains different land use/cover classes (Figure 1).

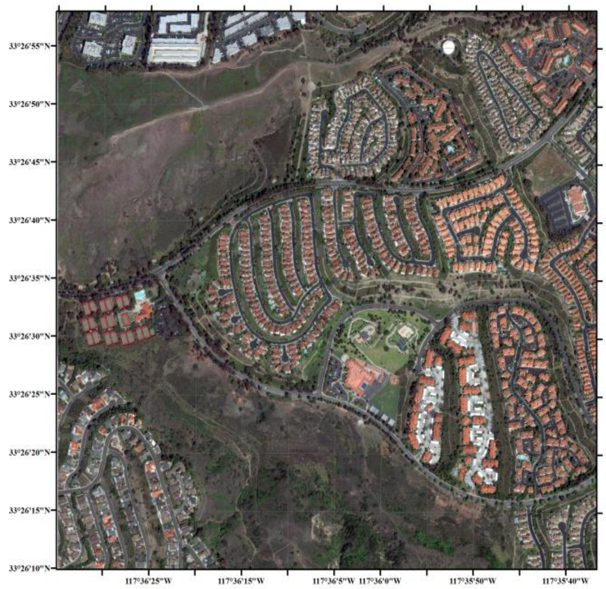

Figure 1. Location of the study area. San Clemente, USA

3. METHODOLOGY

3.1 Multi-resolution Segmentation

The multi-resolution segmentation algorithm is a bottom-up approach based on local homogeneity criteria. This approach starts at the pixel level and collects pixels of different shapes, sizes, and properties in image objects until they reach a homogeneous threshold specified by the user (Baatz and Schäpe, 2000). Thus, the maximum allowed heterogeneity for the generated image objects is determined. Multi-resolution segmentation consists of three parameters: scale, shape and compactness. Scale parameter is the most effective parameter that determines the average image object size. It designates the maximum allowed heterogeneity for creating segments (Kim et al., 2011). As the scale parameter gets higher value, larger objects are created. Shape parameter determines the spatial homogeneity and helps to discriminate classes and compactness has a direct effect on quality of the boundaries of image objects (Kavzoglu et al., 2017). The multi-resolution segmentation is embedded in the eCognition Developer software for OBIA operations.

3.2 Evaluation of Segmentation Quality

Segmentation is the first and intrinsic step of image analysis workflow. In the ideal case, over-segmentation and under-segmentation should be minimum level and the real Earth objects overlap with the constructed image objects (Kavzoglu et al., 2017). Therefore, it is important to conduct a cognitive assessment of segmentation quality for created segments (Kavzoglu and Tonbul, 2018).

In this study, three segmentation evaluation metrics (i.e. shape index (SI), area fit index (*AFI*) and quality rate (*Qr*)) were used for evaluating the segmentation quality of constructed image objects. Formulations of the metrics are presented in Table 1. Where $A_{r(i)}$ specifies total area of reference objects and $A_{s(j)}$ shows the e total area of corresponding created segments. Furthermore, shows the object perimeter and indicates the object area.

Quality Metric	Formula	Source
Shape Index	$SI = \frac{P}{4.\sqrt{A}}$	Neubert et al., (2006)
Area-fit index	$AFI = \left\| \frac{A_{r(i)} - A_{s(j)}}{A_{r(i)}} \right\|$	Lucieer and Stein, (2002)
Quality rate	$Qr = \frac{A_{r(i} \bigcap A_{s(j)}}{A_{r(i)} \bigcup A_{s(j)}}$	Winter et al., (2000)

Table 1. Description of segmentation quality metrics

The *SI* depicts the border smoothness and complexity of an object. The bigger *SI* addresses the object is more complex (Zhang et al., 2014). *AFI* estimates the degree of overlap between a reference polygon and its corresponded segments. *Qr* presents overlap between reference objects and corresponding segments. In the ideal case of perfect spatial match between reference polygons and created image objects, *AFI* would be zero and *Qr* would be 1.

4. RESULTS

First of all, each of the eight WorldView-2 bands was resampled from fine spatial resolution to coarse spatial resolution gradually. The resampling process for all Worldview-2 bands performed in five different levels, ranging from 0.5 meters to 16 meters. The nearest neighbour resampling technique was used for resampling the data. Figure 2 shows the sub images of resampled WorldView-2 true colour composite.

In order to scrutinize the effect of the spatial resolution on the segmentation quality, a series of segmentation processes were implemented. Due to the different spatial resolutions, optimal parameter values for segmentation have been reestimated for each image separately. In searching optimal scale value, Estimation of Scale Parameter (ESP-2) tool developed by Drăguţ et al. (2014) was used.

The shape and compactness were taken as constant values of 0.1 and 0.7, respectively. The parameter analysis of the multi-resolution algorithm consists of 5 segmentations with a varying parameter scale, shape and compactness (Table 2).

In the process setting, all eight bands of Worldview-2 imagery were utilized and weights of the spectral bands were set equally. At the end of segmentation processes, totally 55,681, 9,520, 2,331, 1,984 and 1,004 image objects were created for 0.5, 2, 4, 8, 16 meters spatial resolutions, respectively. All segmentation analyses were performed using eCognition software (Definiens Imaging, Munchen, Germany, version 9.2) and ArcGIS (version 10.0) software.

The segmentations results were estimated by comparing the geometries of created image objects with reference polygons. In order to conduct inclusive analyses on the resulting segmentation images, specific portions of the imagery including three specific land use/cover types namely, building, pasture and road were subtracted, and detailed quality assessments were conducted on the segments of these classes separately. The referenced polygons were manually digitized by using ArcGIS software package. Totally 30 reference polygons (13 polygons for building, 10 polygons for pasture and 7 polygons for roads) were selected. Three sample sites for each LULC type showing the segments generated by the different spatial resolutions and related reference polygons were extracted and shown as zoomed in Figure 3.

Spatial Resolution(m)	Scal	Shap	Compactne
0.5	35	0.3	0.7
2	24	0.3	0.7
4	25	0.3	0.7
8	16	0.3	0.7
16	13	0.3	0.7

Table 2. Summary of parameter settings

It should be stated that the analyses were performed on the extent of the whole image, but sample sites showed the efficiency of implemented segmentation algorithms in the creation of segments. As can be seen from the figure 3a, 0,5, 2 and 4 m resolutions segmented the boundaries of roads better than the 8 and 16 m resolutions. For the pasture, reference polygons and constructed segments overlay perfectly only 0.5 and 2 m resolutions, however other resolutions (i.e. 4, 8, 16 m) exposed to under-segmentation (Figure 3b). When the segments for building were analysed, it was observed that the segmentation quality similar to pasture classes and 0.5 and 2 m resolutions segmentation results were successful (Figure 3c). In general, it can be stated that that the and 0.5 and 2 m resolutions produced the most reasonable image objects compared to the others.

Figure 2. Comparison of varying spatial resolution: a) 0.5 m, b) 2m, c) 4m, d) 8m, e) 16m

In order to compare the goodness of segments generated by the five different resolutions, three quality measures (i.e. SI, AFI and Qr) were calculated for the segmentation results produced for three LULC separately.

It should be noted that, with a minimum percent overlap of 50%, were utilized to evaluate segmentation results. If the overlap of the segment and the reference object is <50%, this object is not selected in analysis.

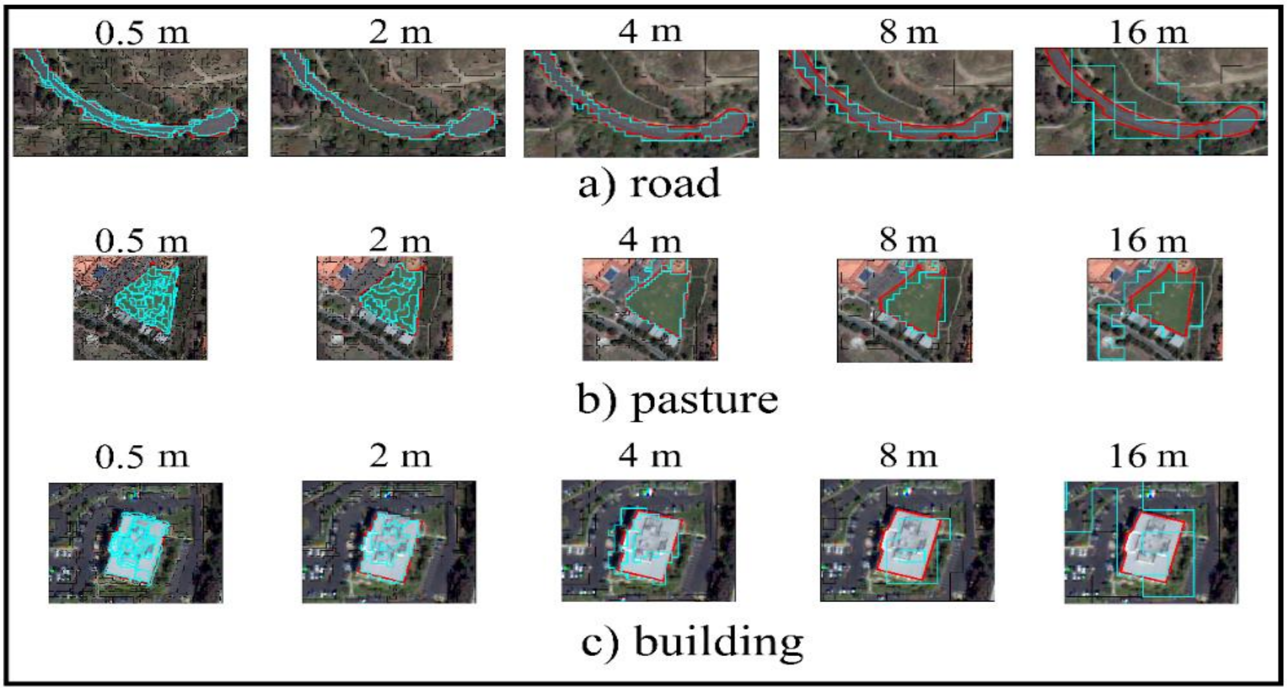

Figure 3. Comparison of selected reference areas with corresponding segments generated by five different spatial resolutions. The red polygons display the reference areas while the blue polygons illustrate the corresponding segments.

Spatial Resolution (m)	Reference Object	*AFI*	*Qr*	*SI*
0,5	Road	0.017	0.842	30.249
	Pasture	0.084	0.905	25.926
	Building	0.013	0.888	23.251
2	Road	0.028	0.740	11.199
	Pasture	0.083	0.899	13.145
	Building	0.075	0.761	10.559
4	Road	0.089	0.629	7.998
	Pasture	0.388	0.659	6.024
	Building	0.145	0.505	6.600
8	Road	0.508	0.418	7.256
	Pasture	0.477	0.515	5.350
	Building	0.481	0.385	4.260
16	Road	0.567	0.291	4.900
	Pasture	0.782	0.347	4.595
	Building	2.681	0.247	4.012

Table 3. Segmentation quality assessment of reference objects for road, pasture and building classes using 0.5, 2, 4, 8, 16 m spatial resolutions.

Table 3 illustrates the summary of the quality evaluation for each spatial resolution. It can be observed that higher spatial resolution produces more segments than lower one. It is worth noting that the pan-sharpened image (i.e. 0.5 m spatial resolution) generated better segments in terms of all quality metrics.

According to the estimated quality values, the 16 m resolution generated the worst accuracy results in terms of shape index, *AFI*, and *Qr*. When increasing the spatial resolution, it was seen that all segmentation quality results dramatically decreased. For instance, when increasing the spatial resolution from 8 to 16 meters, the quality rate decreased by about 77% for road class. For other classes (i.e. pasture and building), the decrease in quality ratio was observed as nearly 48% and 56%, respectively.

Segmentation quality comparisons between classes according to *Qr* value differences were illustrated in Table 4. When the pixel size was reduced to 2 meters for pasture class, almost no change (less than 1%) was estimated. This definitely indicates the change in segmentation quality depending on the specific class features. This finding can be also validated from the results of other classes (changes in *Qr* values are not linear nor uniform).

Reference Object	Spatial Resolution (m)	Difference in *Qr*	Difference in *Qr* (%)
Road	0.5 – 2	0.102	13.78
	2 – 4	0.111	17.64
	4 – 8	0.114	22.13
	8 - 16	0.224	76.97
Pasture	0.5 – 2	0.006	0.66
	2 – 4	0.240	36.41
	4 – 8	0.144	27.96
	8 - 16	0.168	48.41
Building	0.5 – 2	0.127	16.68
	2 – 4	0.256	50.69
	4 – 8	0.120	31.16
	8 - 16	0.138	55.87

Table 4. Segmentation evaluation according to *Qr* value differences

5. CONCLUSIONS

In this study, the effect of segmentation quality on different land use/cover classes (building, pasture and road) was investigated based on the varying spatial resolution. The optimal parameters of multi-resolution segmentation have been determined based on unsupervised estimation tool (ESP-2 tool) and trial-and-error method for each spatial resolution. Overall, this study aims to optimize the spatial resolution of WorldView-2 imagery for discriminating pasture, road and building classes. The spatial analysis of segmentation shows that the use of high-spatial resolution data offers a higher quality of segmentation. The best segmentation results were achieved in all metrics for the original image (i.e. 0.5 m), the worst results were estimated for the 16 m image. The down-sampling the spatial resolution extremely diminished the segmentation quality and the objects are not recognized. The result is important in understanding the effect of optimizing spatial resolution for remote sensing applications.

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SPATIAL PROPERTY SYSTEM AS A BASIC INDICATOR OF GEOSPATIAL MATURITY IN TURKEY

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ABSTRACT:

Within the framework of developing spatial technologies, cadastral systems are evolving, undertaking new vision and roles. Twenty years ago, we only talked about tax cadastre, multipurpose cadastre and legal cadastre, but nowadays land administration and sustainability are in our agenda. In today's understanding, cadastre has become a part of economy, society, justice and social life.

Our society today is being challenged by issues of global scale: economic development, social conflicts, urban growth, rural development, climate change, global warming, carbon credit management, or disaster management, are just a few issues that need careful assessment and sustainable action. In one way or another, all those issues are linked to location, as “everything happens somewhere”, i.e. there is a need for effective and efficient geo-information.

There are essentially six key elements required to help realize the vision of spatially enabled society. These are legal framework, data integration, positioning infrastructure, spatial data infrastructure, land ownership information, increasing availability of free to re-use geospatial data. When organizations, cities, and regions understand how mature their geospatial data and processes are, they can begin to meet their objectives-opening up more data, ensuring better transparency, and reducing costs.

This article summarizes spatial maturity as an indicator of the institutional spatial maturation process, and explains the “spatial property system” inquiries completed directly by citizens and other institutions, which have reached 100.000.000 a month on average.

KEY WORDS: Spatial Property System, Map Services, e-Government Services, Orthophoto Services, Spatial Maturity

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1. INTRODUCTION

Spatial information technologies and sustainability theory drove the creation of new visions, models and roles for the cadastre for the past three decades. The public administration, the private companies and citizens need accurate spatial positioning, easy access to accurate and trusted spatial information on all relevant boundaries. People will need information technology that enables them to visualize this boundary information relative to the real world or spatial information about the real world. In order to meet these needs, the Australian Cadastral Strategy document has been developed and the document underlines the importance of digitally readable and presentable cadastral data (Grant et al, 2014).

Cadastre 2014 concept is a very important document that reveals technical developments as a roadmap. Since its publication the document, has become a "transformation and application" booklet for Cadastre organizations. There are six future oriented statements in the document and especially from 2nd to 6th statements were extremely important for Turkish cadastre. Because the juridical cadastral system applied in Turkey since 1926, the requirements of number 1 statement were already fulfilled in legal sense.

The technical trends of Cadastre 2014 are given as an automation of system, scanning, digitizing, networking, linkage of different systems, setting-up of databases, GPS / DGPS, standards for data exchange and, orthophoto usage. These trends were revolutionary principles 20 years ago.

Spatial enablement requires information to be collected, updated, analysed, represented, and communicated, together with information on land ownership and custodianship, in a consistent manner to underpin good governance of land and its natural resources, whole-of-government efficiency, public safety and security towards the wellbeing of societies, the environment and economy. A society can be regarded as spatially enabled when location and spatial information are “commonly available to citizens and businesses” to encourage creativity and product development (Steudler et al, 2012; Molen, 2007; Potsiou, 2017).

Previously we were in need of reliable, evidence-based open and/or low-cost data which describes “spatially enabled” society. But today we have to ensure the transition from being “spatially enabled” society to “spatially mature” society for decision-making. This transition requires; massive creation & consumption of data (structured/or not), extended use of affordable smart devices, increasingly high downloading speeds, the Internet of Things, cognitive computing for all to improve human decision-making, the provision of personalized information and the Internet of Me. There should be established mechanism for a consistent and repeatable update of information to compare & monitor the “geospatial maturity” of our society: our ability to retrieve the right information and to for optimizing activities required to achieve the Sustainable Development Goals - SDGs. (Potsiou, 2017).

Turkish General Directorate of Land Registry and Cadastre (TKGM) have carried out the following projects in the last two decades: The Cadastre Completion Project, the Land Registry and Cadastre Information System (TAKBİS), the Spatial Information System (MEGSİS), the Digitalization, the Cadastral Map Inventory, the Cadastral Parcel Inquiries Through E-Government Services and Parcel Inquiry Software, the Cadastre Renovation Project and the Continuously Operating Reference Stations (CORS). Consequently, the land registry and cadastre have been digitized and made available to citizens and business world.

The keywords of Turkish cadastre can be summarized as follows; state guarantee of registers, legal security, fast service for users, complete coverage terms of cadastre and land registration, a comprehensive, liable and secure system, legally computerized and automated land registry system, spatial property system – that also serves other purposes (i.e. as a basis for Land Related Information Systems such as agriculture, municipalities, spatial planning, census, address, tax offices etc.), integration of different systems, land registry & cadastre mapping in one organization, legal support, legal basis, private sector involvement, licensed cadastre engineers/bureaus, successful cost recovery system, deep involvement in economy, centralized management.

Following the completion of the first cadastre establishment, reconstruction studies began with the Law No. 6083 on Organization and Duties of the Directorate General of Land and Cadastre, in accordance with the needs and technological advancements in that period.

Subsection of the law No. 6083, regulates the duties and responsibilities of the General Directorate as “Creating the spatial information system infrastructure and map production monitoring center, allowing real and legal persons, and public institutions and bodies to take advantage of the data, and accomplishing tasks on geographical information system”.

In this context the inventory of existing cadastre maps has been taken all cadastre parcels have been digitized, and the digitized data has been used to establish the Spatial Property System (MEGSIS). With this development, the institution has become a spatial data provider, and has opened cadastral parcel queries to the public and private bodies via the e-government and web portals.

2. DEVELOPMENT OF THE SPATIAL MATURITY PROCESS

2.1 Cadastre Parcel Inventory Work

TKGM conducted a study in 2008 to determine the current number of cadastral maps and the methods used of measurement in these maps in order to create cadastral map inventory TKGM 2008). It was determined that there are 594,479 cadastral maps in total and 38.19% of them are in digital format. The number of cadastral sheets and the measurement methods available in the TKGM are given in detail in Figure 1 and Table 1.

Figure 1: Numbers of cadastral map sheets

Surveying Method	No of Map Sheets	Ratio %
Numerical Method	227.031	38.19
Graphical	91.804	15.44
Polar Method	127.118	21.38
Orthogonal	61.271	10.30
5K Analogue Photogrammetric	81.334	13.68
Photoplan	1.782	0.30
Others	4.139	0.70
TOTAL	594.479	100.00

Table 1: Measurement methods of cadastral map sheets

When the collected data were analysed, it was understood that the cadastral field measurements were made in 4 different geodesic reference systems, Figure 2 and Figure 3 demonstrates that 9% of the data is graphic (not related to coordinates), 14% from (local) coordinate systems, 53% from the ED50 (European Datum-1950) coordinate systems, and 24% from ITRF (International Terrestrial Reference Frame) coordinate systems. (https://www.tkgm.gov.tr/tr/sayfa/mekansal-gayrimenkul-sistemi-megsis)

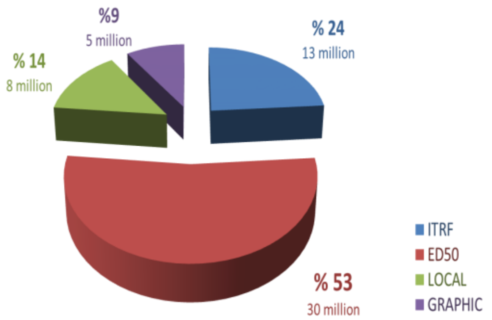

Figure 2: Geodetic reference systems used in the cadastral field measurements (2008)

Figure 3: Geodetic reference systems used in Cadastral Data Production

It has been determined that approximately 33.5 million parcels were converted into digital form within the scope of cadastre inventory determination project as it is summarized in Figure 4.

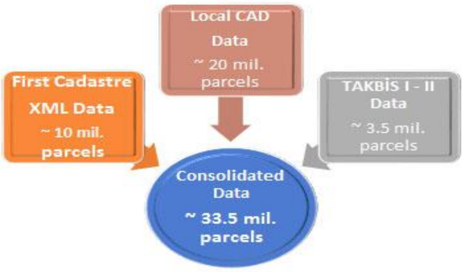

Figure 4: Digital cadastral data and their sources

In 2013, digitization of approximately 10 million rural cadastral parcels was carried out in collaboration with the General Directorate of Agrarian Reform.

TKGM and World Bank started a Land Registry and Cadastre Modernization Project (TKMP) in 2009 and have been renewing the cadastre data which were too disjointed to yield results. In 2017, almost 10 million cadastral parcels have been renewed within the scope of the project.

One of the most important issues to be addressed on the automation work which will be carried out with the cadastre data is to gather the data from different coordinate systems in an integrated infrastructure and to present it in the way required by cadastre directorates. In the scope of the project all binary coded closed data has been converted into open data structure, ISO standards have been applied to data model, and Cadastre and Land Registry data integration process has been implemented.

The Cadastre Parcel Inventory application has been developed to serve as a basis for the work to be conducted by TKGM and the existing cadastre data has been entered into the system by cadastre directories.

2.2 Spatial Property System (MEGSIS)

MEGSIS is an open source application developed to collect cadastral data digitally, integrate with the land registry data, and submit it to the stakeholder institutions, organizations and municipalities. MEGSIS is an integrated spatial property system that ensures integration between cadastre and land registry data in Figure 5.

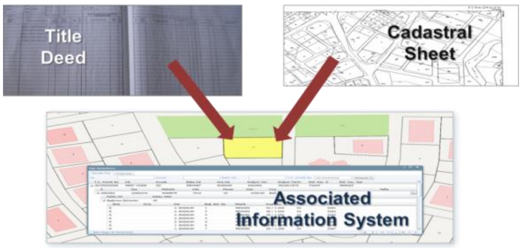

Figure 5: MEGSIS Integrated Information System

Spatial Property System (MEGSIS) is an open source application available to the public via an e-government service by the Directorate of Land Registry and Cadastre. The application matches up land registry data with the digitized .cad data that exists on the directorates' local computers, and shares this data with shareholding institutions, municipalities and the public via map services at international standards.

Project management and responsibility lies with the TKGM team, and TKGM and TÜRKSAT Inc. Co. employees have established a joint work group. Considering the corporate automation infrastructure, this team has been making efforts to develop a service based application that uses Microsoft .NET Framework 4.0 - Silverlight 5.0 and C# language (https://www.tkgm.gov.tr/tr/sayfa/mekansal-gayrimenkul-sistemi-megsis)

PostgreSQL + PostGIS is used for the database, and GeoServer is used for the geographical server in MEGSIS design as an associated information system. The information system that is integrated with MEGSIS can be seen in Figure 5, while the server-side system architecture is given in Figure 6.

MEGSIS Server architecture is designed in accordance with N-Teir structure. This architecture consists of various layers; Identification and Authorization, Integration (Land Registry Database (TSUY), Citizen Information System (MERNIS), e-payment), Business, Map, Cache and Log. These layers are designed to serve on multiple servers. It distributes the Apache load balancer located at the front of incoming request servers. This architecture includes Cadastre Directorates via MEGSIS Silverlight Application, Citizen via home, Land Registry offices with TSUY application and Public institutions that share data with protocol are in demand.

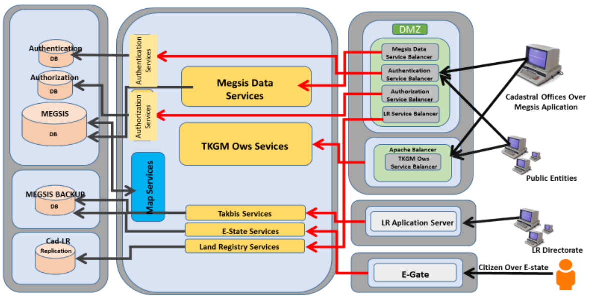

Figure 6: MEGSIS Server Side Architecture

The works carried out within the scope of Spatial Real Estate System (MEGSIS) are gathered under four main headings as given below;

- Web-based application software
- Map services in international standards
- E-Government Services
- Orthophoto Services

2.2.1 Web based application software: Web based application software allows the application to be used at different levels and need and under the roof of administrator identification/authorization, and is made up of modules that control and monitor internal and external user data entry, data downloads, land registry data and integration process inquiries, and all work that is being done.

Within the web based application software;

- Controlling the compatibility of land registry and cadastral data with each other,
- Collection of attribute information,
- Integration and presentation in the ITRF96 coordinate system,
- Verification using air images (orthophoto and googlemaps),
- Increasing the quality of the data with control inquiries,
- The data can be kept up to date.

2.2.2 Map services at international standards: Map services is used to share cadastre data collected within the scope of MEGSIS with institutions, organizations and municipalities that have demanded them according appropriate protocols. The standards of the data are tested with open source and commercial products.

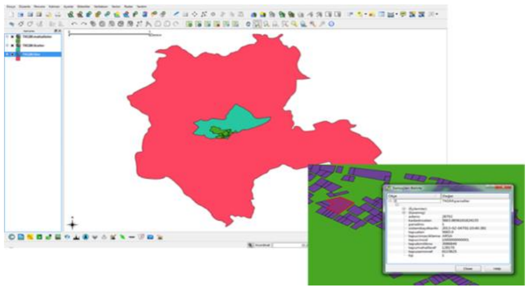

Figure 7: Map services

As it can be seen in Table 2, data is shared via map services. By 2018, the average of the last 6 months has reached 66.000.000 WMS service demands per month and 12.000.000 WFS service demands per month.

2018 TOTAL INQUIRY AMOUNTS VIA WEB SERVICES IN TURKEY		
MONTHS	WMS	WFS
January	100.929.192	9.306.910
February	86.684.046	8.167.796
March	53.975.560	12.479.842
April	50.786.816	16.453.716
May	62.165.763	12.147.124
June	43.408.687	13.803.928
TOTAL Monthly Average	397.950.064 66.325.011	72.359.316 12.059.886

Table 2: WMS and WFS service demands

2.2.3 E-Government Map Services: E-government map services present the collected data to the public together with land registry data from the e-government gate. These services are the first and only geographical services offered from www.turkiye.gov.tr.

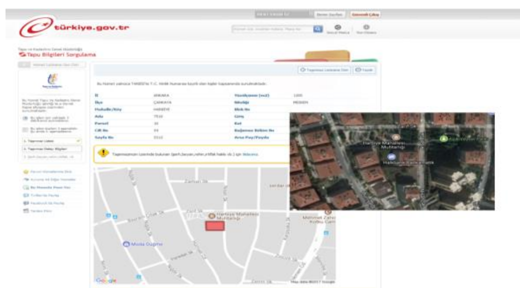

Figure 8: Parcel inquiry from an e-government gate

Since October 2010, land registry and cadastre data has been served to the citizen at the www.turkiye.gov.tr gateway. As it is seen in the Table 3 the number has been reached to 6.000.000 in months (TKGM – 2018).

2018 E-GOVERNMENT INQUIRIES	AMOUNT
January	6.148.161
February	7.485.479
March	6.667.477
April	4.999.923
May	5.277.207
June	5.690.788
TOTAL	36.269.035
Monthly Average	6.044.839

Table 3. 2018 parcel inquiries made at e-government

2.2.4 Orthophoto Services: Orthophoto services present orthophoto maps that have been produced at 1/5.000 scale, by using the open source GDAL library services, and at a TileMap Service (TMS) standard. An example from the orthophoto web service can be seen shown in Figure 9.

Figure 9. Orthophoto Web Services

3. DATA SHARING

The General Directorate of Land Registry and Cadastre has registered 57.677.571 parcels (cbs.tkgm.gov.tr). As the land registry data on TAKBIS and the cadastre data on MEGSIS is digitized, it has become the main provider in Turkey by sharing data with 864 public institutions, municipalities and organizations by 2018.

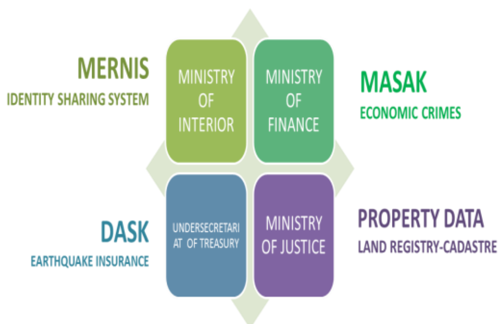

Figure 9. TKGM Data Sharing

4. CONCLUSION

It is a well-known fact that location information has changed people's perceptions. We cannot measure or monitor sustainability and growth without the intelligent use of evidence-based geospatial data. Technology helps us "uncover" the missing information and reduce inequalities.

In this context, we would like to integrate spatial cadastral data and land registry data in MEGSIS, in order to increase the usability of data, systems and tools, and to interpret and process it (collect once and use /serve it several times).

MEGSIS parcel based cadastral data is 100% free for citizen use. Within the framework of the protocols made with Public Institutions, cadastral data sets and large data needs are provided by fee.

MEGSIS data APIs are accessible, and data sets are downloadable, searchable and machine readable. Most data sets are available in MEGSIS in the CSV format.

MEGSIS spatial data are widely used by the individuals, institutions and organizations listed below.

- Citizens,
- Public organizations that use land related information (General Directorate of Agrarian Reform, General Directorate State Hydraulic Works, General Directorate for Highways, General Directorate of National Property, municipalities etc.),
- Land professionals (land surveying and mapping companies, licensed cadastre offices, land appraisers, land developers, expropriation experts, real estate agencies etc.),
- Turkish Statistical Institute (TURKSTAT),
- Financial and contracting institutions,
- Infrastructure and investment organizations (electricity, drinking water, natural gas etc.)

As a result of the project, land registry and cadastre data has been digitized and made available to citizens and business people.

The data offered by TKGM in the first half of 2018 can be analysed with statistic given below;

1) 66.325.011 WMS inquiries in average per month,
2) 12.059.886 WFS inquiries in average per month,
3) 6.044.839 inquiries in average per month over e-government,

by national and international users.

In addition, 864 public institutions, municipalities and organizations are provided with land registry and cadastre data.

Even though TKGM has important technical issues to address, it has proved its spatial maturity and met the cadastral spatial data needs of citizens, other public institutions and investors.

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THE ANALYSIS OF PUBLIC PROPERTY APPLICATION PRINCIPLES AND REGISTRY PROBLEMS IN LAND CONSOLIDATION WORKS IN TURKEY

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ABSTRACT

This study was conducted to determine the processes that were performed before and after the Land Consolidation (LC) on meadows, summer pastures, winter quarters, pastures and prairies, which are still ongoing in Tomek Neighborhood of Selcuklu County in Konya. In this study, the viewpoints, problems of the actors that played active roles in LC applications (Agricultural Reform General Management (ARGM), land owners, and the companies that run the processes) were investigated; and solution offers were made. The LC works performed in Tomek Neighborhood are run by the Konya Provincial Food, Agriculture and Animal Husbandry Management in ERGM under the title of Konya 1 Project. The parcel information of the public properties in these neighborhoods were received from Konya Cadastral Management and the LC data were received from Konya Provincial Food and Animal Husbandry Management. Land Consolidation was performed in an area of 4996 hectares within Tomek neighborhood borders. A total of 821 cadastral parcels and 1888 farmers (businesses) were included in the Land Consolidation. A total of 16 village common properties that had the quality of being meadow were included in the consolidation as 3559763 m² area. After the consolidation project was applied, it was observed that 16 parcels were converted into 10 parcels. The official correspondence between the relevant institutions for the purpose of shrinking the meadow areas and changing their places were also examined and analyzed in the present study.

Keywords: Meadow, prairie, land consolidation, characteristic change, institution

1-Introduction

Land Consolidation (LC) works are among the indispensable projects that have priority in rural areas for the State of Republic of Turkey. According to the end-of-the-year data of 2015 (URL1), nowadays, LC works are performed in an intense manner in 7 regions that have a population of 1 million 850 thousand. There are enough public properties (pastures, summer pastures, winter quarters, and grasslands) in the LC application projects. The public properties located in these projects are subject to practices according to the regulations. The pastures, winter pastures, meadows, and grassland are the most important and indispensable above-the-ground natural resources for animal husbandry and ecological balance in Turkey. The pasture, winter pasture, meadow, and grassland wealth of Turkey is estimated to be 14.6 million hectares according to the 2014 data released by Turkey Statistical Institute (TUIK) (Anonymous, 2014). According to the data released by the Ministry of Food, Agriculture and Animal Husbandry at regional base, these areas cover 388 thousand 846 hectares in the Aegean Region; 280 thousand 619 hectares in the Marmara Region; 501 thousand 765 hectares in the Mediterranean Region; 3 million 726 thousand 55 hectares in the Central Anatolia Region; 1 million 73 thousand 371 hectares in the Black Sea Region; 3 million 824 thousand 257 hectares in the Eastern Anatolian Region; 553 thousand 256 hectares in the Southeastern Anatolian Region. The total surface area of Konya is 3 million 887 thousand 300 hectares. The pastures, summer pastures, winter quarters, and grasslands occupy a total of 736 thousand 852 hectares, which means 19% of the total area. In addition, in Turkey, until our present time, each passing year; and the meadow and grasslands that were 44 million hectares in 1935 decreased to 14.61 million hectares in 2001 with a decrease of 66.8%. In addition, the determination of the existing meadows, drawing their boundaries and the allocation processes must be completed as soon as possible. For this, today's technologies such as Remote Sensing Method should be made use of (Tekeli et al., 2015).

In modern countries, meadows are perceived as a very important natural resource for animal rough feed, as an important factor in environmental protection, and as very productive and profitable enterprises due to their high inputs thanks to their ecological conditions and especially favorable rainfall regimes (Avcıoğlu et al., 2010).

In Turkey, pastures, summer pastures, winter quarters, and grasslands are generally located in very inclined and rough areas; and 90% of them are located in VI. and VII. Class areas (Aydin and Uzun, 2002). Pasture areas are considered as areas to be invested on especially in non-agricultural sectors. Cities that are constantly expanding are applying pressure on agricultural areas and pasture areas. These areas and agricultural areas are undergoing a process in which they are used outside their original purposes and are being destroyed due to unconscious urbanization. Another important issue, which is as important as preventing the use of the pasture areas outside their intended purposes, is that they should be made use of at the highest level. It is also important to improve the dry grass production and the grazing capacities in meadows (Bayraktar, 2014).

Determining the plant composition and the species that constitute pasture areas will enable us to define the animals that may graze in them, the grazing capacities of these area and the feed plants that are important for the region (Babalık and Fakir, 2017). In addition, the areas covered with plants in most of the grazing areas are around 15-30% due to the unplanned and irregular use of them in many years (Büyükburç, 1999).

The process of combining, shaping and reorganization of the mostly fragmented, scattered and distorted parcels due to various reasons in line with the modern agricultural management principles and to develop irrigation services is called "Land Consolidation" (Çay, T., 2017). In Turkey, Land Consolidation works are carried out in the framework of the Agricultural Reform in Irrigation Areas for Land Organization Law No. 3083 and with the regulations in the context of Soil Conservation and Land Use Law No. 5403. Both laws mention that the Participation Share to Common Facilities (DOPO) up to 10% may be deducted of the land that are in the boundaries of Land Consolidation organization.

In Turkey, the legal basis of the management of pastures, summer pastures, winter quarters, and grasslands is provided by the Pasture Law No. 4342 that was issued in 1998. In the 4th Item of this law, it says "Grasslands, summer pastures and winter pastures may not be transferred to private property status, cannot be used other than their intended purposes, the time-out principle cannot be applied, and the boundaries of these areas cannot be narrowed". The statement "the boundaries of these areas cannot be narrowed" means that the DOPO rate cannot be deducted in the lands that are subject to Land Consolidation. Since grasslands, summer pastures and winter pastures are generally large areas, if no deduction is made from them to obtain common facilities, it is necessary to cut-out more in the other lands. This implementation is not a desired situation by other landowners. On the contrary, they are of the opinion that "if there are grasslands, summer pastures and winter pastures in the area, all participation fees should be covered from these areas; and if these areas are insufficient, the remaining amount is deducted from the territories of the citizens". In this context, in order to enhance the practices of land consolidation works in legal terms, it is understood that by making use of the statement in the 14th Article of the Law "The grasslands, summer pastures and winter pastures cannot be used otherwise than stated in the Law unless the allocation purpose is changed", these areas may be made use of by changing their legal status. In this respect, the following statements were added to the Law; Addition 27/5/2004-5178/3 Item; Addition 3.7.2005-5403/27 Item; and Addition 9.7.2008-5784/26 Item. Thus, the final statement became "The allocation purpose of areas like pastures, summer pastures, winter quarters, and grasslands may be altered by the Governor's Office upon the demand of the relevant Directorate and upon the approval of the Commission and the Revenues Office; and the registration of such areas is made in the name of the Treasury Department. When necessary, the Commission requires from the Ministry that the Agricultural Reform in Irrigation Areas for Land Organization Law No. 3083 is applied; and then it allows villages and municipalities to apply Land Consolidation projects." An Application Protocol was carried out between TRGM Land Consolidation Department and General Directorate of Agricultural Production and Development (TUGEM) (Anonymous 2002) by making use of these statements in the Law with an issue number 299 on 28.12.2002. The pastures, summer pastures, winter quarters, and grasslands in land consolidation areas are subject to applications within the framework of this protocol.

In this study, the aim is to reveal the route that was taken and the problems observed during the application of the abovementioned Protocol in pastures, summer pastures, winter quarters, and grasslands in Konya-1 Project which is carried out by Konya Provincial Directorate of Food, Agriculture and Animal

Husbandry under TRGM. In addition, what kind of changes occurred in these areas, how they could be achieved in other ways, and the benefits and the solution proposals were also revealed.

2. Material and Method

The pasture, summer pasture, winter quarter, and grassland areas located in the boundaries of Tömek neighborhood of Selçuklu District of Konya province included in the Land Consolidation were selected as the study material. The Study Area (Figure 1) is 30 km away from the city center; and has a population of 350. The main way of living is animal husbandry and agriculture for the farmers in the area. There are not many varieties in the agricultural techniques used in the area and in the product designs. Wheat, barley, clover, sunflower, corn, and beet are planted in the agricultural areas. The project site has a flat topographic structure in general.

Figure 1. The Study Area (Google Maps)

Land Consolidation was carried out in an area of 4.996 hectares within the border of Tömek Neighborhood. A total of 821 cadastral parcels and 1888 farmers (businesses) were included in the consolidation. In the scope of the Land Consolidation works, 16 pieces of meadow-qualified village common property were included in the organized as 3 million 559 thousand 763 m² area. The grassland parcels that have been included in the practice in Tömek Neighborhood are given in Figure 2. It was observed that the number of 16 parcels became 10 after applying the Land Consolidation project.

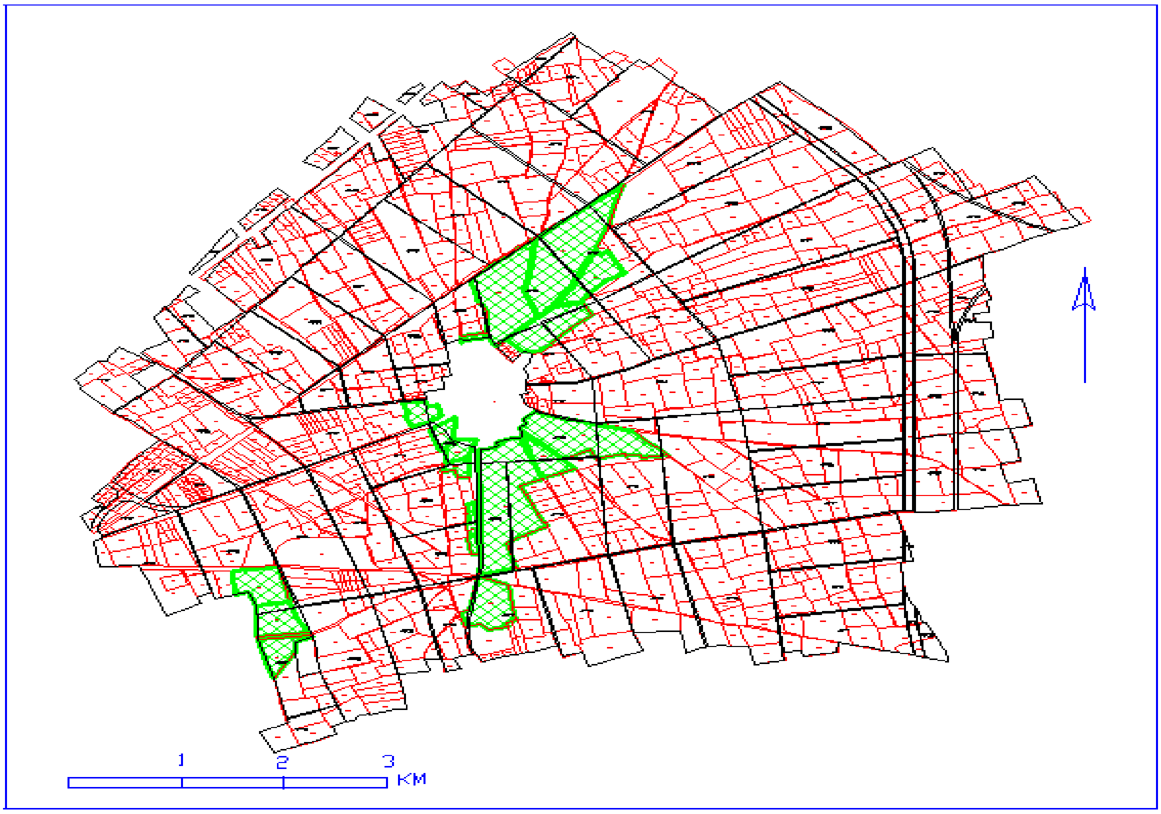

Figure 2. The map showing the former status of the grasslands

According to the results of the LC application, two main procedures are required. In this respect, the first procedure is altering the allocation purposes of the 16 areas in the Land Consolidation Project area in the boundaries of Tömek Neighborhood as required by the last paragraph of Article 14 of the Pasture Law No. 4342; and registering them in the name of the Treasury Department. After this first procedure is completed, the next procedure is altering the qualification of these 10 new areas that have the quality of belonging to the Treasury Department as being Pasture Area. These procedures are carried out by the staff of the Directorate of Plant Production and Health Branch under the Provincial Directorate of Food, Agriculture and Animal Husbandry.

In order to register the pasture-qualified parcels that are in the application field in the name of the Treasury Department by changing their allocation purposes, it is necessary to make a file by making the following procedures. The documents that must be included in the Qualification Change File are given in Table 2.

Table 2. The documents that must be included in the Qualification Change File

No	Name of the Procedure
1	Decision of the Council of Ministers on the declaration of the area as Consolidation Area
2	The Cadastral Map in which the pasture parcels in the area is marked and shown (6 pieces).
3	Map of the pasture in which the new situations of the parcels in the area are marked by (4 pieces)
4	A map in which the old and new situations of the pasture parcels in the area are marked (4 pieces)
5	Justification report
6	Explanation report
7	All of the LC Lists for old and new situations of the pasture parcels in the area
8	The chart of the application cost of the pasture plots in the area
9	5000-scale Cadastral Situation Chart
10	Old and new parcel scale chart
11	Coordinated summary and area chart
12	Soil examination report for the old and new pasture parcels in the area
13	Photocopy of the pasture parcels log in the area
14	Chart showing the included-excluded parts of the pasture parcels in the area
15	1 CD of the file
16	5000-scale map section of the cadaster

After the above-mentioned documents are prepared, four copies are reproduced and delivered to the relevant Provincial Directorate of Food, Agriculture and Animal Husbandry. The Provincial Directorate refers these files to the Directorate of Plant Production and Health, which is in its own organization. The staff of the Directorate starts the inter-institutional processes according to the sequence of procedures given in Table 3.

Table 3. The inter-institutional procedure order of the pasture files in the Tömek Neighborhood

No	Procedure
1	Performing general checks of the files
2	Referring the files to the Provincial Pastoral Commission
3	Return to the Provincial Directorate of Food, Agriculture and Animal Husbandry after the approval of the Pastoral Commission
4	Referring the files from the Provincial Directorate to the District Directorate for the staff of it to -Take photographs of the pasture areas - Collecting signatures to show that at least half of the residents dealing with farming are eligible -Completion of the Written approval of the Provincial Pastoral Commission
5	Returning the files to the Provincial Food, Agriculture and Animal Husbandry Directorate
6	Sending the files to the Provincial National Real-Estate Directorate from the Provincial Directorate -Sending the files to the National Real-Estate Directorate -Completion of the approval letter of the District National Real-Estate Directorate -Returning the files to the Provincial National Real-Estate Directorate
7	Returning the files from the Provincial National Real-Estate Directorate to the Provincial Directorate of Food, Agriculture and Animal Husbandry
8	Sending the files from the Provincial Directorate of Food, Agriculture and Animal Husbandry to TRGM
9	Sending the files from the TRGM to the Provincial Directorate of Food, Agriculture and Animal Husbandry
10	Sending the files to the Provincial Cadaster Directorate together with all approval letters of the Provincial Directorate of Food, Agriculture and Animal Husbandry

3. Findings and Discussion

It was determined that there was continuous grazing in the 16 pieces of 3616813 m² pasture land in the Study Area. No technical procedures such as improvements were carried out by the Plant Production and Health Branch Directorate of the Provincial Directorate of Food, Agriculture and Animal Husbandry in these pasture areas.

3.1 LC Findings

The DOP Ratio of the Project was found to be 0.004. This ratio has been deducted from all the parcels including pasture, summer pasture, winter quarter, and grassland areas in the consolidation area. At the end of the Land Consolidation, 958 new parcels were created. After the Consolidation Project was applied, the number of 16 pasture parcels was reduced to 10 parcels and the area became 3527048.80 m2. In the context of the above-mentioned numbers, 12932,62 m2 was deducted for the share of the common participation share. It was seen that there was a decrease of 19782,23 m2 due to the grading. The staff of the contractor, who carried out the new parceling plan, stated that they used the pasture lands to balance the blocks usually from where they were. They also stated that they did not pay much attention to the geometric shapes of the new pasture parcels, and did not connect them to each other.

It was determined that businesses in Tömek had two viewpoints on pasture areas. According to the first viewpoint, those who were involved in agriculture wanted that the DOP deduction should be deducted firstly from the pasture areas and not from them. The second viewpoint was that the pastures that belonged to businesses in the area dealing with animal husbandry should never be reduced, and even the blocks should not divide the pasture areas. The businesses dealing with animal husbandry stated that they were satisfied mostly with pasture areas where animal husbandry was common.

The new pasture parcels that were created out of the old ones as a result of the LC application are given in Figure 3; and the old and new forms of the pasture areas are given in Figure 4.

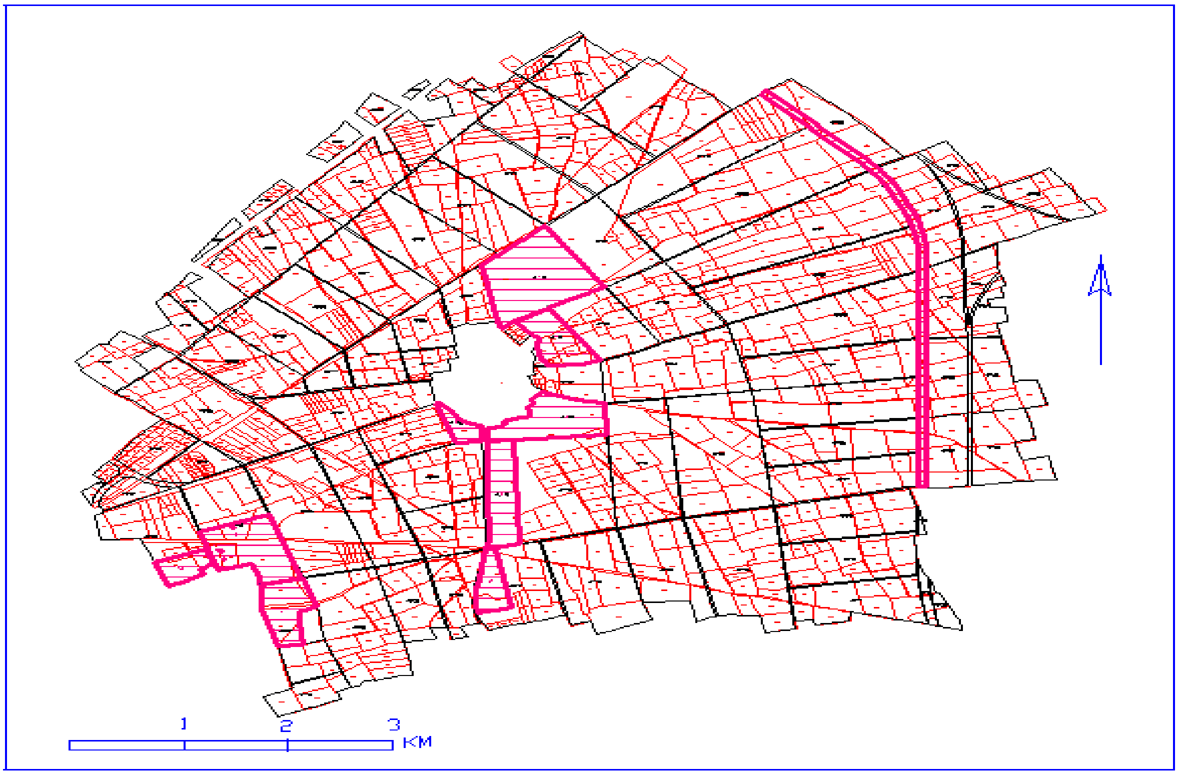

Figure 3. The new form of the pasture areas of the Tömek Neighborhood

The old and new forms of the pasture areas are given in Chart 1 as areas they cover.

Chart 1. The old and new forms of the pasture areas in Tömek Neighborhood

Eski Mera Parselleri					Yeni Mera Parselleri		
SIRA NO	PARSEL NO	ALAN (m^2)	GİREN ALAN (m^2)	GİRMEYEN ALAN (m^2)	SIRA NO	PARSEL NO	ALAN (m^2)
1	29661/11	231574.74	231574.74	0.00	1	42737/1	180989.34
2	29702/4	434315.00	434315	0.00	2	42741/1	291228.45
3	29703/1	100278.21	100278.21	0.00	3	42742/13	149091.05
4	29704/14	695069.26	695069.26	0.00	4	42743/8	477811.21
5	29707/19	58804.85	46725.07	12079.78	5	42746/1	95502.53
6	29707/20	40172.82	40172.82	0.00	6	42749/1	354205.06
7	29707/24	44096.99	44096.99	0.00	7	42750/1	439712.75
8	29718/12	75795.29	53594.31	22200.98	8	42755/1	800479.93
9	29735/2	454008.53	454008.53	0.00	9	42756/1	459304.70
10	29736/1	586163.34	586163.34	0.00	10	42780/7	278723.78
11	29737/35	163953.14	163953.14	0.00	TOPLAM		#########
12	29745/1	218312.83	218312.83	0.00			
13	29746/1	118016.48	118016.48	0.00			
14	29751/6	187135.73	187135.73	0.00			
15	29751/22	151254.95	151254.95	0.00			
16	29757/1	57861.38	35092.25	22769.13			
TOPLAM		3616813.54	3559763.65	57049.89			

It is seen in practice that the new pasture areas were usually given from the places where they formerly were. It is seen that the old pasture areas are collected in three regions. It is also seen that the new parcellation is also collected in three regions. The old and new forms of these three regions are planned approximately at the same distance from the village center.

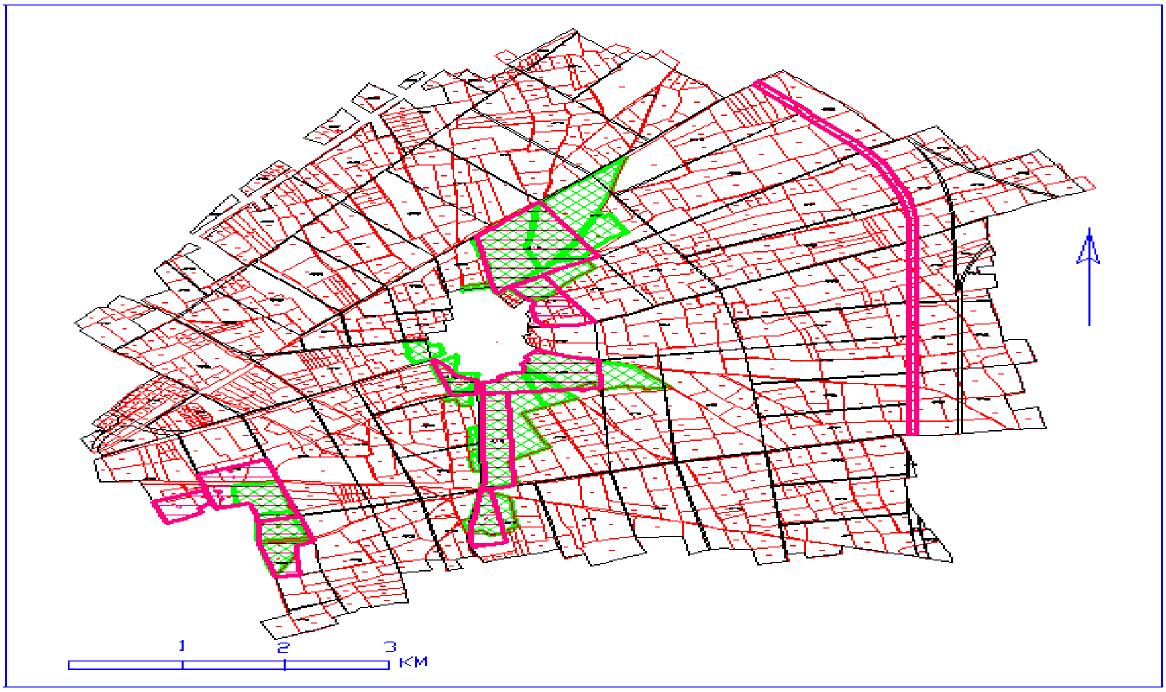

Figure 4. Former and new situations of the pasture areas of Tömek Neighborhood

3.2. Procedure order findings

It was determined that the three documents mentioned in Table 3 that were required by the Directorate of Plant Production and Health of the Provincial Directorate of Food, Agriculture and Animal Husbandry were prepared LC contracting companies instead of the Land Consolidation Directorate and were submitted to the Directorate of Plant Production and Plant Health Branch.

All of the steps in Table 3 are started after all the procedures of the LC project (grading, block planning, interviews, distributions, creation of the new parcels, construction of the 3 hangers, delivery of the new places to the businesses in the area, approval of TRGM for the project, cadastral control by the Provincial Cadaster Directorate) are completed. The completion of these procedures means that the consolidation process is completed except for the issuing of the new title-deeds.

The application was the same in the Tömek Neighborhood and all the procedures were completed; the files were prepared as shown in Table 3 by the contractor company; and formal entry was performed on 15.11.2017 to the Plant Production and Health Branch Directorate. The procedures given in Tables 3 and 4 could not be completed by 15.06.2018.

4. Result and Recommendations

The spatial and formal changes, and the effects of the institutions on the application and their roles before and after the LC Project in the Tömek Neighborhood were examined; and the results and recommendations were made about the 16 pasture areas that were included in the project.

The procedures for changing the characteristics of pasture, summer pasture, winter quarter, and grassland areas, which are among the public properties in the LC area, are carried out by two branch offices in the same directorate. The LC branch office prepares the qualification change files for the contractor company because it takes too much time due to inadequate staff and time. The files are then sent to the Plant Production and Health Branch Directorate; and are checked there one by one. This procedure takes too much time and causes that the works are delayed. In order to eliminate this drawback, it would be appropriate to change the characteristics of the pasture areas included in the LC projects by the LC Branch Office.

The conversion of the pasture areas included in the LC project into treasure area and the correspondence between the institutions are carried out in 10 steps. This procedure takes too much time as they are started after the Land Consolidation process is over (since the final status of the pasture area is clarified). For the purpose of not extending this period, it is necessary for the LC Branch Office to carry out the procedure only by writing an informative letter to relevant offices.

It was seen that two parts of the pasture areas in the Tömek Neighborhood were located near the residential area of the neighborhood, and one part is located far to it. It was determined that the new parceling plan was given in three parts, from the same place as the former ones. These pieces must be combined and planned together to surround the neighborhood (so that animals can walk around in all the pasture areas in an uninterrupted manner).

It was determined that all the pasture areas in the application area are located next to the areas of the citizens both in the former and in the new situations. This is such an application that may cause that citizens enter the pasture areas and use them as cultivation areas in the following days. Parcels must be produced in such a way that will prevent citizens from entering the pasture areas directly by absolutely placing a road between the pasture parcels that will be created after the LC and the citizen parcels.

It is known that the Determination Limitation and Allocation of the pasture areas in Turkey are carried out at a very slow pace. Only 10.14 million hectares of the 14.6 million hectares of pasture areas could be identified. A total of 5.76 million hectares of this area are in Limited status. This makes unintended use of these undetected areas even easier. For this reason, the procedures for Detection, Limitation and Allocation are deemed to have been completed in the places where LC is carried out.

Today, to carry out the industrialization, rural development and urbanization goals of Turkey, the above-mentioned public properties come to the mind firstly. Since it is obvious that Turkey will not abandon its targets in industrialization, urbanization and rural development, the public properties that are included in planning made today must be planned in such a way that will enable the current use as well as future use of these by individuals. When Land Consolidation projects are performed, it is necessary to produce the pasture, summer pasture, winter quarter, and grassland areas in suitable size and in a usable manner.

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INFLUENCE OF RIVERBED CHANGE ON A POSSIBILITY OF FLOODING DURING WATER LEVEL RISE OF THE RIVER KURA

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ABSTRACT:

The study of floods by remote sensing data and GIS technology is necessary for the rapid detection of floods in the populated areas, provision of an early evacuation of the population and implementing correct response measures.
This paper has been dedicated to studying the methodology of flood mapping by GIS technology on the basis of processing the taken by Earth observation satellite “AZERSKY/SPOT-6” for the period of 2014-2016.
Flood-prone areas at river Kura, Khrami and Debed were identified using software package ENVI 5.2 and ArcGIS version 10.4.1. The initial images have been received in the project «Promotion of Earth remote surveillance services for the sake of sustainable development of Azerbaijan» of Azercosmos OJSCo.
This research has been carried out on the basis of software and methodological support of «Processing of the aerospace information» sector of «Aerospace Monitoring» within «Aerospace Monitoring of the Environment» department of National Aviation Academy.

KEY WORDS: RS, DEM, aerospace monitoring, satellite image, freshet, flood, floodplain, riverbed.

1. INTRODUCTION

Freshets and floods are natural disasters, covering large territories and exceeding all other emergency situations on damage. The most effective method of tracking them is aerospace monitoring using remote sensing (RS) data of the Earth.
The goal is to identify the zones of flooding in the floodplains of transboundary rivers Kura, Khrami and Debed in images taken at different time periods by AZERSKY satellite during the period of summer low-water and autumn freshet. Using GIS-technologies is necessary to define zones of floodplains of the rivers during the autumn and summer periods, to identify the floodplains of rivers and the nearest territories that are an object to flooding, to calculate their areas, to prepare flood risk maps and create graphs of a cross profile of rivers using DEM model [2].

2. METHODOLOGY

2.1 Technology for the introduction of aerospace monitoring of freshets and floods

Based on the application of aerospace monitoring of freshets and floods, it is possible:
- to quickly detect areas of flooding;
- to calculate the areas of flood zones;
- to forecast the development of freshets and to assess their potential danger for populated areas and especially important objects;
- to assess and analyse the risks of flooding.

Structural scheme of aerospace monitoring of freshets and floods is shown in figure 1. It consists of three main blocks: operational mapping, forecasting and verification [3].

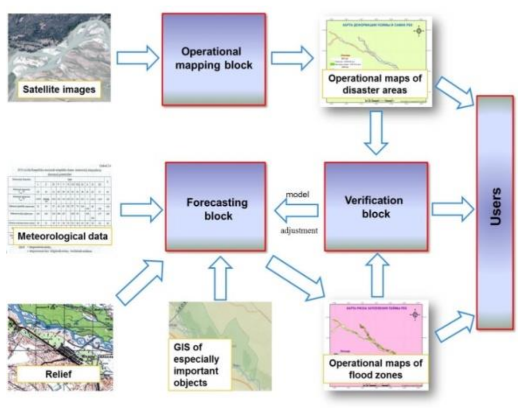


Figure 1. Structural scheme of aerospace monitoring of freshets and floods

Satellite images are sent to the block of operational mapping of flood zones, which uses daily imagery of riverbeds. For monitoring freshets and floods, satellite images of AZERSKY for 2014-2016, data from the Google Earth portal, topographic maps, and data from the ArcGIS Online Internet resource were used. As a result, operational maps of disaster areas are prepared, which are sent either immediately to users, or to the verification block, i.e. for ascertaining the veracity of the information obtained. In the verification block, the results of the forecast and operational maps of the flooded areas, constructed on the relevant date, are compared. Based on the results of the comparison, differences are identified, the causes of errors are determined and the model is adjusted. After that, the operational maps are sent to the forecasting block, where it is also necessary to deliver the meteorological data of the studied area, relief data, and data of, especially important objects. The forecasting block serves to forecast the development of the situation in, especially dangerous areas. Calculations for flooding areas in freshets use the calculation functions in ArcGIS. The finished product - operational maps of the flooded areas are sent either repeatedly to the verification block to validate the information, or to users [1].

2.2 Processing of images taken by AZERSKY satellite

The floods and freshets prone areas on the river Kura, on the river Khrami flowing into the river Kura, also on the river Debed flowing into the river Khrami were identified by the processing of images for the period 2014 and 2016 using software package ENVI 5.2 and ArcGIS version 10.4.1.

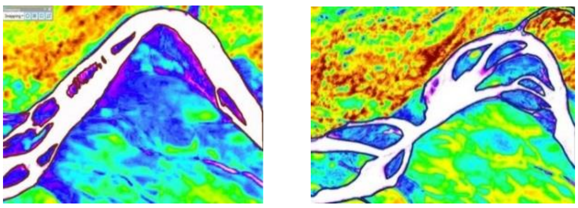
After the visual analysis of the images, it was determined the need to improve the resolution of satellite images, which is carried out during pre-processing. Therefore, in order to improve the visual perception of satellite images with the help of software package ENVI-5.2, we perform the operation Pan Sharpening. Figure 2 shows images before and after the Pan Sharpening operation.

(a) (b)

Figure 2. Images before (a) and after (b) Pan Sharpening

After the successful implementation of the first stage of image processing, we can proceed to the second stage, i.e. to the thematic processing of improved images. For the thematic processing, we use ArcGIS software version 10.4.1.

In order to study the objects under investigation, we use the classification by the NDVI index. Thus, we create index images, which serve as additional material for interpretation. Figure 3 shows the result of the classification according to the vegetative index NDVI, the land-water boundary is clearly distinguished; riverbanks, forests, etc. are visible.

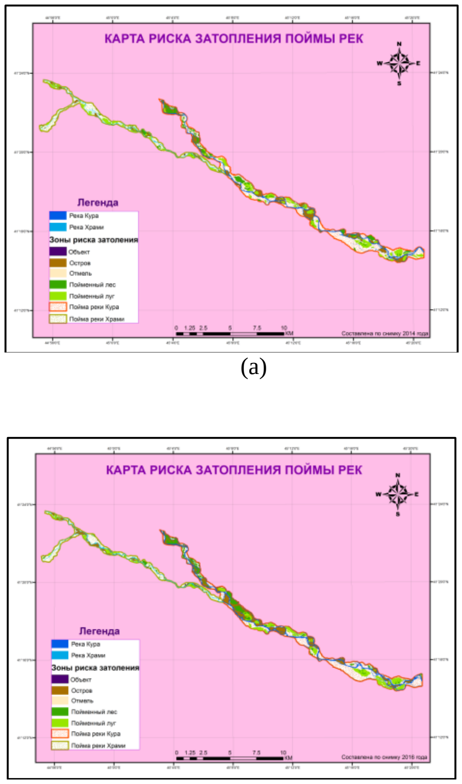


(a) (b)

Figure 3. Fragments of classified images for 2014 (a) and 2016 (b) for the index NDVI

As a result, flood risk maps of the river floodplains, a map of populated areas exposed to flooding, a map of deformation of the floodplains of rivers Kura and Khrami (Debed) were obtained.

Developed risk maps for 2014, 2016 and a Map of human settlements potentially at risk of flooding, shown in figures 4 and 5, are part of a single map database. They are the ultimate cartographic product and have the entire set of hidden attributive information.



(a)

(b)

Figure 4. Risk maps of river floodplain flooding, compiled from images of 2014 (a) and 2016 (b)

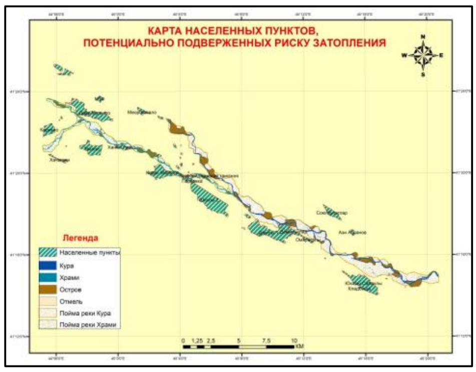


Figure 5. Map of human settlements potentially at risk of flooding

As a result of calculations using calculate geometry on ArcGIS, it was determined that the village Demirchilar is located at the shortest distance of 40 m from the river Kura, agricultural field near the village Yukhary-Salakhly by 12 m and etc. An especially important object located near the floodplain of the river Kura and susceptible to flooding is the nature reserve Gardabani.

2.3 The comparative analysis of the obtained maps

Having studied separate fragments of the made maps it is possible to see accurately deformation of the riverbed of the river Kura, as shown in figure 6.

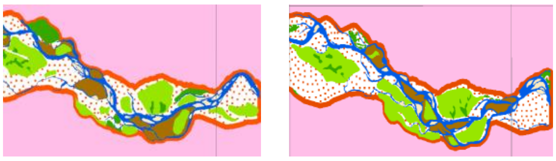


Figure 6. Fragments of maps for 2014 (a) and 2016 (b) floodplains of the river Kura

During the monitoring period, the obtained maps show the change in the areas and locations of floodplain meadows (on the map they are marked with green color), floodplain islands (brown), floodplain forests (dark green), riverbed (blue) and floodplain (orange).

For the purpose of a more detailed review of the changes, based on the created two risk maps for flooding the floodplains of rivers, a map of the deformation of the floodplains of the rivers Kura and Khrami and the riverbeds of these rivers was created, which is shown in figure 7.

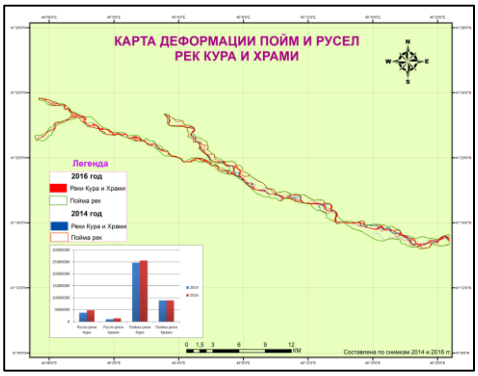


Figure 7. Deformation map of the floodplains and riverbeds of the rivers Kura and Khrami (Debed)

Next, using the statistics function, we can get the smallest, largest area of the object under study and calculate their sum.

Thus, according to the calculations made on ArcGIS and Microsoft Excel, the area of the riverbed of the river Kura increased by 1.05 km^2, and the riverbed of the river Khrami (Debed) - by 0.39 km^2. The floodplain of the Kura increased by 0.91 km^2, and the floodplain of the river Khrami (Debed) increased by 0.012 km^2. The area of the floodplain islands increased by 2.01 km^2, the shoals decreased by 0.48 km^2. The area of forests decreased by 0.022 km^2, and meadows - by 0.23 km^2. The area of objects that were built in the floodplain of rivers increased by 0.0043 km^2 [1].

2.4 Creation of the cross profile graphs of the rivers

In order to confirm the reliability of the information obtained earlier, the research work was carried out on the basis of the DEM model of the study area, which was received from the database of Azercosmos OJSCo.
With a view to determining the possibility of floods in villages that have been shown on a map of human settlements potentially at risk of flooding in figure 5, it is important to know the terrain.
The goal was achieved as the application of the DEM model of the study area's relief, on the basis of which it is possible to create the cross profiles graphs of the studied rivers Kura, Khrami and Debed.
First of all, the necessary two DEM models were attached using the Mosaic tool, which is located in the Data Management Tools.
When creating a cross profile of rivers on ArcGIS, use the interpolate line tool and profile graph from the 3D analyst, the lines of the cross profile are drawn a perpendicular to the river's flow from left to right, as shown in figure 8.

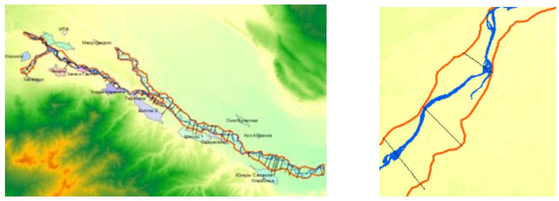


Figure 8. Creation of the cross profile of the rivers Kura, Khrami and Debed

The graph of the cross profile of the river Debed A0-A1 close to the agricultural field, which is located near the village Khachagani, is shown in figure 9.

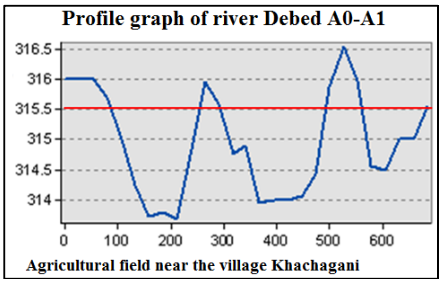


Figure 9. Profile graph of the river Debed A0-A1

According to the curve shown in the graph, the agricultural field is at an altitude of 315.5 m, and if the water level rises by 316 m, there is a risk of flooding and erosion of this agricultural field. The red line indicates the risk of flooding.
The graph of the cross profile of the Khrami River A1-A2 near the village of Kirach-Muganlo, which is also located on the territory of Georgia, is shown in figure 10.

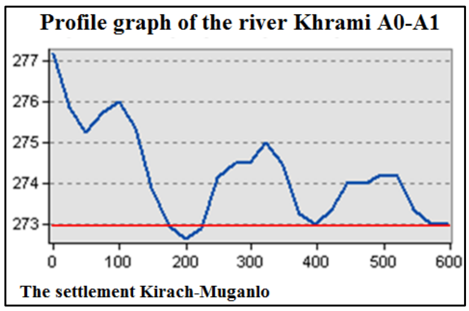


Figure 10. Profile graph of the river Khrami A0-A1

The settlement Kirach-Muganlo is located at an altitude of 273 m and in case the water level in the river Khrami rises by 1 m, there is a risk of flooding this settlement.
According to the graph presented in figure 11, the agricultural field located near the village Shikhly-2 is located at an altitude of 264 m, and if the water level in the river Kura rises by 2-3 m, it can be assumed that there is a risk of erosion of this field and will thus be destroyed harvest and economic damage.

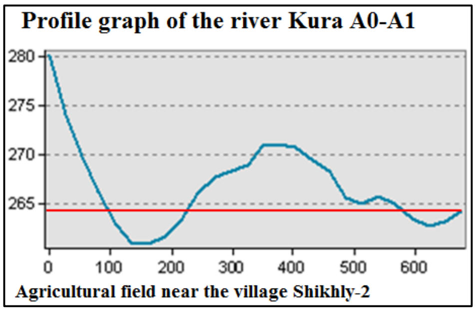


Figure 11. Profile graph of the river Kura A0-A1

The settlement Shikhly-1 is located at an altitude of 251 m and if the water level of the river Kura rises above this mark shown by the red line in the graph of figure 12, then the flooding of this village is possible.

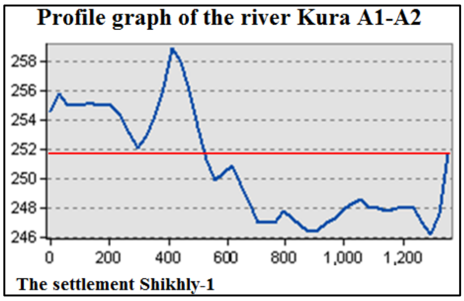


Figure 12. Profile graph of the river Kura A1-A2

The settlement Demirchilar is located at an altitude of 249 m, and if the water level rises above this mark, flooding of this area may occur (figure 13).

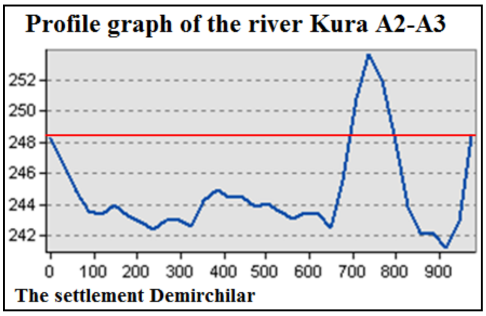


Figure 13. Profile graph of the river Kura A2-A3

3. CONCLUSIONS

The system of aerospace monitoring of transboundary rivers Kura, Khrami and Debed based on the use of GIS-technologies proves the occurrence of flood hazard as a result of the fact that the riverbed is deformed even during the examined 2 years period of 2014-2016.

According to the graphs of cross profiles, which were created based on the DEM model of the study area, the values of river water level rise were assumed, under which there may be a risk of flood hazard on riverbanks.

Thanks to the satellite AZERSKY Azercosmos OJSCo., in our country, it was possible to conduct aerospace monitoring of territories with different time periods (for example, annually, according to the season of the year), which allows us to create a database of archival data for use in forecasting and assessing the risk of freshets and floods.

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PROSPECTS FOR INCREASING THE EFFICIENCY OF AEROSPACE MONITORING METHODS USED TO SOLVE THE PROBLEMS OF THE OIL AND GAS COMPLEX

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ABSTRACT:

In this article we propose methods of spatial analysis, integration of GIS with remote sensing data, three-dimensional modeling promising for monitoring oil spills, infrastructure dynamics of oil fields, exploration of new oil and gas fields.
Spillage of oil and petroleum products at sea and on land, as well as gas emissions into the atmosphere lead to various negative consequences. The most promising methods for monitoring oil-contaminated land and sea surfaces are based on space technology. Periodic information from the Azerbaijan satellite of remote sensing (AZERSKY) increases possibilities of space monitoring of oil-gas fields. DEM-model and high-resolution images submitted from the satellite allow for lineament analysis at a new qualitative level with the help of GIS technologies and integration with other software (ENVI, RockWorks15 and others). On the basis of multi-time satellite data, maps of the dynamics of the oilfield infrastructure of the Absheron Peninsula have been created.

KEY WORDS: Remote sensing data, integration of GIS, maps, DEM-model, aerospace monitoring

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1. INTRODUCTION

Financing made by various national and international programs, functioning of aerospace faculty and GIS departments at higher educational institutions contribute methods of aerospace monitoring and their further upgrading, likewise open joint-stock company “AZERKOSMOS” and domestic satellite of remote sensing “AZERSKY” play a huge significant part. The introduced work has been conducted in the laboratory “Aerospace monitoring” faculty of “Aerospace monitoring of environment” at National Academy of Aviation. The researches have been conducted in the territory where mining and exploration of oil and gas for many years, particularly on licensed territories of oilfields in Absheron peninsula(fig.1). Such territories are unique geo environment where reliable and true decrypted signs of localizing fields of oil and gas, dynamics of infrastructure of fields, also effects of activities of oil companies on environment. The work has also been conducted in frames of a project under a grant of SOCAR (SOCAREF2012) and open joint-stock company “Azerkosmos”[4].

2. MATERIAL AND METHODS

2.1. Raw data

In research following sources have been used:

1. Topographic maps of Absheron peninsula of a scale 1:10000;
2. Thematic maps of a scale 1:500000 (landscape, geomorphology, geological, maps of plate tectonics, soil salinization, vegetation, lithology, desertification);
3. High-resolution images from the following satellites: AZERSKY (2013, 2014, 2016, MS:6m, PAN:1,5m), GEOEYE(2013,MS:0,65m), PLIEDIES(2013,1m), IKONOS (2007,MS:1m), TERRASAT (2014,2015, 18m,3m).

Space images were taken in a basic cartographic projection: UTM, WGS84, zone 39N [5]. Space sources were scanned in paper version and translated into a digital format in a basic cartographic projection.

2.2. Methodology

2.2.1. **Set objectives**. Mining hydrocarbon raw materials are always accompanied by development of infrastructural objects of oil and gas industry, which can negatively influence the environment. The negative phenomenon takes place as a result of exploration, mining and transport of oil and gas, also their treatment it is impossible to avert the accidents or other emergency cases. As a result of those emergency situations fire can take place, violation of land cover, soil contamination and water surface. They lead, as a rule, to violation of ecosystem, health worsening of the population, which is naturally the reason of conducting periodic object monitoring of oil-producing and oil-treating industries.

Owing to major benefits of resources of remote sensing system the most effective is aerospace monitoring. The benefits of space information are periodic images, contactless methods of measurement under different external conditions, availability of satellites with high and very high spatial resolution and radio locative images under any weather conditions.

With the help of aerospace monitoring and integration with GIS-technologies following objectives are considered [1,3,4, 6]:

- Inventory of industrial objects of oil and gas industries both on land and sea
- Monitoring dynamics of oil industries
- Upgrading maps of oil industries
- Monitoring of oil spillage onto land and soil contamination
- Operational monitoring of oil spillages onto sea surface
- Exploration oil and gas deposits on the base of space information

2.2.2 **Structure of geoinformational systems.** Geo informational analytical system “Oil industries of Absheron” has been created in order to achieve efficiency and reliability in decrypting the objects of oil industries and land contamination. Here information has been fallen into following sections:

A. Vector thematic layers, vectored from different existing maps on oil industries of Absheron (in main scale 1:10000 and 1:500000), there is an archived information

B. Vectored thematic layers of vectored after processing images of oil industries, transmitted from satellites of high resolution GEOEYE1,IKONOS, PLIEDIES, SPOT6, AZERSKY, TERRASAT, DEM-model (SPOT6,8m);

C. Vectored thematic layers taken after processing field-based researches and land measurements;

D. Raster layers divided into sections: satellite information, topographic maps, thematic maps of Absheron (landscape, geo morphology, geological maps of plates tectonics, soil salinization, vegetation, lithology, desertification);

Moreover, there has been implemented decryption of industrial objects of oil industries based on images of high resolution on the basis of complexes of program funds: ENVI 5.2, ArcGIS10.3, RockWorks 15.

As a result of accomplishing projects SOCAR (grant) Data Base has been created to apply data of satellites AZERSKY in oil and gas industries.

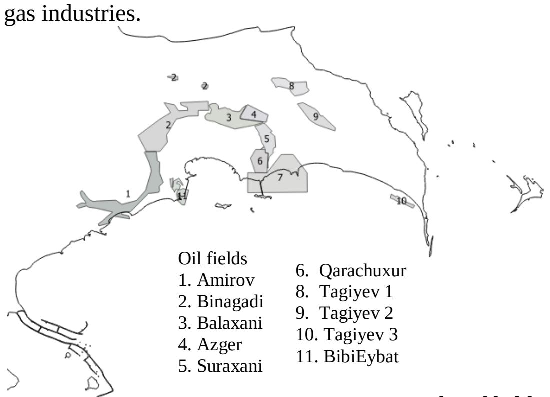


Figure 1. Territories of oilfields in Absheron peninsula

3. THE OBJECTS OF OIL AND GAS FIELD INFRASTRUCTURE ON LAND AND SEA

3.1 The inventory of industrial objects of licensed oil industries on land and sea

The inventory of industrial objects of licensed oil industries on land has been conducted in two stages:

First stage. Creation of geo informational Geo Data Base against previous records (vectorization data from maps with a scale 1:10000(1978 and 1980), from archived images from satellites LANDSAT TM, 1998, 2000.

Point layers have been included into the geo data archives (oil wells, pumps, towers, pools), marine platforms;

Linear layers: lines of oil and gas pipes, roads, channels, lines of electro transmission and water pipes;

Polygonal layers: objects of oil fields infrastructure (buildings, oil storage and etc.).
Second stage. Creation of a vector geodata base based on the results of processing of aerospace information (2013-2017).
The models are showed on fig. 2,3,4,5.

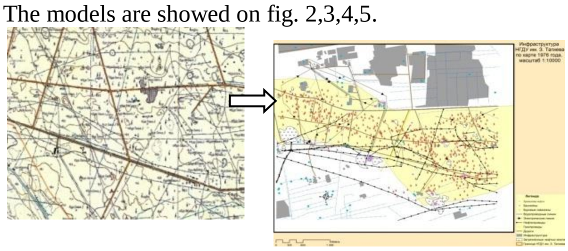


Figure 2. Vectorization of oil field map elements on land[4]

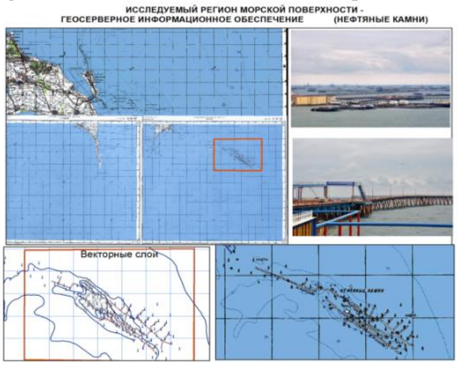


Figure 3. Vectorization of oilfield map elements on sea [4]

3.2. Decryption of oil field industrial objects based on data of space images from 2013-2017

The methodology for image processing was carried out using the following steps:
1. Space images of high resolution received from projects SOCAR and open joint-stock company "Azerkosmos", initially were processed with the help of program ENVI 5.2. Multispectral images from satellites AZERSKY, GEOEYE, PLIEDIES were initially processed with the help of operation Pansharping and brought to spatial resolution according to their panchromatic images.
2. A contour of oil fields of Absheron, created with the help of GIS-technology, was overlapped onto the space images, implemented into GIS environment (fig.4).
3. Vectored layers were created on each oil field in the frames of its territory (highlighted with a contour) as a result of decrypting objects, their infrastructure and square of contaminated with oil and wastes of oil mining on land (fig.5).
4. Vectored layers of oil platforms, flyovers and other objects around oil fields were created per each marine oil field.

Figure 4. Contour of oil in fields on the image

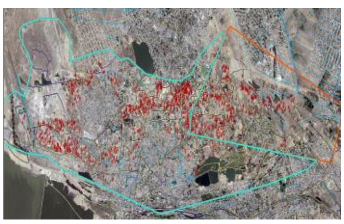


Figure 5. Vector layers of oil wells on space image

4. MONITORING DYNAMICS OF OIL FIELDS INFRASTRUCTURE. UPGRADING MAPS OF OIL FIELDS.

When comparing archived vectored information with results of decrypted space images of oil fields dynamics of their territorial infrastructure are showed. As a result of such comparison an upgrade of oil fields maps is possible. On the fig.6 the quantitative dynamics of oil wells in one of the oil fields is displayed. As a result of such reduction the area of oil fields territory has decreased. The fig.6 (on the right) is displaying that the territory which was revealed from oil mining was harnessed into residential constructions.

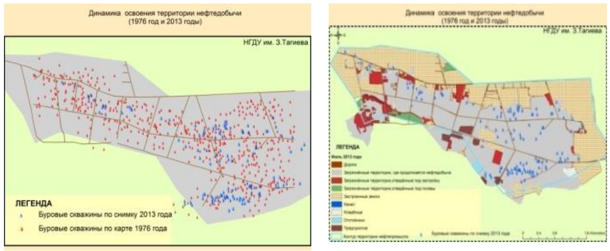


Figure 6. The quantitative dynamics of oil wells (on the left) and area oilfields (on the right)[4]

When comparing different images, the dynamics of oil fields “BibiEybat Oil” infrastructure (fig.7,8) were observed.
Monitoring this territory shows the results of reclamation of oil exploration contaminated from wastes between 2007 and 2014.

Figure7. Space image taken in 2007 (on the left) and space image taken in 2014 (on the right) are territories of oil fields BibiEybat [4].

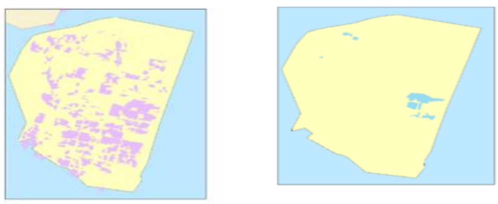
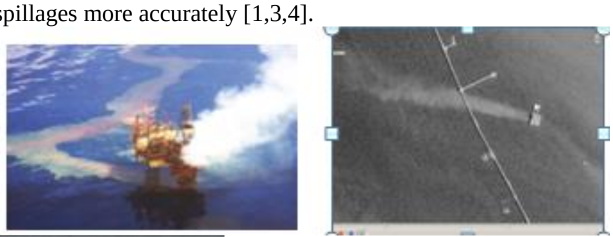


Figure 8. Area of contaminated lands in 2007 (on the left) and 2014 (on the right) [4].

3.4 Operational monitoring of oil spillage on marine surface

Oil footage have an impact on surface waters by suppressing short waved components of wind turbulence and creating well distinguished slicks.
Slick is a common term which signifies the area of burnishing wind on the surface of the sea. When classifying the phenomenon, that create slicks on the water surface, there are natural and anthropological slicks, filmed and non-filmed. In order to differentiate different types slicks and their origin it is necessary to have an experience of decryption them on space images. To that end, informational data base of different manifestations of slicks on water surface has been created. Also, *vectored layers of different sources of oil spillage were included*

(pipes, oil platforms, serving ship platforms, fig.3,9,10). Also, according to different images, various cases of oil spillage are recorded into the data base, thus the area and direction of dissemination oil slicks under weather conditions are being learnt.
To identify oil slicks radio locative images are used, but images of optic spectrum are used as additional material. Radio locative images are initially processed in program ENVI 5.2 to present a black and white image in different color arrays, with an aim to highlight the area of disseminating oil spillage. (fig.10,on the left).
Such informational field allows to identify and decrypt oil spillages more accurately [1,3,4].



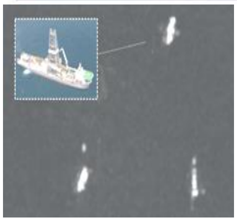


Figure 9. The photo of oil spillages and a burning torch (on the left) from data base allow to decrypt correctly the image of platforms with a burning torch, The photo of the ship corresponds to the ship on the image (below)

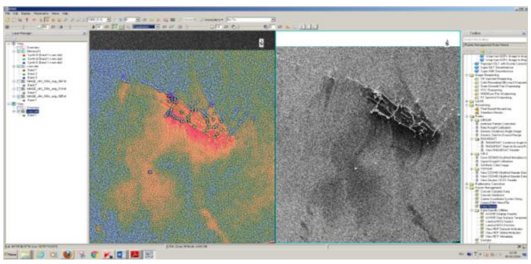


Figure10. Source image (right), transformed image(left)[4]

4.2 Creation of geological data base

Processing original DEM models were conducted with the help of tools Spatial Analyst ArcGIS10.3 (fig.11). The tools of a group Surface serve for quantitative expression and reflection of forms of topography, submitted by digital model of a relief.

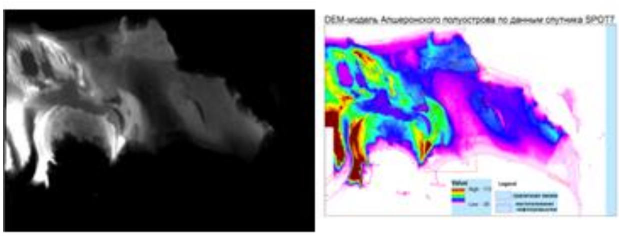


Figure 11.The original DEM model (on the left) and digital model of a relief (on the right)

On the basis of a received map of expositions, features of locating oil deposits can be researched (fig.12- red contours of oil fields). After they were used for visual analysis of direct and round linear structures, built based on images of high resolution (Azersky 6m and 1.5m) and also for geomorphological analysis based on data of DEM model of Absheron peninsula with sufficiently high resolution for such kind of information, be precise 5-8m. (fig. 12).

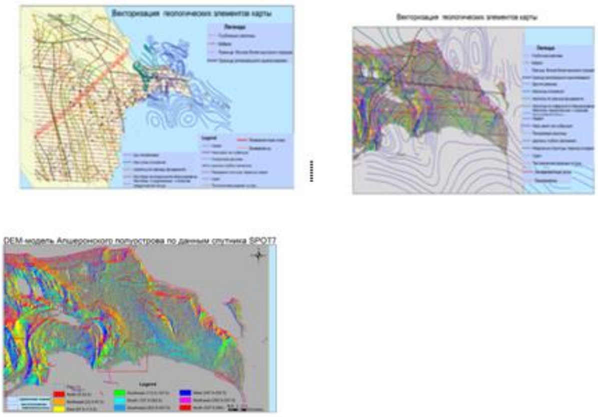


Figure 12.Vectored elements of tectonic maps (on the left) imposed on a grid exposition(on the right), grid exposition and counter of the oilfields(below)[2,4].

5. Results and discussion

Comparative analysis of archived information and data received while decrypting images shows reduction of square of the territory, reduction of the quantity of existing oil wells of some of oil fields on land. For example:
- since 1988 the territory of oil fields "A. Amirov" 559 oil wells were vectored, while based on the image of Azersky taken in 2016, 285 oil wells were decrypted;
- on the territory of oil fields "Garachuxur" the communities took up 0.137 km^2 based on the map of 1988, while based on the image Azersky the area makes up 2.264 km^2.
Increasing communal areas on the oil fields that previously were used for oil mining means changing infrastructure of oil fields, possibly conducting recultivational works in case of settling these territories.
Usage of space images while works of geological prospecting to seek deposits of hydrocarbon allows:
- Significantly reduce terms of work through responsiveness of space methods of researches;
- Reduce expenses to conduct works through more effective usage of geophysical methods taking into account results of space researches on exploratory phase;
- Increase reliability of received results through comprehensive processing of space and geologically geophysical data;
- In conjunction with geo exploration works to assess environmental events on oil and gas deposits with ecological monitoring carried.

6. CONCLUSIONS

In the article possibilities of widening areas of space technologies on the basis on integration with geoinformational technologies are showed on the examples of different models of using satellite information in oil field industries.
Geoinformational technologies allow interpreting data of remote sensing in conjunction with geo physical, geo chemical, soil, climatic, geographical data. Possibilities of carrying operational aerospace monitoring and its effective application results increase if:

- created there is geo data base of archived information of an investigated territory including different map materials and results of their vectorization with the help of GIS technologies;
- experience of decrypted space images are accumulated based on integrating with ground-based measurements
-archiving information from different satellite data is made in the form of different thematic vectored layers.

Thus with the help of GIS technology informational environment is created to analyze space data and satellite information and formation this of processing results for wider usage.

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PROTECTION OF PERSONAL DATA: EXAMPLE OF GEOGRAPHIC INFORMATION SYSTEMS

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ABSTRACT:

Right of protection of personal data is among the fundamental human rights and freedoms and it bears significant importance legal state principle and democracy to gain depth. Protection of personal data has gained great importance in the last forty years time. An important factor relating with this is that privacy area of private lives of people has become more defenceless as information and communication technologies developed and capacities to collect data and to process them automatically increased. Depending on technological and democratic development levels, countries have began to take important steps to establish legal arrangements and institutional structures with the aim to protect personal data starting from 1970s onward. In Turkey with the provision which is added to the Constitution in 2010, the necessary legal basis relating with protection of personal data has been established. In 2016, the law about the protection of personal data has been accepted and the legal arrangement deficiency in this area has been eliminated. In our study, the provisions of law relating with the protection of personal data will be investigated and afterwards measures which are required to be taken for the protection of existing personal data will be examined in the Geographic Information System, being a database processing system with private computer support which is used with the aim to collect, preserve, process, analyze, and display geographical data, within the context of international law and national regulations.

KEY WORDS: Data, Protection of Personal Data, Geographic Information Systems

Introduction

Data is the series of facts which gain meaning when they are correlated with similar ones (Ayözger, 2016: 40). Information is composed of data which are classified and interpreted, meaning that they are conceptually processed (Ayözger, 2016: 43). Data can transform into information only when they are correlated with a special problem. In order to reach to information, it is required to select, integrate, and interpret appropriate data within a specific data cluster.

Diversification of data sources and increasing the volume of data being established necessitates classification of data in order for legal frame to be established and for the arrangements to be made. Data originating from different sources can be qualified as personal or impersonal data depending on the quality of data. Examples of personal data are given below (Kılınç, 2012: 1099):

- Blogs, interpretations, photos, and videos being created by people,
- Information about internet activity of a person, researches he has made,
- Data in social platform, friends and environment of a person,
- Location information of a person,
- Demographic information of a person,
- Financial data, account details, health records, security records which bear official quality and which can be used to define a person.

As a result of unavoidable increase in the usage of computers, giving their name to the epoch, collection, storage, and sharing of information being named as personal data, has reached to significant levels. A government or private company and even a private person can learn about shopping habits of a person by collecting and comparing personal data and for example by following up his credit card expenses, and they can learn about their areas of interest by using the cookies left during their usage of internet and by means of the information in their mobile phones, they can easily learn about who their relatives are. Information given by an internet user only to get an e-mail address or to use internet banking or to do shopping in internet and information given by a person to become a member of a sports hall, to participate in a lottery, to get credit from a bank and to realize various other processes in daily life without requiring to use internet, are all personal data (Develioğlu, 2017: 59).

There are three basic methods of gathering personal data (Ayözger,2016: 57):

* Person/institution about whom data is requested to be gathered, may give them voluntarily,
* Personal data can be legally followed up and gathered,
* New data sets can be established by processing personal data. The process that takes place from the stage of gathering data to their being used, can be possible by a value chain of four stages being composed of collection, storage, analysis, and usage.

As a result of advancing technologies, the opinion came out that individuals can not freely develop their personalities and participate in democratic life against data processing activities of public organs, unless there are legal arrangements. It can be stated that there are basically three factors in the coming out of law of protection of personal data (Develioğlu, 2017: 66):

- The requirement of various organizations for personal data;
- Technological advancements;
- Worry felt due to the developments lived through in inspection technologies.

Various information such as names, birth dates, genders, professions of people, which define people and which differentiate them from others, are being kept recorded by public authorities for different purposes for a long time. As informatics technologies began to develop in 1970s and as private people and institutions also began to record these data, besides public authorities, and as it became easier to store these data and especially to transmit them to others, the need to protect personal data emerged.

The law which was accepted in 1970 in Hessen Federated State in Germany has been the first arrangement being accepted in this area in the world. Laws relating with protection of personal data have been accepted in 1973 in Sweden, in 1976 in Germany, and in 1978 in France (Cengiz, 2016: 188).

With said arrangements, states try to keep control of the situation where especially the data of their citizens are taken out of their borders and circulate in international ground and they only permit for data to be transmitted to countries which provide sufficient legal security. Certain institutions which consider that these legal arrangements would limit data flows beyond borders and that they would limit international trade in return, try to determine minimum level of protection required to be provided by states, with the regulations they make since 1980s (Johnson, 2007: 113).

First example of international studies relating with law of protection of personal data is OECD Principles. Purpose of Principles of Guideline relating with Protection of personal area and flow of personal data beyond borders is to enable free circulation of data in free market economy and to regulate protection of interests of data owners. Said principles are presented as recommendations and they don't bear any binding effect (Johnson,2007: 118).

In 1981 European Council of Ministers Committee has opened Contract of European Council About protection of individuals with regards to automatic processing of personal data, for signature. This contract evaluates the right of protection of personal data within the context of principle of protection of private lives as being stated in 8th article of European Human Rights Agreement and it provides detailed regulations. Turkey has approved this contract on the date of 30.01.2016 (Kılınç, 2012: 1128).

The most effective regulation regarding the protection of personal data is European Parliament and European Council Directive with no 95/46/EC regarding the protection of individuals with respect to free circulation of personal data, which was put in effect on the date of 24.10.1995. In the month of November in 2010, although fundamental principles of EU Directive remained valid, European Union has decided for European Union to conduct studies relating with the protection of personal data against rapid technological developments and globalization. As a result of these studies, on 4th of May, 2016 EU General Data Protection Code has been published (15). This code will become effective on the date of 25th of May, 2018 and on this date, application of EU Directive with no 95/46/EC will be ended (Develioğlu, 2017: 129).

The code primarily increases the liabilities of data responsibles and data processors. Obligation to keep record of processes being realized, providing details of liability for taking measures relating with data security, foreseeing preliminary inspection mechanisms regarding the processing of personal data, requiring for the assignment of information security official are the important developments (Cengiz, 2016: 213).

Right of protection of personal data was first specified in the Constitution in year 2010. "Law About making amendments in certain articles of Constitution of Turkish Republic" with no.5982 has been published on official gazette dated 13th of May, 2010 with no 27580 with the aim to present it to public opinion as per fourth paraphrase of 175th article of the Constitution and it was accepted with the majority of votes as a result of public opinion on the date of 12th of September, 2010 (Ayözger, 2016: 68). The following paraphrase has been added to 2nd article of this law with no. 5982 and to 20th article of Constitution of Turkish Republic: "Everyone has the right to request protection of personal data relating with himself. This right also includes notification of a person about his personal data, his having access to these data, requesting for them to be corrected or erased, and to learn whether they are used in line with the purposes or not. Personal data can only be processed in cases which are foreseen by the law or as per explicit consent of the person. Rules and principles relating with protection of personal data are regulated by the law." Afterwards on the date of 24.03.2016, Law for the protection of personal data has been accepted. Nowadays, national arrangement of law of protection for personal data is this law. However, the law which is accepted with the aim to follow up the developments in the area of law of protection for personal data, assumes Directive with no 95/46/EC as basis and it does not contain the renewals brought up by EU General Data Protection Code (Korkmaz, 2016: 89; Çayır, 2016: 12).

The purpose of this law is defined as: "Protection of fundamental rights and freedoms of people with regards to the processing of personal data and regulation of rules and principles which legal entities processing personal data shall comply with". This law is the application law of the right of protection of personal data which is stated in 20th article of the Constitution (Ayözger, 216: 188; Korkmaz, 2016: 69). Therefore, disciplining the processing of personal data and protection of fundamental rights and freedoms are among the basic purposes of the law.

It is a known fact that personal data are collected by many institutions for various reasons. The law with no.6698 was prepared with the reasoning that these data shall be gathered at a certain center in a controlled way and that it shall be avoided for them to be misuse them. Accordingly, in the law the rules and principles which are required to be complied with and which are related with protection of personal data which are obtained by public or private institutions or by real people from people getting services or not, either by getting their consent or by force, are specified (Develioğlu, 2017: 121).

1. Concept of Personal Data

In many national and international texts, personal data is defined as: "All kinds of information relating with a specific person or a person who can be determined". Starting from this opinion on, in order for an information to be considered as personal data, first of all it is required for it to belong to a real person and it is necessary for the identity of person to be defined with these data.

Personal data also covers information about a person's financial, professional, and communal life as not being limited with his private life. For example data such as a person's name, address, photo, education details, institution registry and tax numbers, phone messages, social sharing messages sent through Twitter/Facebook/Whatsapp etc., aural and visual records, finger prints, e-mail address, biometrical and medical information which we can see in each area of our lives are considered within the context of personal data. In this respect we can state that personal data are "Data which reveal the identity of an individual, which determine a person and which characterize him" (Ayözger, 2016: 51).

Part of personal data are separated from the others as private personal data. According to 6th article of law with no.6698, "Data relating with people's race, ethnic root, political opinion, philosophical beliefs, religion, sectarian, other beliefs, dressing, memberships in associations, unions and foundations, health, sexual life, criminal sentences, and security measures, and their biometrical and genetic data" are considered as private personal data (Develioğlu, 2017: 203).

2. Processing of Personal Data

Processing of personal data is defined as "All kinds of processes such as obtaining, recording, storing, keeping, changing, modifying, explaining, transferring, receiving, providing, classification, and avoiding the usage of personal data either partially or completely through partially automated paths or through ways which are part of a data recording system but which are not automated" (Ayözger, 2016: 44).

All kinds of processes starting from obtaining personal data for the first time as including all processes which are realized on the data are considered as processing of data. Apart from this, it is possible to state that processes realized for combining personal data, correlating them with other data, erasing them or other processes being realized for such purposes are within the context of definition of processing the personal data (Kılınç, 2012: 1099; Korkmaz,2016: 109).

With regards to processing activity, it is required for the rules and principles in law to be foreseen. Compliance of processes being realized with respect to personal data with the human honor and values is a particular that should be paid attention to. Besides, general principles that should be complied with in the processing of personal data are being in conformity with law and rules of honesty, being correct and updated when required, processing for specific, clear and legitimate purposes and to be related with the purpose of processing (Korkmaz, 2016: 110).

Processing of personal data has been connected with certain conditions. First of all the general rule for the process of processing is obtaining the explicit consent of relevant person. The concept of explicit consent has been defined in law as: "Consent which is based on notification and which is explained with free will". There are no provisions relating with the form of explicit consent. As it can be understood from the definition in law, it is possible for the consent to be given in any oral or written way.

With respect to the processing of data, there are certain cases when it is not needed for the consent of data owner to be taken. These situations have been specified in 5th article of law with no. 6698. Such that, these are as stated below (Ayözger, 2016:48; Develioğlu, 2016: 193):

* There is explicit provision i the laws regarding the processing of data,
* It is not possible for the relevant person to declare his consent or the person, to whose consent legal validity is not provided, is obliged for the protection of life or physical integrity of someone else,
* It is required for personal data to be processed on condition that it is directly related with the establishment or execution of a contract,
* It is required for the data responsible to execute his duties,
* It is required for establishing, using or reserving a certain right,
* It is required for the data to be processed with respect to legitimate interests of data responsible on condition that it does not damage the fundamental rights and freedoms of relevant person.

In 28th article of law relating with processing of personal data, a general provision for exceptions has been specified. Such that, in below cases, provisions of law shall not be applied (Ayözger, 2016: 48; Develioğlu, 2017: 194):

a) Processing of personal data by real people within the context of activities relating with themselves or with their family members they are living with in the same residence on condition that they are not given to third parties and that provisions relating with data security are complied with,

b)Processing of data for purposes such as making research, planning and statistics by making them become anonymous with official statistics,

c) Processing of personal data for purposes relating with art, history, literature, or science or within context of freedom of expression on condition not to violate national defense, national security, public order, economic safety, privacy of private life or personal rights or not to constitute any crimes,

d) Processing of personal data within the context of preventive, protective, and informative activities with the aim to provide national defense, national security, public order, or economic safety,

e) Processing of personal data by judicial authorities or execution authorities as relating with investigation, prosecution, judgment, or execution processes.

3. Erasing, Destroying Personal Data and Making Them Become Anonymous

In the 7th article of Law for the protection of personal data, erasure of personal data, their being destroyed or their being made anonymous have been regulated. Accordingly if the reasons requiring for the processing of personal data which are processed as complying with the law, are eliminated, these personal data will be erased, destroyed or made anonymous with the request of relevant person or as ex officio by the data processor.

As it is specified in the reasoning erasure of personal data means erasure of data from recording environments such as document, file, CD, disk or hard disk in a way that it can not be used or obtained again.

Destroying the data means destroying recording materials such as document, CD, disk, hard disk on which data are recorded in a way that they can not be used and obtained again (Develioğlu, 2017: 209).

Making data become anonymous means making it impossible for them to be correlated with a real person, the identity of whom is specific or which can be determined, even if personal data are matched with other data. As with anonymous data, by disconnecting the bond between the individual whose identity can be determined as a result of the processes being done and the data, it can not be possible to reach to the person by means of data. For this reason anonymous data are not personal data (Millard & Hon, 2012: 66). But since at the beginning of process of making anonymous, the situation of personal data's being determined does not vanish and this process is protected within the context of European Union Directive with no 95/46/AT. According to European Council Contract with no 108, if relevant people have processed data as violating the provisions of Contract, they have the right to request for these data to be erased or if their request is rejected, they have the right to apply for legal remedies (Başalp, 2015: 88).

At the end of process of making personal data become anonymous, it is required for it to be impossible to determine the person to whom data belongs to by realizing follow up as per the data and by matching with other data or by enabling support. Another issue that needs to be investigated with respect to a data's making a person identifiable or not is related with data in which nick names are used, encrypted data and anonymous data. Data in which nick names are used are those data which are formed especially when more than one data needs to be collected as relating with more than one person for statistical purposes and as the names of these people are changed with other names to avoid these people from being identified. In encrypted data, a code number is written in place of names of people and this code number is stored in a separate place (Korkmaz, 2016: 128). As it can be possible for a person to learn about the identity of a person as he gets access to these code numbers by using them or as he learns nick names by using these nick names, data with nick names and encrypted data are under the protection of data protection laws. Data with nick names have not been defined in Law of protection of personal data. In anonymous data as a result of processes being conducted by disconnecting the bond between a person whose identity can be determined and data, it is made impossible for the identity of individual to be determined and it becomes impossible to reach to people who own these data. For this reason anonymous data are not personal data.

In the reasoning of law it is stated that starting from the stage of obtaining data for the first time all the processes being realized are deemed as processing of personal data. Accordingly transfer of personal data being arranged in 8th and 9th articles of law are within this context. Transfer of data has been divided to two sections which are domestic and foreign transferring. This differentiation bears meaning with respect to conditions required for said processes. Hence different rules and principles have been determined especially for transfers which are made to abroad (Çayır, 2016: 6).

Transfer of personal data to other people within domestic country is subject to the rules foreseen for processing of data. In that respect for the transfer process first of all consent of relevant person should be taken. For the transfers which are made to abroad, besides these conditions it is specified that it is required for adequate protection to be established in the relevant foreign country. Countries having adequate level of protection will be determined and announced by the council (Başalp, 2015: 92). If the country to which data transfer will be made does not provide adequate level of protection, it is required for data processors of both countries to undertake this protection as written and to get permission from the council.

4. Data Responsible and His Liabilities

Data responsible is defined in the 3rd article of law as "Real or legal person who determines tools and purposes of data processing and who is responsible from the establishment and management of data recording system. This person is responsible from all kinds of processes which are realized as relating with the data. 16th article of law has arranged "Registry of data responsibles" in which people being responsible from data will be recorded. Before starting with data processing, it is absolutely required to make recording at this registry.

10th article of law of protection of personal data arranges the liability of data responsible to clarify the relevant person as being stated in the reasoning and being parallel to European Union Directive with no 95/46/AT. According to the law, data responsible or the person authorized by him will inform the relevant person within the context of his liability to clarify the person about his other rights being stated in 11th article with respect to identity of data responsible and his representative, if any, purpose of data processing, people to whom data can be transferred and the relevant reasons, method of data collection and legal reasoning (Başalp, 2015: 93; Atak, 2010: 521).

Data owners who can provide evidence about their identity with relevant documents have the right to request being notified whether data relating to him have been processed or not, for the data to be given back to him in a reasonable way without any unnecessary delays and costs, to request for appropriate corrections and erasures if these data have been recorded in a illegal, unnecessary and wrong way and to be notified if they are transferred to third parties (Atak, 2010: 529).

Notification of the relevant person about the processing of his personal data is important from two respects which are usage of an individual's personal data in an effective way and ensuring transparency of administration.

Furthermore, notification of relevant person is also related with the rule of honesty. For these reasons notification of an individual about the processing of his personal data has an important place in the protection of personal data.

Liabilities of data responsible with regards to the protection of personal data are arranged in 12th article of Law about the protection of personal data. According to this article, data responsible is obliged to take all kinds of technical and administrative measures in order to avoid illegal processing of personal data and having illegal access to the data and to maintain appropriate level of security for storing the data.

In the second paraphrase of the article is is stated that if personal data are processed in his name by other real or legal people, data responsible shall be liable from taking the measures which are stated in the first paraphrase of this article jointly with these people (Korkmaz, 2016: 107).

In the third paraphrase of the article it is stated that data responsible is obliged to make necessary inspections or cause them to be made with the aim to ensure application of provisions of law about the protection of personal data in his own institution or association.

Fourth paraphrase arranges liability of data responsible and data processes to keep secrets and accordingly, data responsibles and data processors can not disclose personal data which they have learned to others by violating the law and they can not use them for their personal benefits. This liability shall continue even if data responsibles and data processors resign from their jobs. In the fifth paraphrase of 12th article of the law it is specified that if the processed data are obtained illegally by others, data responsible will notify the relevant person and the institution at the soonest time. If required, institution will announce this situation from their internet site or by other ways they deem appropriate (Kılınç, 2012: 1128).

In data security, it was aimed to directly secure data and not people. If people relating with data are being protected with the measures that are taken to provide data security, data protection will be provided as well. For this reason in many legal arrangements relating with the protection of personal data, data security has been among the fundamental principles.

Data security and protection of personal data are not particulars having same meaning. Data security which mainly considers technical particulars as basis considers compliance with certain standards as basis. However, data security serves for the protection of personal data. Thus, data security and protection of personal data come in front of us as two integral particulars (Develioğlu,2017: 268).

Technical and administrative measures can be understood as all the measures to be taken by data responsible to fulfill his liabilities. These measures can be related with the infrastructure, organization, personal, software or transmission methods of data responsible. This type of measures can come out as taking necessary measures against cyber attacks, notifying the employees, being continuously subject to training, avoiding unauthorized access with current and variable ciphers, conducting necessary inspections, and defining inter-company data usage policies (Develioğlu, 2017: 268).

In order for data security to be provided and continued in a sustainable way, it is required for data responsible to establish a data management system as per the quality and scope of data being processed (Millard&Hon, 2012: 69).

5. Law About the Protection of Personal Data

In the 19th article of law with no.6698, it is arranged that a new and autonomous institution being responsible from the application of law will be established. Name of this institution which has newly become part of the state organization is Institution for the Protection of Personal Data. Decision organ of institution being composed of council and presidencies is the Council of Protection of Personal Data.

Tasks of the institution are to follow up implementations and legal developments in national and international ground, to realize research and investigations regarding this subject, to collaborate with relevant institutions and associations, and to make proposals in the areas needed.
Organization structure and manner of work of this institution having public legal entity bear similarity to the features of other autonomous institutions. Independence of council, being the decision organ of institution bears significant importance. In the law it is stated that the council will fulfill their tasks and authorizations given to them in an independent way under the responsibility given to them. Regarding these issues, it is absolutely forbidden for the council to take orders and instructions from any authorities, organs, or people (Develioğlu, 2017, 271).

6. Evaluation of Geographical Information Systems with Respect to the Protection of Personal Data

Basic reason for establishment of Geographical Information Systems is the requirement for planning. If it is required to evaluated very different data in planning, showing very different data on a single map can be very difficult and even impossible. Because many of the data overlap with each other. Obtaining the information being required for planning from these data that are stored as different layers in computer environment can be possible by screening them, querying those requested and bu analyzing them. This opportunity is provided to us with Geographical Information Systems. While software of Geographic Information Systems that will realize processes needed such as investigating and analyzing can be used, Geographical Information Systems aiming for the relevant purposes can be developed. There are various advantages of Geographical Information Systems.

When investigated quantitatively, advantages of Geographical Information Systems can be listed as below (Şehsuvaroğlu et al. 2017, 190);

- There are no data repetitions in CBS technology,
- Updating numerical geographic data is easier and cheaper,
- It is more correct and fast to produce information as based on data,
- It is cheaper to transfer data from another CBS with an appropriate data standard instead of producing them again,
- It helps with increasing the production,
- It provides savings from time, money and human force.

Advantages of CBS with regards to qualitative aspects can be listed as below (Şeremet,et al, 2017: 189):

- Sharing of information: By enabling for sharing of locational information between different divisions, institutions and associations, it enables for them to use each other's locational information.
- Avoidance of abundance, complexity and inconsistency of information: Rapid changes in locational information and the need for updating as being parallel to this, gives rise to inconsistencies between locational information being stored in different places. CBS avoids abundance, complexity, and inconsistency of information.
- Gathering information together: An important advantage of CBS is that it promotes integral effectiveness being required for different divisions, institutions and associations to approach positional problems in a more systematic way.
- Classification of information: By means of CBS, data can be classified as per specific features. Classifications can help divisions that are in need of various information to solve their certain problems.

General Directorate of Geographical Information Systems being within the body of Ministry of Environment and Urbanization is assigned to conduct works and processes (or cause them to be realized) for establishing, using, and developing International Geographical Information System, to determine standards of relevant urban information systems regarding activities of local managements relating with planning, mapping, infrastructure and superstructure, to promote their being widely used, and to operate National Geographical Information Portal (Şehsuvaroğlu, 2017: 192). For this purpose, Regulation About Establishment and Management of National Geographical Information Systems has been published on the date of 20th of March, 2015.

Main source of these studies is INSPIRE project which is created to enable access to spatial data being required for the policies and activities and especially for the environmental ones and those relating with environment in Europe. Basic principles of this project were revealed with the directive with number of 2007/E/AT. The directive which emphasizes the importance of free submission of minimum level of infrastructure to users for spatial data infrastructures to be successfully processed, requests for member countries to investigate spatial data sets and to prepare minimum level of data to be submitted as free, by also considering specific private conditions. Said directive emphasizes the necessity of network services for sharing of data between different levels of authorized public institutions and they enable for network services to reveal spatial data, to transform them, to screen them, to load them and to enable spatial data e-commerce requests (Uyan &Akçin, 2017: 44).

Provisions relating with these network services, emphasizes for the fulfillment of obligations as fully complying with relevant principles relating with protection of personal data as per European Parliament Directive with no 95/46/EC and Council directive being dated 24th of October 1995. In the 13th article of directive, it is stated that if having access to spatial data clusters and services influences international relations, public security and national defense in a negative way, it could be restricted (Millard & Hon, 2012: 69). Regarding these particulars in (f) paraphrase it is stated that confidentiality is provided with national law or communal law and that regarding notification of public, if the relevant person has not given his consent, it is required for the confidentiality of data and/or files belonging to the person to be provided. With regards to national law, the institution being assigned to fulfill this liability is General Directorate of Geographical Information Systems. Legal study which is a guide for the protection of existing personal data in Geographical Information Systems is Law about the protection of personal data with no. 6698. It comprises issues that should be paid attention to for the protection of personal data being present in Geographical Information Systems (Johnson, 2017: 4).
In order for the necessary measures to be taken with regards to information security and protection of personal data and for the necessary efforts to be shown, first of all awareness should be created in this subject and level of consciousness should be improved (Gürleyen, 2016: 78).

In the law about the protection of personal data, liability to take necessary administrative and technical measures has been laid on the data responsible. For this reason, especially security, back-up, patching, reviewing the chipper policies bear importance. It is required for crisis management centers to be established and for confidentiality contracts to be signed between companies providing informatics services while having access to most critical information, and their employees (Çayır, 2016: 48). In the informatics systems, it is required for fundamental security measures to be improved. Besides these measures, it is required for administrative arrangement and organization structures to be shaped by considering the particular of information security.

It is required to attach importance to restrictions regarding capturing of geographical data, analyzing them, processing them and making them become anonymous which form the main topics of Geographical Information Systems (Gürleyen, 2016: 77). As being examples to these restrictions, legal and security restrictions relating with data, restrictions relating with having access to data/capturing data, restrictions in using data, legal restrictions, security classification of data, and restrictions relating with security could be listed.

Security is a concept which bears the particulars such as what to be protected, the value being important, threats against this value, existing weaknesses, and measures that can be taken. In the protection of personal data, the value to be protected in "data" and "information" and it bears importance to conduct inventory study to define the content of particular that needs to be protected primarily (Civelek, 2011: 25). With the information systems and data inventory study which is part of these systems, data assets which are required to be protected and their qualities will be determined and accordingly, by considering qualities of data such as those being sensitive data, critical infrastructure data, and confidential data, security measures could be applied as fitting to these qualities (Uyan&Akçin, 2007: 49).

Important particular is for this type of measures not to be fixed but to be continuously updated, to be in conformity with the solid event, and for the process to be continuously reviewed (Civelek, 2011: 25). Within this frame it is required for data responsible to establish a data management system in accordance with the quality and scope of data being processed. In order for data management system to be established, it is primarily required for data security concept to be determined and then it should be tested to see whether this concept is actually operating or not and to determine how functional it is (Uyan&Akçin, 2007: 49). Besides it is required for data management system to be organized in a way to avoid for data to be used for reasons other than those being intended. Data responsible who is obliged to take administrative and technical measures for the data to be processed as per the conditions being foreseen in the law, should take measures such as notifying his personal who process data, training them, avoiding having access to those other than the authorized people, following up data processing activities, and keeping record of them.

By considering that any problems that may be experienced in information systems could influence the efficiency and quality of service provision negatively in the long term and that they could cause delays in daily service provisions, it could be thought that security of information systems should be considered starting from the design stage onwards and that balance should be established between functionality and security within this context (Civelek, 2011: 26-27).

Conclusion

Information is one of the most important values of modern life. Each day state institutions and private associations gather, store, process, and transfer important amount of information about individuals. Furthermore, technology develops in a way to permit sharing of personal information and their being spread worldwide. All of these cause for people to lose control of their information and for dangerous situations to arise such us their being used against them. Protection of personal data is a right owned by people against their individual data's being used by other people or institutions in an unauthorized way. By adding the following paraphrase to the law about the protection of this right with no 5982 and to 20th article of Constitution regulating confidentiality of private life, protection of personal data has been explicitly taken under constitutional security. Law about the protection of personal data has been accepted and legalized in Grand National Assembly of Turkey on 24th of March, 2016.

It is required for explicit consent of data owner to be taken for conducting processes such as defining personal data, processing personal data, erasing them, destroying them, or making them become anonymous. Personal data responsible has legal, administrative, and technical liabilities which he is obliged to fulfill within the context of law. Furthermore, in 19th article of law for the protection of personal data, constitution of Institution for protection of personal data, having public legal entity, as being established to fulfill the tasks that are defined in the law, as also having administrative and financial autonomy is being arranged.

The system being composed of software, hardware and users with the aim to obtain information about geographical assets, storing them, processing them, and analyzing them is named as Geographical Information System (CBS). According to various sources, CBS is being defined as follows: It is a system dealing with management and analysis of big volume of geographical data relating with complex social, economical and environmental problems on the globe and the solutions being created for them. CBS, is a series of software and methods consisting of hardware, map module and database, which is designed for solving complex planning and method problems and which enables for spatial data being dependent on location to be stored, modeled, processed, analyzed and submitted. In Geographical Information Systems, besides existing spatial data, it is especially required for data bearing personal qualities to be protected. Among the international texts being accepted as relating with this subject, it is important that reference has been made to the protection of personal data while limitations are brought to having access to spatial data in European Parliament directive with no 2007/2/EC and Council directive being dated 2007. In this regard, measures which should be taken with respect to national law and especially creating awareness for the right about protection of personal data bear importance.

Since data responsible has the liability to take all kinds of technical and administrative measures for the protection of personal data, it is required for him to improve security measures in informatics system. With the information systems and data inventory study which is part of these systems, data assets to be protected and their qualities should be determined and by considering qualities of data such as their being personal data, sensitive data, critical infrastructure data or confidential data, appropriate security measures should be implemented. It is required for data responsible to establish data management system as per the quality and context of data being processed. In order for data management system to be established, it is first required to define data security concept and then to test whether this concept is actually operating or not and to determine how functional it is.

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GEOGRAPHIC INFORMATION SYSTEMS USE IN ENVIRONMENTAL IMPACT EVALUATION

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ABSTRACT

This article deals with the geographical information systems and their role in assessing and protecting the environment. When it comes to GIS environmental modelling applications, in many respects GIS software can be considered comparable to a programming language. Unfortunately, however, the typical environmental GIS users are focused on environmental issues and only rarely do they have the additional technical knowledge necessary to develop new GIS applications. As a consequence, most domain experts are forced to work with GIS that have predefined underlying data structures and 'standard' interfaces.

KEY WORDS: GIS**,** Analysis systems, Comparison of alternatives, technical knowledge, environmental impact, domain experts, crisis managment

INTRODUCTION

This chapter will deal with the issues to be considered by the designers and programmers of such turn-key applications within the areas of environmental monitoring and assessment. Each distinct type of system presents its own demands to the designer and together these requirements may form a 'requirements matrix'. Some characteristic examples of applications will be given together with a closer look at the demands that the individual applications make. First it is useful to distinguish between the various types of environmental monitoring and assessment systems. In monitoring systems emphasis is placed on data collection, pre-processing, and quality control. Analysis systems focus on using tools to manipulate and model data. Information systems, on the other hand, are more concerned with the storage and management of data (Ji and Mitchell 1995).

MATERIALS AND METHODS

Nowadays, GIS is used in many different areas. Field suitability analysis, service and service management, fire risk simulation, market analysis, crisis management, risk analysis, epidemiological studies, transportation, environmental management are examples of this mentioned.

There are five main components required to install a GIS. These are software, hardware, workgroup, organization and data to use the system. Given spatial availability and quality of GIS in terms of impact assessment is very important. The quality of the presentation will also reveal the value of the results. The most important GIS Features are successful spatial analyzes and depending reliable results on them. GIS is not a tool used only for map production.Especially in terms of EIA, GIS has very high analytical potential bears. Many GIS applications in EIA, length and area measurement, map generation, zoning and classic map registration operations, as well as a few basic CBS function. There is no doubt that the classification and location of the registration method used in the selection process has been used for a very long time.This method was developed by Ian McHarg in 1969 (Şahin 1998).

RESULTS AND DISCUSSION

Many researchers have found a very useful tool to assess the environmental impact of GIS and predicted that their use would spread rapidly (João 1998). GIS can be used at all stages of EIA studies.

Tool:

1. Screening,

2. Scope,

3. Definition of the project,

4. Description of the area,

5. Identification, measurement and evaluation of impacts,

6. Comparison of alternatives,

7. Development of measures,

8. Presentation of the report,

9. Monitoring and monitoring after EIA.

The use of GIS in EIA studies is often associated with highways, pipelines,housing development projects, coastal and flood protection works, dams, tourism investment projects, ports and energy lines.

The advantages of using GIS in EIA studies are the following.

- spatial analysis that allows better impact assessment and evaluation; and modeling,

- Convenience in project site selection and comparison of alternatives providing,

- The literary and numerical data belonging to the area under the impact evaluation storage, editing and easy updating,

- People involved in the impact assessment process of the project with effective presentation technique

to be more easily understood by each group including,

- The most accurate results are obtained by minimizing human errors in evaluation

to be made available at the time. Despite the many advantages of using GIS in EIA studies

Here are some reasons why the use of GIS is not common yet:

- GIS is a relatively complex method.

- Investment, time and trained staff are required for GIS technology.

- sufficient experience in the use of GIS in EIA studies and

there is no document.

- Due to insufficient data in the digital format yet, transferring and processing the data to the computer in a long time

It may require.

- Education and technical support systems have not been established sufficiently.

- The interest in GIS is inexcusable.

In highway EIA projects, the possibilities for utilization in GIS are hypothetical a generated example field has been applied. In this example, the first three of the GIS application areas have been realized in highway projects.

Stage 1: Detection of sensitive areas in the ecological direction:

Hypothetical example"agricultural landscape" and "vegetation cover" were taken as the basis for the determination of these areas.

Ecological determination of the sensitive regions from the direction, different criteria of different area (erosionrisk, sedimentation, surface permeability, etc.). Developed for this purpose and many ecological approaches have been applied.

Stage 2: Route selection:

A number of criteria for selecting a road route is assessed. In this simplified hypothetical example, criteria were used in route selection.

- Slope: Areas with a gradient lower than 5%

- Distance to rural areas (minimum): 250 m

- Distance to river bank (minimum): 200 m

- Distance to city center: Max. 10 km, minimum 5 km

- Ecological sensitivity: Hypothetical area 1.

Firstly, according to these criteria, the fields are created separately in the GIS environment where AutoCAD / MAP is used as software has been identified. From rural roads to rural settlements, to riverside and urban distances to the center were obtained by performing buffer analysis. Then, these areas can be used primarily in the selection of the highway route .The route alternatives were established taking these areas into consideration.

Stage 3: Comparison of alternatives:

For this purpose,are based on the first-degree domains that make up the center of this area.It is a corridor with a length of 50 m on both sides of the line. Total 100 m all alternatives to this area of breadth of agricultural land loss and eco-direction alternative which has the least effect by comparing the occupation of vulnerable areas.The spatial expression in the comparison of alternatives.All parameters can be used in GIS environment.

RESULT

One of the important uses of Geographic Information Systems is Environmental Impact Assessment (EIA) studies. The recommendation is that the potential environmental impacts of a decision making mechanism in relation to approval or rejection of the project EIA studies aimed at producing data that can be used by increasingly important and legally enforced common environmental management tool. In this report, GIS use possibilities in EIA studies are a hypothetical example area. In this example, in particular, the roadway alternatives detection of vulnerable areas in the ecological direction, maps on the use of GIS in their comparative studies.

In addition, air, water (ground and surface waters), soil and water in an EIA studysoftware to be used in noise pollution modeling can be integrated with GIS. In this way, with the help of GIS in the prevention of impact, in terms of importance in these pollution areas grade inhibition strategies can be created.

On the other hand, EIA can be caused by any project in the works calculations on the spatial distribution of economic effects are also increasingly has being dismissed. This geographical distribution of economic effects is analyzed by Regional Input-Output Analysis Interregional Interaction, GIS, and local multiplier values of various community levels calculation. A new urban development project in Hong Kong, type of work, location and the distribution of the residential areas within the area where the persons who will work in this occupation.In the calculation, a specific economic model has been used by being integrated with GIS. (Leistritz 1998)

Finally, the GIS data update estimates after the project activity started measurement of impacted parameters and comparison with predicted values.

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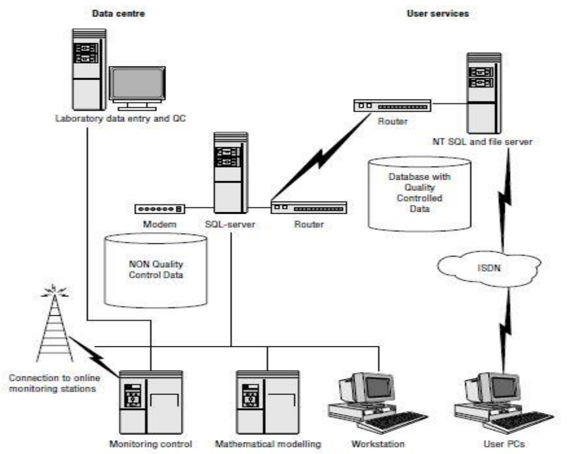

Fig 1. Data flow and hardware network for an example environmental monitoring and assessment system.

APPLICATIONS OF GIS IN OIL AND GAS INDUSTRY

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ABSTRACT

The oil and gas industry is an important sector in the world. It provides 99% of all transport and is 2.5% of GDP.

Oil and gas information is closely related to geography. For example, oil exploration, pipeline construction and environment use CBS. All these features are places in nature.

Interest in GIS in oil and gas industry. GIS programs in the oil and gas industry can be used for various purposes.

The Geographic Information System (GIS) is a system for storing, collecting, translating and presenting geographical information. Oil and Gas GIS programs include oil and gas information, oil and gas pipeline and exploration plans, asset management, geological or supply routing information.

Implementation of GIS in the oil and gas industry can increase cost efficiency and provide timely information. There are several ways to implement GIS in oil and gas related sectors. For example, you can use geodatabases, remote sensing, map automation and much more. Oil and gas datasets are mostly geographically based. For this reason, GIS can provide solutions for pipeline construction, oil drilling and environmental protection.

Keywords: GIS, Oilfield, Exploration, Drilling, Completion**,** Pipeline Routing, HSE, ArcGIS.

1. Introduction.

In the 21st century, the creation of an oil and gas resource information system entered the maturity and development phase, two technical difficulties: the integration of information on various aspects and integration of information on attributes and location information. This document is analyzing technical specifications and the advantages of the Geographical Information System (GIS) and GIS methods of using information systems for oil and gas resources.

It proposes a plan to classify information on oil and gas. Using the technology of spatial GIS databases, basic information about oil and gas resources, including programs and data, can be managed collectively on a single database platform. Based on GIS technology, it can provide a variety of methods to request information between spatial orientation and attribute data. Using the multiple data integration technology supported by GIS, it performs flexible transformation and transmission of spatial data. Based on its ability to draw a GIS vector, it applies a flexible geological map for thematic mapping. Through the spatial analysis of GIS, it performs the functions of supporting decision-making mechanisms such as virtual drilling in the field of oil and gas. And an oil and gas resource can be applied to the construction of the information system. The discovery of new sources of oil on the eve of the tender is one of the key ways of successful success in the oil industry. GIS can help you assess the potential of oil in promising places. The study often requires the analysis of satellite imagery, digital aerial photographs, seismic surveys, surface geology studies, interpretation of subsurface and transverse sections and images, well locations and information on the existing infrastructure. GIS can associate these data elements with the appropriate location in the form of a map and allows you to overlay, view and manipulate data to analyze and understand its potential. Today, GIS technology allows you to manage the spatial components of these "business objects", such as leases, wells, pipelines, environmental problems, facilities and retail outlets, in a corporate database and effectively conduct appropriate geographic analysis in the enterprise.

In the oil industry, it is necessary to manage large amounts of data to cope with the complexity of the process of discovering new resources and managing production assets. Thus, the oil business requires analysis of many different types of spatial data, often achieved using GIS.

In recent years, significant progress has been made in integrating spatial information systems with existing systems for managing and interpreting data to the extent that GIS has become an integral part of the technology used in the oil business. Esri is one of the leading suppliers of GIS to the exploration and production (E & P) sector and, among other things, includes partners from Halliburton, Schlumberger, Oracle, IBM, SAP and Microsoft. Many oil companies are struggling to determine the role of GIS in their business, and few companies get the most out of their investments in spatial data systems and analysis.

In the 1990s, the use of GIS in the oil industry also increased, and many large multinational companies switched to GIS from CAD. The first group of users of Esri Petroleum (PUG), led by companies such as Exxon and Shell, met in the early 1990s. By the late 1990s, oil and gas companies such as Landmark and Schlumberger began packaging GIS technologies in their commercial software products, and the use of GIS in data management, exploration, pipeline and land use began to develop.

2. **Material and Methods.**

GIS technology has applications throughout the whole life cycle of the oilfield (Figure 1), from the acquisition of new enterprises through exploration and production to failure. Below are examples of how GIS is used in each of these areas.

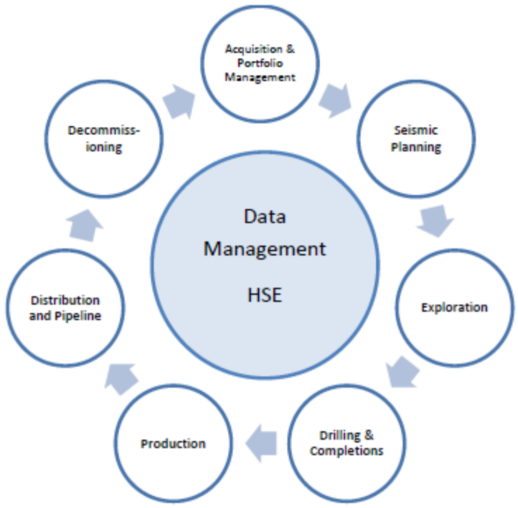

Figure 1. The oil field life-cycle.

2.1 Acquisition and portfolio management. The oil and gas exploration portfolio contains data in various formats on potential hydrocarbon accumulations, for example, potential customers and prospects, as well as information on competing companies and assessing their quality and the value of their portfolio for use during farms or when acquiring companies.

The key tasks of working with such data are to ensure that many data sets can be integrated so that the data is up-to-date, consistent, has a clear audit trail and remains safe, but accessible to those who must use It. Not surprisingly, GIS is increasingly being used for this.

2.2 Seismic planning. Using geodetic accuracy, visualization and data integration, GIS technology is often applied to seismic survey planning. Onshore, using satellite imagery or on a shelf, using bathymetry, seabed research and data on the shipping line, GIS can help in analyzing the areas where seismic 2D or 3D should be obtained.

2.3 Exploration

Analysis of games and squares is a key part of the research process, but, as a rule, the most weakly defined in terms of standardized processes. Solutions are often based on subsets of large amounts of data available to the research team, as well as on a personal or historical bias based on past experience or exploration strategies.

GIS can be used to analyze oil systems using data such as regional, structure, faults, coarse sedimentation, hydrocarbon seepage, gravity and magnets.

Standard GIS functionality can be used to create a series of exploration statistics that are commonly used by geologists, such as cream curves, field-size distributions, and another analysis.

GIS has for some time been used to map the fairway and evaluate the game. Maps of areas of interest can be presented with good results, well traversal, paleogeography, coarse sedimentary environment, structure and other relevant data sets. GIS allows the geologist to first view all the data available in one application. In addition, the ability of GIS to label and symbolize functions using complex patterns and forms allows you to display several attribute attributes on the map, for example. The well can show the location of the well, the depth of penetration, net to the total cost, as well as indicators of the presence or absence of the source of the game, the reservoir and the seal.

In the event of a random or general comparison of risk segments, the geologist may assign a success rate (COS) for each key element of the oil game, such as a reservoir, seal, source, migration and structure. Once the data has been transformed into a consistent numerical scheme, geophysicists can perform mathematical calculations on the stack of elements of the game element to summarize the adequacy of the game or the overall probability of success.

If the region has a high COS in all categories, it is colored green, if one or more categories are risky, it is colored in amber, and if it is known that the critical element is missing, the block is colored red. Before the use of GIS, this can be a slow process, with each block being individually evaluated on a number of regional maps. Any changes in the regional risk model mean that the entire process will need to be repeated.

However, once the process is created within the GIS, it can be performed within a few minutes, rather than days, and is repeated many times, which leads to a significant improvement in the quality of the solution.

Exprodat Exploration Analyst software contains easy-to-use tools to create game chances or shared risk segment maps using GIS.

GIS is sometimes used in prospect analysis, usually as the first stock of a hydrocarbon reserve or a volume assessment tool before the deployment of more specialized software.

In **conventional** hydrocarbon games where oil reservoirs can be delineated and mapped, a raster GIS analysis can be used to calculate the volume between two lattice surfaces or between one surface and a series of depth levels.

The resulting volume can be multiplied by other volume factors, such as extraction efficiency, net to total weight, porosity and oil saturation to create a prospective volume that determines the passage of the first step.

In **unconventional** games with hydrocarbons, such as shale gas, shale oil or coal bed methane, it is often useful to know the number of areas that are estimated to contain proven, possible and probable reserves based on preliminary drilling results from exploratory or exploration wells with using a common drill (DSU).

Given that the first geo-information system ever created (the Geographic Information System of Canada, developed by Dr. Roger Tomlinson in 1960), was used for land management, it is not surprising that the oil sector has for some time used GIS for land management, especially in North America,

The mapping of oil rent begins with the organization of information on rights to extract mineral resources and leases in a database, and then an individual analysis of the lease data to determine its legal position.

Data types integrated into a typical land administration system include survey data, such as county boundaries, blocks and sections; Lease data, such as district court data; well locations and regulatory data, such as appraisal units.

One of the most obvious applications of GIS for the oil industry is the creation and maintenance of geological maps. The geology data model ArcGIS from Esri was built specifically for geophysical industries to help in the construction of geological maps in ArcGIS.

In addition, GIS can be very useful in a terrestrial trick, ie, the process of verifying interpretations made remotely (for example, from satellite images) through field research. As in the case of land management, the use of mobile GIS and GPS technology with an enterprise geodetic database can simplify the integration of data-derived data with a GIS database.

3. Results and Discussion.

In this section, we saw how GIS is a key technology to support and improve the exploration process, including risk assessment and capacity assessment and ranking. The main advantages of this approach are given below:

• GIS provides an ideal platform for data integration in the analysis of geological exploration. Using all available data, consistently, increases the level of confidence in the assessment of risk and uncertainty.

• GIS can significantly reduce the cycle time for an exploration project, especially for manual intensive processes such as data integration, analysis and risk mapping. This time can be used to repeat and refine the models used to rank opportunities, or to reduce the overall project time.

• GIS provides the basis for the development of consistent processes for the exploration of all assets within the company. This leads to a more consistent, proven corporate portfolio of potential customers and better portfolio management solutions.

Reducing technical uncertainty, standardizing the process and understanding risk increases the effectiveness of decision making and the effectiveness of the study. Improved prospects can be drilled earlier in the program, and an improved framework can be established to integrate the results of new wells into the regional risk model of the game.

3.1 Drilling and Completion

GIS is increasingly being used in the well planning arena, especially with the growth of non-traditional resources such as shale gas, oil shale oil and coal bed methanol. Not only can GIS be used to schedule well patterns around a variety of surface drilling restrictions, but its unique spatial analytics can be used to calculate the most efficient drilling configuration.

One example of this is the Pinedale field in the Green River basin in Wyoming, where Shell uses GIS to support the well planning and execution team, including drilling engineers, surveyors, exploration geologists and drilling rig planners. Using an integrated GIS database and analytical tools, Shell's planning cycle was shortened from three to five months to two weeks and Shell was able to simultaneously conduct several planning cycles.

3.2 Production.

Oil and gas companies begin to use GIS in oil production, ie, to receive oil and gas from the ground and into pipelines for distribution. GIS is used to increase the efficiency of field production from individual wells to the monitoring of entire reservoirs.

The possibilities of integration and visualization of GIS data allow manufacturing engineers to create smart cards containing production volumes, injection speed and recovery efficiency. Production data can be updated almost in real time on the map, and this allows operators to create production dashboards that show holes or fields displayed using traffic lights (ie, red, orange and green), depending on whether the production expected or target levels.

Field Operations.

GIS provides much more effective planning and monitoring of field operations by coordinating the movement of equipment and personnel around rig facilities, site planning and personnel safety. Using GPS technology, assets can be monitored in real time, providing access to the most up-to-date information on which to base decisions.

On land, especially in a non-traditional arena, field objects can be monitored using GIS, for example. using regularly updated DEMs to help detect subsidence caused by resource extraction.

The emerging use of GIS for field operations is the use of the technology of flying sensors to collect high-resolution images on demand in the field to survey the site. This allows companies to regularly track sites, identify and manage changes, without the need to charge expensive satellite data.

Facilities Management.

Many oil companies have developed tools for field development and planning using GIS technology to reduce project risk and cost. This is achieved by creating a common 3D visualization tool for data generated by engineering disciplines, such as reservoir design, seabed equipment and ground-based process units.

The Chevron system, presented at the PUG conference in 2009, brings together decision planning, minimizes field design conflicts, supports centralized database development, provides design validation using 3D modeling based on ROV, facilitates learning, allows you to test solutions before equipment will be ordered, will improve mutual understanding between the oil company and contractors and support supplies throughout the life cycle of the field.

GIS planning begins with geophysical assessments, hazard maps, bathymetry, existing infrastructure, reservoirs and well data. Then, engineers position the equipment, such as pipelines, umbilical cordons, a surface treatment host, mooring lines and risers. The 3D GIS technology can then be used to visualize the field layout.

Data can be exported to AutoCAD, so engineering drawings can be created-they are used with pipeline and design contactors (FEED) and for creating bids.

Inspection of installed equipment (for example, foundation manifold piles and wellhead conductors) can be integrated into the GIS to provide embedded field layout components. 3D modeling uses these embedded parts to provide virtual measurements for the locations of underwater equipment, which makes it possible to fabricate jumpers, which reduces the need for underwater metrological and design costs.

3.3 Distribution and Pipeline

Strict rules applied to pipelines in combination with the negative consequences of an accident make decisions regarding pipeline integrity management increasingly important.

As a result, many oil companies use GIS throughout the project lifecycle, recording engineering information, and projects are under development and run during the operational phase, which can be significant for meeting reporting obligations.

In addition to the benefits that GIS provides for the centralization of data management for such infrastructure projects, GIS analysis and monitoring can also be used for specific value-added scenarios, such as pipeline routing and pipeline monitoring.

Outside the gas pipeline area, GIS also plays an important role in the successful use of ships in the safe and clean distribution of hydrocarbons by sea. Although GIS is widely used in port management, oil companies use similar technologies for applications such as vessel tracking.

3.4 Pipeline Routing

Pipelines transporting petroleum products are capital intensive projects, so determining the optimal route becomes very important in managing significant operating costs. This is a non-trivial and time-consuming task, including the analysis of terrain types and distances.

However, using spatial and network analysis of GIS, the process can be greatly simplified by using the "least cost cost analysis" - the path of least resistance between the source point and the destination, based on the effort required to pass through the cells in one or more expensive raster datasets, such as the slope (based on DEM) and the cover.

Studies have shown that least cost routing analysis based on GIS can create more eco-friendly routes, which are 5-15% cheaper to implement than traditional routing methods.

3.5 Pipeline Monitoring

Once the pipelines have been constructed, they need to be constantly monitored to check for leaks and geo information, and to monitor and monitor checks, the frequency of which is often a normative requirement.

An excellent example of the use of GIS for pipeline monitoring is Ormen Lange, Europe's largest marine underwater development that serves c. 20% of the demand for gas in the UK. It includes giant underwater patterns, wells and pipelines delivering gas to a processing plant in Nichman, from where it is transported to the UK via the world's largest underwater gas pipeline, c. 1200 km.

GIS is used in the project to support field and survey operations; underwater inspection; geodesy of the seabed; and asset management. One of the key applications of GIS is understanding complex seabed topography, and digital video has been integrated with GIS so engineers can view pipeline sections and monitor any hazards that affect the installation.

Tracking ships

Far from the pipeline area, GIS is also useful for tracking valuable assets, especially mobile assets, such as vehicles and boats.

As an example, the existing telecommunication infrastructure of Saudi Aramco is used to send and track the movement of cars of companies, heavy trucks and ocean oil tankers. Knowing the exact location of vehicles and vessels is important for the timely delivery of goods and services, as well as for effective response to emergencies.

3.6 Decommissioning

Once oil is extracted from the field, it is usually necessary to decommission it, removing the production infrastructure and, if on land, to restore the land for reuse.

This process, in fact, is a complex management of objects and environmental problems, and it can be regulated to a large extent. Therefore, it is natural that the GIS should play a role, especially if the data on field data from the earlier phases of the life cycle of the oil field have already been centralized in the enterprise GIS.

3.7 Health, Safety and Environment (HSE)

Environmental management is an integral part of oil operations throughout the life cycle of an oil field. GIS can help create environmental impact assessments, adhere to local rules for responding to natural disasters, rebuilding sites after decommissioning and tracing natural phenomena such as hurricanes or storms in order to minimize the destruction of production facilities.

GIS is also used by many companies to provide updated maps for personnel traveling to remote places in the desert and to track their vehicles in real time. Companies can provide their field staff with the most up-to-date GIS data using mobile GIS tools or printed map books to ensure their safety in the field.

GIS is becoming increasingly important in response to emergencies such as oil spills and gas explosions, both in mitigation planning and in response. Data, including environmentally sensitive areas, biological resources and human activities, can be uploaded to GIS and shared with all stakeholders, potentially even the public. Users of the system can rank areas using environmental sensitivity or ease of cleaning or monitor the progress of the current response.

The best practice for responding to emergencies is to support a common "common working picture" (COP) at any time. This can be done using GIS applications on a web server or dashboard that contain all relevant data to provide accurate situational awareness with the ability to add data from the field. This leads to better decision making to improve responses.

Data models define how geographic objects are described by GIS applications. The choice of a specific data model can be useful in terms of simplifying real functions and supporting the interaction of data between applications (both with GIS and with non-GIS).

For the oil sector, the following GIS data models are available:

Public Petroleum Data Model (PPDM)- PPDM is developed and maintained by the PPDM Association, a non-profit society whose purpose is to develop and maintain standards for the energy industry. A number of exploration and production organizations (E & P) have implemented PPDM-compatible data stores to manage corporate data in a neutral vendor format. This allows the company to develop a single master data repository for all corporate data that can be integrated with multiple vendor products and services.

Pipeline Open Data Standard (PODS) – PODS is an independent database modeling initiative applicable to gas and liquid collection and transmission systems, as well as to distribution and distribution systems. PODS was developed by the PODS Association, a non-profit organization whose specific the mandate is to develop and maintain data standards and exchange formats for the pipeline industry.

• **ArcGIS Pipeline Data Model (APDM)** – APDM is a database template designed to store information related to functions found in collecting and transmitting pipelines, especially in gas and liquid systems. APDM is specifically designed to be implemented in the ArcGIS geodatabase for use with Esri products and is designed to work as a template for ArcGIS users, rather than as a cross-platform standard.

• **Seabed Survey Data Model (SSDM)** – Oil and gas companies seek to manage seabed survey data based on the principles and practices of rational geoinformation management. The International Association of Oil and Gas Producers (OGP) in 2010 set up a task force to define a standard GIS data model for seabed survey data. The resulting SSDM model can be used both as a data exchange standard (for example, for survey data between operators and contractors) and as a data model for managing seabed survey data in an enterprise.

Perhaps no other industry has such a huge investment in data collection and maintenance, like the exploration and production industry (E & P). The use of these investments is critical to success, and the application of data standards must be an integral part of this.

However, in our experience, many business processes in the field of exploration and production (E & P) do not use spatial data standards. This is partly due to the fact that spatial data is historically stored in non-standards-based systems, and because the transfer of obsolete data and systems to new products based on standards is seen as too time-consuming and expensive to cost problems.

If the use of the standard seems overwhelming, Esri has created a number of templates that will help you get started, and they are available at the ArcGIS Petroleum Resource Center. It is usually easier to start something based on a standard or template, rather than on a blank sheet of paper, and we recommend the pragmatic use of data standards for new projects where possible.

4. Conclusions.

GIS is clearly on the 'oil patch' to stay. From its heartland of use in exploration and data management, GIS is emerging as an important technology across much of the oil field life-cycle, with Esri's ArcGIS Platform the dominant GIS technology.

There are a number of concrete benefits that you can gain by applying the data integration and spatial analytic power of GIS:

- Streamlined workflows which can result in significant cost savings
- Better decision making (integrating the geographical component) which can lead to reduced risks (exploration or operational)
- **Upstream**- When there is a possibility of oil exploration, quickly gain access to important data for an accurate assessment of prospects. Use maps and analysis to realize the full potential of land holdings. During upstream production, situational awareness in real time increases efficiency.
- **Midstream**- GIS goes beyond environmental planning and compliance. Get a complete picture of the interim operations with handy maps and applications that show a complete network of oil and gas. Accelerate checks, routing and compliance with user-friendly workflows and dashboards.
- **Downstream**- Extended maps and spatial analysis are necessary for optimal operation of oil refineries and distribution networks. More efficiently manage the infrastructure downstream. It is more easy to determine the ideal areas of oil refineries. Effectively reduce risk. Significantly improve the retail margin.
- **Health, Safety, and Environment (HSE)**- The best approach to HSE in the oil and gas industry is prevention. Advanced maps and spatial analysis identify vulnerabilities that can be eliminated before the signal is emitted. Know where people and assets are, and their status in real time, in order to minimize the risk. Make a path to preparedness with plans for evacuation, containment and mitigation that can save lives and property if an emergency occurs.
- The oil and gas industry was relatively late for GIS. Nevertheless, it is rapidly developing as an industry with the highest potential for applying GIS throughout the life cycle. Moreover, it allows seamless integration of geospatial technologies, such as UAVs, sensors and existing computer systems within GIS. This helps companies compete in a global race to unlock new energy sources and maximize the value of their assets.

5. Acknowledgements

I have thanks for Chris Jepps (Exprodat).

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APPLYING AN OBJECT-BASED CLASSIFICATION APPROACH THROUGH A CELLULAR AUTOMATA-MARKOV METHOD IN LANDCOVER/LANDUSE CHANGE DETECTION PROCEDURE "CASE OF THE URMIA LAKE"

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ABSTRACT:

The main aim of the present research was to reveal changes on Land-Cover/Land-Use Changes (LC/LUC) patterns in the in the northern coast of the Urmia Lake by applying an object-based image analysis (OBIA) process. Accordingly, in the image process procedures stage, spatial changes on the Urmia Lake surfaces were carefully acquired from the Landsat imageries, since 1987 to 2016. Then, in the second stage, LC/LU change patterns have been precisely delineated, for the southern hillsides of the Misho Mountain. The resulting models showed an overall accuracy of nearly about 92.54% and a Kappa coefficient of 91% in the image classification procedures. In the final stage, by introducing a Cellular Automata-Markov (CA-Markov) method and setting a transition matrix, the spatial changes on the LC/LU patterns have been progressively simulated for the approaching years till year 2020 inside the study area.
The final models illustrate a meaningful significant decrease in the Urmia Lake surface, accompanying by certain water volumes diminishing tendency, highlighting the fact that the amount of salty lands are meaningfully increasing. This harmful inclination has successively causes a critical diminishing on the vegetation's types by emerging the most recent changes on LC/LU types accompanying by a critical hyper-saline condition mainly around the coastal parts of the Urmia Lake. Implementations of the current significant changes strongly pointing up that the majority of local biotic and abiotic components are in imitate dangers with serious environmental negative observations. Such rapidly occurring revolutionized changes on LC/LU will impose various critical effects on the existing in danger ecosystems and vulnerable climatic sub-systems in immediate prospect.

KEY WORDS: Urmia Lake, Landuse Changes, Object-Based Approach and CA-Markov Method

1. INTRODUCTION

Land is one of the essential natural resources [21]. The unprecedented rate of land change has become a major concern around the world that's why this issue has affected the environmental services and biodiversity at the global level. Both anthropogenic and natural forces are responsible for these changes in Earth's surface. Anthropogenic forces such as urban expansion and the destruction of forests and meadows for economic purposes (development of agricultural land); and natural forces such as fire, flood and tsunami; have changed the type of land cover/use (LC/LU) all over the world [13]. Monitoring and assessing LC/LU information is one of the most essential for managing natural resources and a variety of planning. In recent decades, research has shown considerable progress towards assessing LUCC. Remote sensing technology is one of the suitable technologies for monitoring environmental and land cover/use changes, which has multi temporal, resolution and spectral capabilities [23]. Landsat spectral data, which are free on the United States Geological Survey (USGS) website for downloading, have a remarkable temporal range of over 40 years and have great potential for LC/LU classification, change detection, and relevant analysis [24]. A new classification method, object-based image analysis (OBIA), referred to as edge-detection, feature extraction, feature analysis or object-based remote sensing, appears to used best on satellite imagery [5]. This form of feature extraction lets to use of additional variables such as shape, texture, and contextual relationships to classify image features.
In addition, geographic information systems (GIS) and remote sensing tools enable researchers to predict future LC/LU changes [13]. In this research, we applied a cellular automata–Markov chain model (CA–Markov) to simulate future LC/LU changes. Both CA and the Markov chain model have great advantages in the study on LULC changes. The Markov model can quantitatively predict the dynamic changes of landscape patterns, but it is difficult to predict the spatial pattern of land use changes. In contrast the CA model with strong spatial computing can be used to simulate the spatial variation of the system effectively [12].
The objectives of this study are (1) Object-based classification Landsat imageries, which were converted into TOA reflectance; (2) Analyzing LC/LU changes from 1987 to 2016; (3) Predict future LC/LU change in 2020 based on CA-Markov model. The Markov-CA model contributes to the understanding of LC/LU change in the northern coast of the Urmia Lake, which facilitates future planning.

2. MATERIALS AND METHODS

2.1 Study Area and Materials

The study area is located between 38° 0′ 32″ and 38° 25′ 28″ latitude and between 44° 57′ 23″ and 46° 01′ 14″ longitude in north-west of Iran (the Southern hillsides of the Misho Mountain and the northern coast of the Urmia Lake. The total area covers about 2951 km^2 (Figure 1). The elevation of the study area varies from approximately 3100 m to 1270 m above mean sea level.

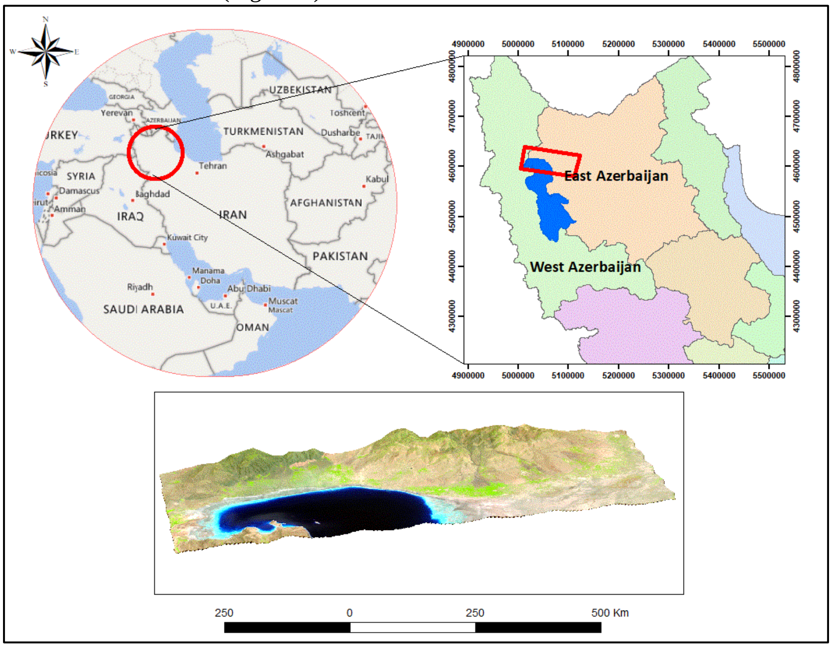

Figure 1: Study area - location of Urmia Lake in the Northwest of Iran and Middle East

Misho Mountain is one of the most important animal husbandry and agricultural center in the East Azerbaijan province which separate Marand plain from Shabestar plain and Urmia Lake. Also, the Urmia Lake is as a second largest salty lake in the world. The Urmia Lake is located in the north-west of Iran; as a second largest salty lake in the world. The last decade droughts based on climate change episodes, water consumption in agricultural fields, artificial coastal changes (roads building operations) and importantly dam construction programs have simultaneously caused more evaporation of the lake water and thus considerable variations of water surface levels. Average salinity of the lake ranges between 220- 300 mg/lit depending upon temporal and spatial conditions. It is worth to identify that Urmia Lake is the 20th largest lake and the second hyper-saline lake in the world and its basin is covered about 3.15 percent of the whole country [22].

2.2 Data Analyzed

Landsat imageries with a 30 m spatial resolution (path/row 169/33) were the main data for this study. The earliest one was Landsat Thematic Mapper (TM) taken on June 1987. The images were obtained from United States Geological Survey (USGS) site. Based on accessible time intervals and the image quality, other Landsat (ETM+ and OLI) images were provided and have been taken on different image processing procedures respectively. A 30 m Digital Elevation Model (DEM), based on Aster imagery, was also employed. Table 1 indicates all datasets which have been processed in current study.

Table 1: Dataset summary

No.	Dataset Type	Acquisition Date	Sensor Name
1	Landsat 5	June 1987	TM
2	Landsat 5	July 1989	TM
3	Landsat 5	July 1995	TM
4	Landsat 5	June 2000	TM
5	Landsat 7	July 2002	ETM+
6	Landsat 5	July 2006	TM

7	Landsat 5	July 2010	TM
8	Landsat 8	July 2014	OLI
9	Landsat 8	June 2015	OLI
10	Landsat 8	July 2016	OLI
11	Aster		Terra

2.3 Methods Applied

The image processing was performed in four stages including pre-processing, object oriented classification, post processing and predicting a LULC for 2020.

2.3.1 Data pre-processing

In the pre-processing stage radiometric correction and atmospheric correction are prerequisite for generating

$$L_\lambda = \left(\frac{L_{max}-L_{min}}{Q_{cal_{max}}-Q_{cal_{min}}}\right) \times (Q_{cal} - Q_{cal_{min}}) + L_{min} \quad (1)$$

$$\rho_\lambda = \frac{\pi \times L_\lambda \times d^2}{ESUN_\lambda \times \cos\theta_S} \quad (2)$$

$$d_r = 1 + 0.033\cos\left(DOY\,\frac{2\pi}{365}\right) \quad (3)$$

Where:
L_{max}= the spectral radiance scales to $Q_{cal_{max}}$
L_{min}= the spectral radiance scales to $Q_{cal_{min}}$
$Q_{cal_{max}}$= the maximum quantized calibrated pixel value
$Q_{cal_{min}}$= the minimum quantized calibrated pixel value
$Q_{cal} =$ DN
d= the distance from the earth to the sun
$DOY =$ Day of year
$ESUN_\lambda$=mean solar exo-atmospheric irradiance
θ_S= Solar zenith angle
In the case of the data from the Landsat 8, the radiometric

high-quality scientific data [7], making it possible to discriminate between product artefacts and real changes in Earth processes [11] as well as accurately produce LULC maps and detect changes [26]. The radiometric conversion for The Landsat TM and ETM+ was performed in the software of Environment for Visualizing Images (ENVI, Version 5.3) by following the Equations (1) and (2), where the spectral radiance (L_λ) and the TOA reflectance (ρ_λ) were obtained:
conversion was performed by applying the Equation (4) and (5):

$$\rho'_\lambda = M_\rho \times Q_{cal} + A_p \quad (4)$$

$$\rho_\lambda = \frac{\rho'_\lambda}{\sin\theta_{SE}} \quad (5)$$

Where:
M_ρ= Band-specific multiplicative rescaling factor
A_p =Band-specific additive rescaling factor
ρ'_λ = TOA planetary reflectance, with correction for solar angle
θ_{SE} = the local sun elevation angle.
ENVI has a Quick atmospheric correction module for retrieving spectral reflectance. This method can be very time-consuming; hence to reduce the time of image processing all data were subset with a vector file of study area.

2.3.2 Image Processing

At the processing stage, we used object-based classification method based on a set of spectral, texture and contextual indicators. In general, this method aiming to relate geographic features with image objects can be divided into two main parts, namely segmentation and classification [16]. This method uses geographic objects as basic units for LULC classification. We used eCognition Developer 9.0 to classification each date of imagery. The eCognition software provides a systematic approach and user-friendly interface that permits implementation of concepts developed in the past [6]. Based on different standards such as quality of segmentation without considering classification accuracy, they found that eCognition segmentation was better than the alternatives, including ERDAS Imagine, for a variety of reasons including having different segmentation algorithms and classifiers [17]. In software setting, the image classification is based on attributes of image objects rather than on the attributes of individual pixels. Therefore, Object-oriented classifier found to deliver results noticeably better than conventional methods. It leads to better semantic differentiation and higher classification accuracy [22]. The quality of classification is directly affected by segmentation quality. Image segmentation means the partitioning of an image into meaningful regions based on homogeneity or heterogeneity criteria, respectively [18]. This research used a multi-resolution segmentation approach, a bottom-up homogenous region aggregation technique based on certain criteria (e.g., scale, shape, and compactness criteria). The scale parameter determines the size of objects [4]. All non-thermal bands of the Landsat images (six bands) and DEM were used for image segmentation. The appropriate segmentation scale and the parameters associated are indicated in Table 2.

Table 2: Multi-resolution segmentation parameters

Scale	**Shape**	**Compactness**	**Band Weights**
25	0.2	0.5	Blue (1), Green (1), Red (1), NIR (1), SWIR1 (1), SWIR2 (1), DEM (1)

At the classification stage we used the assign class algorithm to classify the image objects into 7 classes that Urmia Lake, salty area and agricultural area were our three main LULC.

$$NDVI1 = \frac{NIR - Red}{NIR + Red}$$
$$NDWI2 = \frac{Green - NIR}{Green + NIR}$$
$$SI93 = \frac{Blue * Red}{Green}$$
$$SI104 = \frac{Blue}{Red}$$
$$NDSI5 = \frac{Red - NIR}{Red + NIR}$$

2.3.3 LC/LU Change Analysis

Post-classification analysis allows us to know the quantity, location and nature of LULC changes by comparing two classified maps; in such a way, a "from-to" matrix of changes was generated [25]. using the Cross tabulation module of IDRISI Selva 17.0. The ten images classified by object oriented were pairwise compared to detect patterns of change between 1987–1989, 1989–1995, 1995–2000, 2000–2002, 2002- 2006, 2006- 2010, 2010- 2014, 2014-2015 and 2015-2016 .

2.3.4 Markov Chain Analysis

This kind of predictive LULC change modeling is appropriate when the past trend of LULC changing pattern is known [9]. A Markov chain is a stochastic process (based on probabilities) with discrete state space and discrete or continuous parameter space [3]. In this random process, the state of a system s at time (t+1) depends only on the state of the system at time t, not on the previous states. The Markov model not only explains the quantification of conversion states between the LULC types, but can also reveal the transfer rate among different LULC types. It is commonly used in the prediction of geographical characteristics with no after-effect event which has now become an important predicting method in geographic research [14]. Based on the conditional probability formula-Bayes, the prediction of LULC changes is calculated by the following equation:

$$S_{(t+1)} = P_{(ij)} \times S_{(t)}$$

Where $S_{(t)}$, $S_{(t+1)}$ is the system status at the time of (t) or (t + 1); $P_{(ij)}$ is the transition probability matrix in a state which is calculated as follows (Xiyong et al., 2004):

The Markov model can quantitatively predict the dynamic changes of landscape pattern, while it is not good at dealing with the spatial pattern of landscape change. On the other hand, Cellular Automata (CA) has the ability to predict any transition among any number of categories [19].Combining the advantages of Cellular Automata theory and the space layout forecast of Markov theory, CA-Markov model performs better in modelling LULC change in both time and spatial dimension. At present, IDRISI software is one of the best platforms to conduct CA-Markov model, which is developed by Clark Labs in the U.S.

$$BSI6 = \frac{(SWIR1 + Red) - (NIR + Blue)}{(SWIR1 + Red) + (NIR + Blue)}$$

A classification is not complete until its accuracy is assessed [15]. Accuracy assessment of classification maps was achieved using a random sampling method. After land-cover classification, a minimum of about 50 sample points were randomly selected for the evaluation of classification accuracy for six land-cover classes. Accuracy assessment was based on the calculation of the overall accuracy and kappa coefficient.

$$P_{ij} = \begin{bmatrix} P_{11} & P_{12} & \cdots & P_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ p_{n1} & p_{n2} & \cdots & p_{nn} \end{bmatrix}$$

$$(0 \le P_{ij} \le 1 \text{ and } \sum_{j=1}^{N} P_{ij} = 1,\ (\text{i}, \text{j} = 1{,}2\ 3, \ldots, \text{n}))$$

According to the matrix of the initial $S_{(0)}$ and the transition probability of the nth stage $P_{(n)}$, the LULC distribution in the northern coast of the Urmia in the future can be calculated by using a computer simulation. The Markov simulation model $S_{(0)}$ is as follows:

$$S_{(n)} = S_{(n-1)} \times P^{(1)} = S_{(0)} \times P^{(n)}$$

Multi-Criteria Evaluation process (MCE) involves criteria of varying importance in accordance to decision makers and information about the relative importance of the criteria [8]. Factors used in MCE account for suitability, accessibility, and neighbourhood effects. This suitability maps determine which pixels will change as per the highest suitability of each LULC type.

Cellular Automata is a simulation model where the space and time are discrete variables and interactions assigned are local variables. In a CA model, the transition of a cell from one land-cover to another depends on the state of the neighbourhood cells. This is based on the idea that a cell will have a higher probability to change to land-cover class 'A' than to a land-cover class 'B' if the cell is in closer proximity to land-cover class 'A'. Thus the CA model not only uses the information of the previous state of a land-cover as done by a Markov model but also uses the state of neighbourhood cells for its transition rules [1].

In this study we used the CA–Markov model to simulate LULC. Three datasets, (1) LULC base map in 2010, (2), the 2010 land suitability maps which created by using MCE (Multi-Criteria Evaluation) model and (3), transition probability matrix from 2006 to 2010 are integrated using CA neighbourhood to simulate land use map in 2016. The standard 5×5 contiguity filter is used as the neighbourhood definition in this study. That is, each cellular center is surrounded by a matrix space which is composed by 5×5 cellular to impact the cellular changes significantly. The filter used analysis is based on:

[1] Normalized Difference Vegetation Index
[2] Normalized Difference Water Index
[3] Salinity Index 9
[4] Salinity Index 10
[5] Normalized Difference Salt Index
[6] Bare Soil Index

0	0	I	0	0
0	I	I	I	0
I	I	I	I	I
0	I	I	I	0
0	0	I	0	0

Figure 2: Filter configuration used in CA Markov

2.3.5 Model Validation

In order to ensure that the model is reliable in predicting an LC/LU for a specific project year, it must be validated using existing datasets [10]. Now the aim is to select the most appropriate model. The traditional way of validating a model or comparing two maps, using Kappa statistics, is now out-of-date [2]. A method of comparing three maps (a reference map of time 1, a reference map of time 2 and a simulation map of time 2) has been implemented for model validation [20]. The confirm module in IDRISI Selva was used for validating the model by producing After converting Landsat radiance values to reflectance and eliminating the negative effects of molecular scattering and aerosols the quality of the image was improved. As we have mentioned we applied an object-oriented image analysis of eCognition software for the classification LC/LU on Landsat images between 1987 and 2016. Object-oriented image analysis requires the

several parameters: K-standard, K-location, and K-no which are used to identify the accuracy of the model. The predictive power of the model is considered strong when around 80% accuracy is achieved [9].

At the end, following the same process, the LC/LU for the year 2020 was projected with the CA–Markov model using the transition probabilities from 2010 to 2016 and the LC/LU base map from the year 2016.

3 RESULTS

creation of objects or separated regions in an image. After conducting the Multi Resolution Segmentation process, we developed the rule sets for classifying each test area. Then, the threshold values were obtained (Table 3). Figure (3) indicates the LC/LU map of the study area. The results from the classification were shown in Table 4, indicating the total area and percentages of LC/LU classes.

Table 3: Threshold values for each rule

LC/LU Classes	Threshold Conditions
Urmia Lake	NDWI > -0.138 NDSI > -0.096
New Salt	$SI9 > 750$ $BS < 0.17$
Salted Soil	$SI10 > 0.48$
Salty barren lands	$NDSI > -0.32$ $Brightness > 2700$
Vegetation (Agricultural and Garden Lands)	NDVI > 0.35 $Mean\ DEM \leq 1735$
Dams and Agricultural ponds	NDWI > -0.138 Mean DEM < 1300

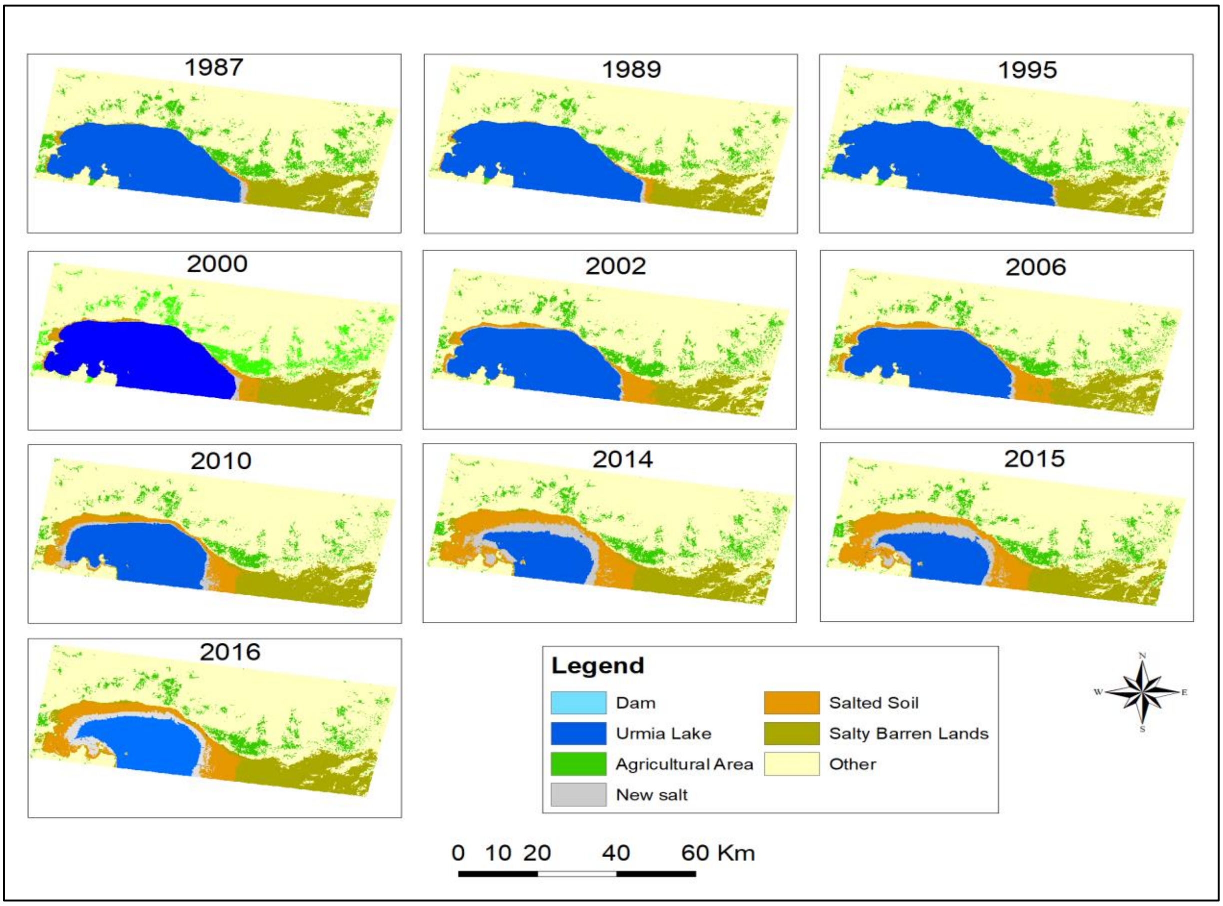

Figure 3: LC/LU classification maps

Table 4: Area and percentage of LC/LU classes

Year / LC/LU		1987	1989	1995	2000	2002	2006	2010	2014	2015	2016
Dams and Agricultural ponds	Area	0.0044	0.028	0.081	0.104	0.094	0.112	0.186	0.25	0.418	0.332
	percentages	0.001	0.001	0.003	0.04	0.003	0.004	0.006	0.008	0.014	0.011
Urmia Lake	Area	742.954	761.564	813.567	721.976	670.681	642.403	515.919	290.438	306.442	378.678
	percentages	25.182	25.81	27.58	24.47	22.73	21.77	17.49	9.84	10.39	12.83
Agricultural Area	Area	251.813	169.811	239.697	233.447	212.806	197.134	157.08	190.877	209.867	172.872
	percentages	8.535	5.76	8.12	7.91	7.21	6.68	5.32	6.47	7.11	5.86
New Salt	Area	19.147	8.609	5.1589	10.915	20.54	31.641	56.498	144.374	133.658	117.779
	percentages	0.649	0.29	0.17	0.37	0.7	1.07	1.91	4.89	4.53	3.99
Salted Soil	Area	19.088	26.941	3.593	58.754	110.003	129.647	165.063	303.208	298.631	240.158
	percentages	0.647	0.91	0.12	1.99	3.73	4.39	5.59	10.28	10.12	8.14
Salty Barren Lands	Area	291.816	227.635	230.895	279.207	216.221	254.975	331.64	283.545	300.067	332.906
	percentages	9.891	7.72	7.83	9.46	7.33	8.64	11.24	9.61	10.17	11.28
Other Lands	Area	1625.497	1755.772	1657.376	1645.957	1720.016	1694.447	1723.97	1737.666	1701.275	1707.634
	percentages	55.095	59.51	56.18	55.79	58.3	57.43	58.43	58.9	57.66	57.88
Total	Area	2950.4	2950.4	2950.4	2950.4	2950.4	2950.4	2950.4	2950.4	2950.4	2950.4

The accuracy of the classified image was then assessed by using randomly selected around 50 points. Table 5 informs the results of the overall accuracy and kappa.

This accuracy assessment shows that the classification is stable.

Table 5: The classification accuracy values and Kappa coefficients

Year	Kappa	Overall Accuracy %
1987	0.89	90.2
1989	0.86	89.5
1995	0.90	93.7
2000	0.90	92.4
2002	0.91	91.7
2006	0.90	92.1
2010	0.92	93.6
2014	0.93	93.7
2015	0.91	93.1
2016	0.91	92.4

The overall classification accuracy for the extracted LC/LU maps in table 3 indicate the suitability of the classified remote sensing images for effective LC/LU change analysis. A cross tabulation process was applied to identify the major changes between two LC/LU maps of the specified time periods. Trend of LC/LU change maps in each class from the nine periods are displayed in Figure 4.

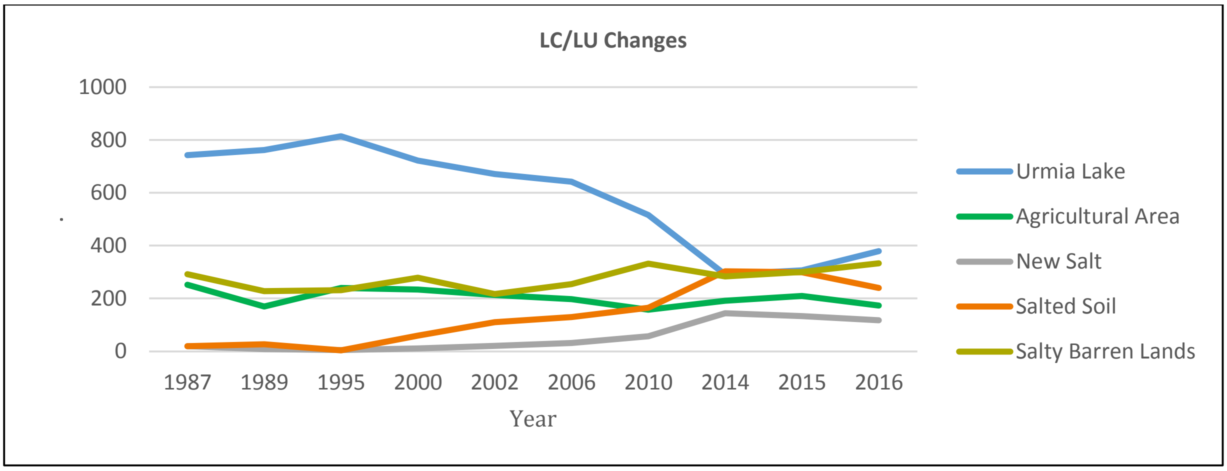

Figure 4: LC/LU changes (km^2)

There was a lot of fluctuation in the amounts of LC/LU changes. Spatial analysis of the LC/LU changes illustrates evidently that the conversions between Urmia Lake and salt was the most distinctive change of the study period. The LC/LU was projected using Markov's transition probability matrix (Tables 6 and 7) to show how each land type was projected to change. The diagonal of the transition probability represents the self-replacement probabilities, that is, the probability of a salt cover class remaining the same, whereas the off-diagonal values indicate the probability of a change occurring from one salt cover class to another. The LC/LU map in 2006 and 2010 were operated by the Markov chain model in order to identify the probability of changing and transition areas. Such probability transition values were applied to predict the LC/LU for the year 2016 with a CA_Markov model.

According to the graph, from 1987 to 2016, there was sharp fall in the Urmia Lake surfaces and a gradual decrease in agricultural lands. However, there is a slight increase in salty lands.

Table 6: Transition probability matrix, calculated based on LC/LU maps of 2006-2010

LC/LU	Dams and Agricultural ponds	Urmia Lake	Agricultural Area	New Salt	Salted Soil	Salty Barren Lands	Other Lands
Dams and Agricultural ponds	0.579	0	0.0013	0	0	0.0022	0.4175
Urmia Lake	0	0.7177	0	0.079	0.1978	0.0041	0.0014
Agricultural Area	0	0	0.5558	0	0.0001	0.0027	0.4415
New Salt	0	0.0017	0.0006	0.0004	0.6603	0.3151	0.0218
Salted Soil	0	0.0005	0.0014	0.0001	0.3307	0.587	0.0803
Salty Barren Lands	0	0	0.0005	0	0.0015	0.8783	0.1197
Other Lands	0.0001	0	0.0186	0	0.0004	0.0325	0.9484

Table 7: Transition probability matrix, calculated based on LC/LU maps of 2010-2016

LC/LU	Dams and Agricultural ponds	Urmia Lake	Agricultural Area	New Salt	Salted Soil	Salty Barren Lands	Other Lands
Dams and Agricultural ponds	0.7844	0	0	0	0	0.0701	0.1455
Urmia Lake	0	0.8104	0	0.1888	0	0.0007	0.0001
Agricultural Area	0	0	0.8492	0	0	0	0.1507
New Salt	0	0.0002	0	0.1771	0.8227	0	0
Salted Soil	0	0.0005	0	0.0154	0.9621	0.0207	0.0013
Salty Barren Lands	0	0	0	0	0.0085	0.9419	0.0495
Other Lands	0.0001	0	0.0203	0	0.0003	0.0096	0.9698

3.1 Model Validation

For the model validation, we compared the simulated map of 2016 with the actual LC/LU map. The K-standard, K-no, and K-location indicators resulted in measures of 89.4%, 91.26% and 94.02%, respectively. Visual comparison also shows great similarity between the actual and simulated maps for the year 2016 (Figure 5).
The Kappa statistics value indicates that the CA–Markov model was effective in simulating LC/LU change in 2016. Therefore, the Markov–CA model can be used to predicting the spatial distribution of LC/LU in the future with the assumption that an unvarying rate of change will occur in the future.

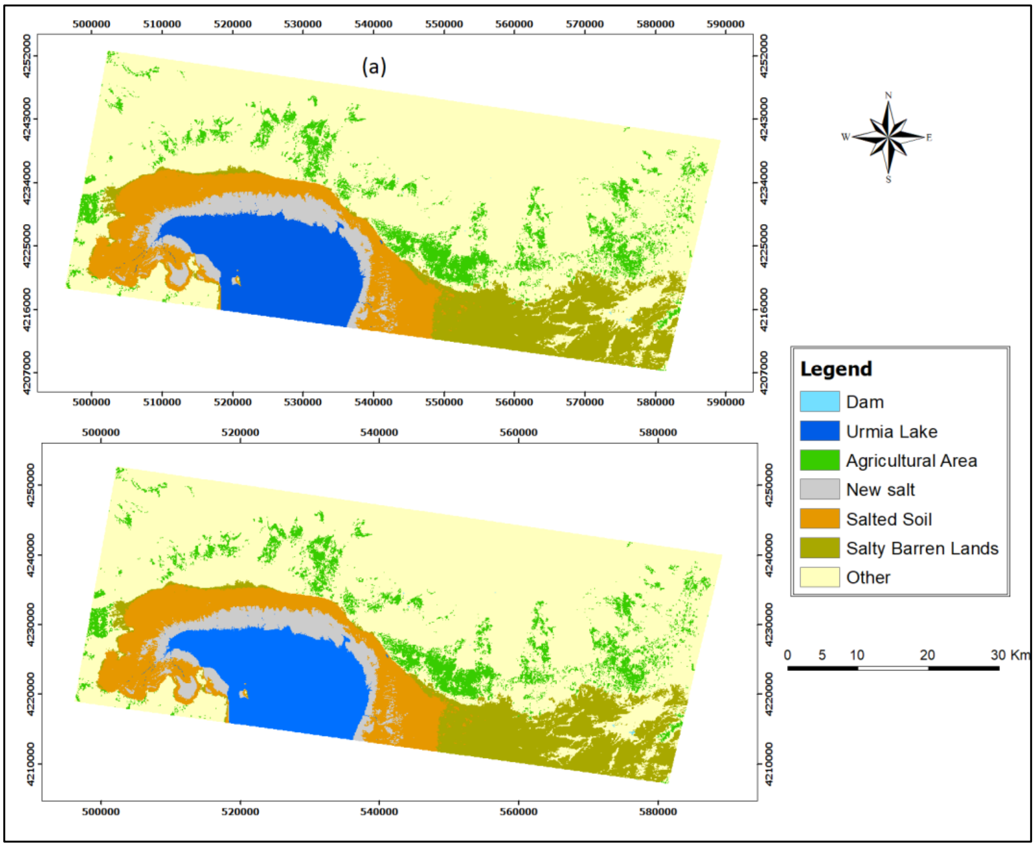

Figure 5: LC/LU map for year 2016: (a) actual map (b), simulated map

3.2 Prediction of LC/LU changes for 2020

By assuming of persistence of speed of LC/LU changes like past years (i.e. 2010-2016), the future LC/LU map for the year 2020 were predicted (Figure 6). A Comparison of LC/LU maps for 2016 and 2020 shows that the extent of Urmia Lake in our study area and new salt will decrease from 378.7 km^2 to 307.023 km^2 and from 117.779 km^2 to 96.0596 km^2, respectively. As well the results show the salted soil, salty barren lands and agricultural areas will increase by 331.227 km^2, 335.246 Km^2 and 181.426 km^2, respectively.

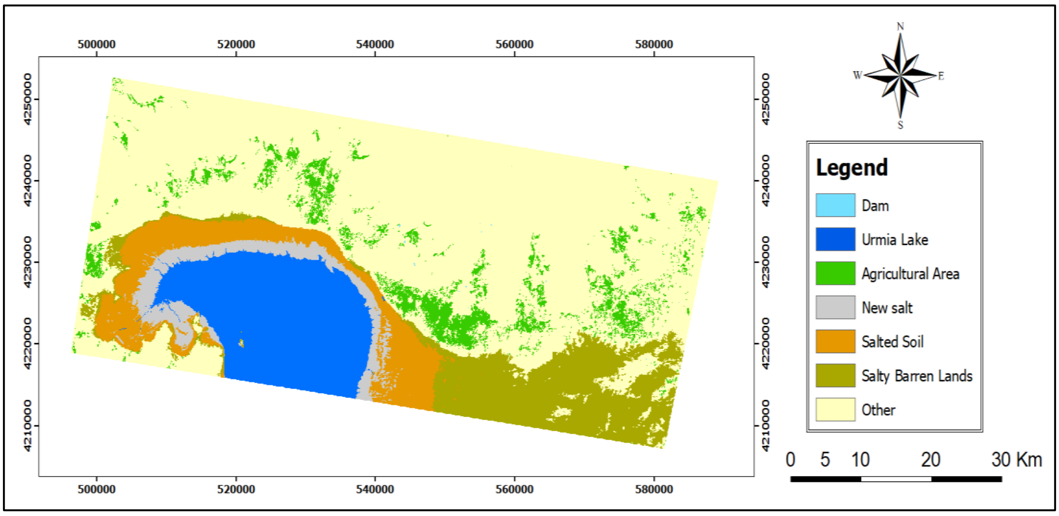

Figure 6: Predicted LC/LU map for year 2020

4 CONCLOUDING REMARKS

The assessment of LC/LU changes and predicting future are crucial information for planners and organizations to allocate important infrastructures and land management in response to the diverse requirements of the people in this region. In this context, to accommodate this need, satellite images, objects-based classification and a combination of Markov chain analysis and CA were used.

The main advantage of OBIA is that it represents the classification units as real world objects on the ground, thereby reduces the within class variability. In addition, the CA–Markov land use simulation model has an important contribution to land use modeling.

In the present study, we were able to depict the relationship among LC/LU types in different time periods. A change survey of the study area revealed that water surface and the amount of salty lands are changing sharply. Thus it is urgent to strengthen the protection of arable land and water and prevent acts of indiscriminate use of cultivated land in order to promote land protection and rational use of land.

Reducing the surface of Lake Urmia and, as a result, increasing the salty lands around the lake, as well as reducing the agricultural area in the Misho Mountain, has increased the use of inhabitants from underground water, which is a reason to reduce the input water into the lake. Hence, by modifying the irrigation methods or choosing corps that have little water requirement, it is possible to improve the lake situation and increase its level.

Some recommendations are provided. First, Landsat data is not mandatory, any other type of image can be useful, and a higher resolution such as Spot imageries will greatly improve the results obtained. Second, it is suggested that data belong to similar dates in order to avoid seasonality, since an erroneous LC/LU classification could affect the succession analysis.

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OBJECT-BASED WATER BODIES EXTRACTION METHOD BY PROCESSING OF SENTINEL SATELLITE IMAGERY CASE STUDY: BAKU CITY, AZERBAIJAN

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ABSTRACT:

Satellite imageries are increasingly being processed to map land cover/use at local, regional, and global scales. More impotently, monitoring of open water bodies accurately is a main and essential application in remote sensing, as this issue is significant for monitoring the environment, ecosystems, climate and other applications. In this paper, Sentinel-2 spectral bands with different resolutions, including visible spectrum and Near-Infra-Red (NIR) bands in 10 m and Short-Wavelength InfraRed (SWIR) bands in 20 m, were processed to extract surface water information of Baku, the capital city of Azerbaijan. Extracting of urban surface water bodies from Landsat satellite images with NDWI index cannot separate other objects that have a low albedo, such as shadows. Consequently, in current research, we applied combined pixel-based and object-based methods on Sentinel-2 satellite images by introducing of multi-resolution segmentation and threshold classification methods inside of the eCognition software. The final accuracy assessment results show that, among many of classification algorithms, Normalized Difference Water Index (NDWI) and Modified NDWI (MNDWI) are more suitable for enhancing and extracting of water bodies. In addition, these methods suppress built-up features more efficiently than traditional approaches; demonstrating seasonal and yearly persuaded fluctuations on the water surfaces around or inside the Baku Metropolitan. Moreover, this method successively could show diminishing of shorelines and changing on the land cover and land use types by depletion or even restoration of wetlands, as implementations of a modern remote sensing technology. Distinctively an object-based approach provides a new avenue to the classification of remotely sensed imagery and has demonstrated its advantages over the pixel-based approach in various remote sensing studies.

KEY WORDS: Baku City, Object-based Classification Indices, Water Body Extraction Process, Sentinel-2 Images

1. INTRODUCTION

Water bodies are most vital earth resource which are of great significance for urban planning, urban heat-island effects, climate changes, and urban ecosystem maintenance [1]. Rapid urbanisation increasingly leads to the damage and decline of water bodies [2], which these changes in surface water may result in disasters such as flooding, outbreaks of waterborne disease and water shortage in dry tropical areas, which may involve loss of lives [3]. Hence, it is essential to know about urban water extension and changes in the water area.

Among current urban water-extraction technologies, remote sensing technology is a timely and accurate way to gather urban water information [4]. The most important features of the water spectral are that the water body absorbs near-infrared radiation considerably and lets the green and red lights penetrate through water body, which can be reflected by the sand, hard bottom, and reef. Based on these features, either a single band or a ratio of two bands is used for water extraction [5]. Water classification accuracy problems may be especially pronounced in areas where the background land cover includes low albedo surfaces such as asphalt roads in urban areas, and shadows from mountains, buildings and clouds. The presence of shadows may cause misclassification due to the similarity in reflectance patterns, and this lessen the accuracy of water mapping [6]. Thus, in such environments simple classification methods such as two-band water indices and single-band thresholding cannot completely distinguish between water pixels and shadows [7]. Feyisa et al. (2014) proposed the automated water extraction index (AWEI) which used five spectral bands in the Landsat 5 TM imagery to extract water from other features. This index aimed to maximize separability of water and non-water pixels through band addition, differencing and applying different coefficients. At 2014 Feyisa proposed the automated water extraction index (AWEI) which used five spectral bands in the Landsat 5 TM imagery to extract water from other features. This index aimed to maximize separability of water and non-water pixels through band addition, differencing and applying different coefficients [8].

Since it is impossible to separate them by their spectral differences, in this paper, we used the AWEI algorithm and the advantages of the OBIA and also Sentinel-2 imagery with a 10-meter resolution.

2. MATERIAL AND METHODS

2.1 Study Areas and Materials

Baku the capital of Azerbaijan was chosen as the study area in this paper. Baku is the largest city which is situated on the western coast of the Caspian Sea. Figure 1 shows the locations and visual characteristics of the study area. There are around 450 lakes in Azerbaijan. Most of these lakes are fresh water, but some of them are salt lakes such as Şor gölü. In its origin, these lakes are tectonic lakes, landslide-dammed lakes, alluvial set lakes, delta set lakes, oxbow lakes, lagoons and so on.

Tow Sentinel-2A satellite images used in this study were collected on 10 June 2018 (Baku) under clear weather conditions. The Sentinel-2 satellite is part of the Earth observation mission developed by the European Space Agency and was launched on 23 June 2015. The satellite carries a single multi-spectral instrument (MSI) with 13 spectral channels, which use the push-broom concept. The resolution varies between 10 and 60 m. The visible and near-infrared (NIR) bands have 10, the vegetation red edge bands (5.6 and 7) and the shortwave infrared (SWIR) bands have 20, and the rest of the bands have 60-m resolution [9] (Figure 1. The location maps of study areas

Table *1*).

The adopted Sentinel-2 level 1C dataset was the standard product of TOA reflectance, which was more suitable for calculating water indices compared with the raw digital number value. Thus, additional pre-processing [10] was not required, and the water indices for the MSI images could be directly calculated. The only preprocessing required to change the bands format to TIFF in the SNAP software.

Figure 1. The location maps of study areas

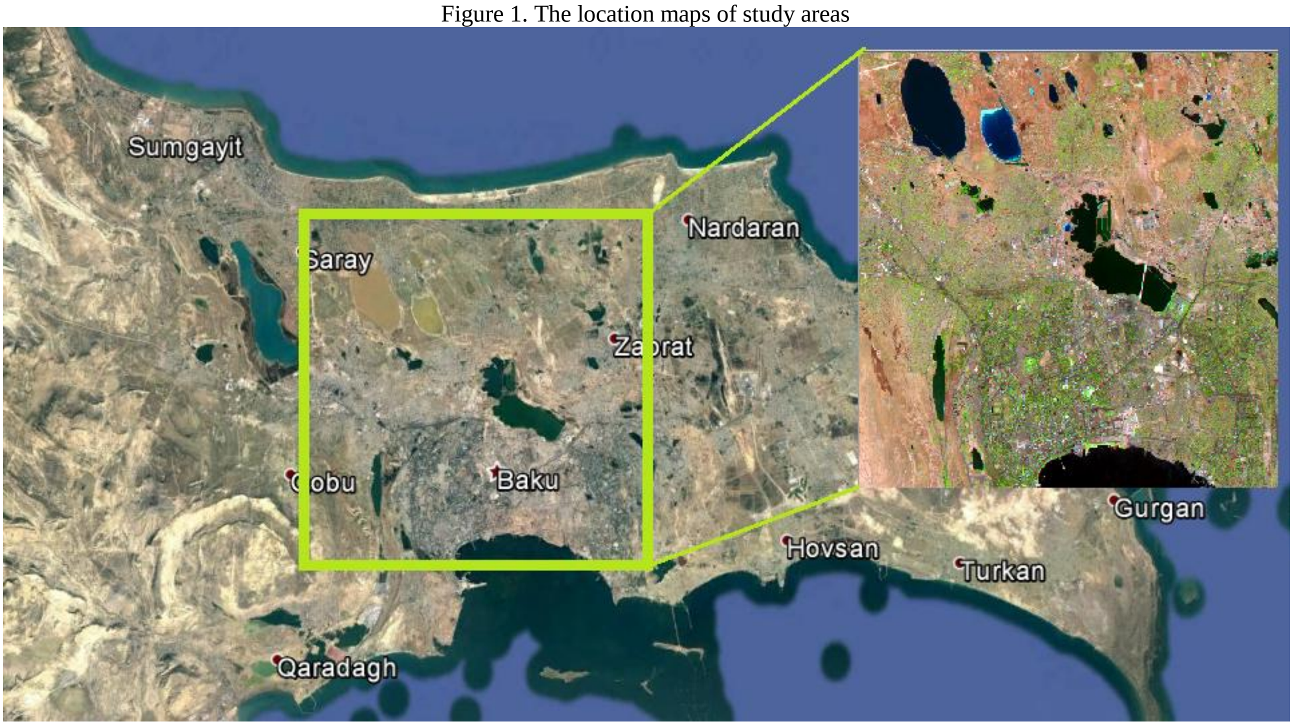

Table 1. Sentinel-2 band characteristics

Band name	Purpose	Central wavelength (nm)	Resolution (m)
Band 01	Coastal aerosol	443	60

Band 02	Blue	490	10
Band 03	Green	560	10
Band 04	Red	665	10
Band 05	Vegetation red edge	705	20
Band 06	Vegetation red edge	740	20
Band 07	Vegetation red edge	783	20
Band 08	NIR	842	10
Band 08A	Vegetation red edge	865	20
Band 09	Water vapour	945	60
Band 10	SWIR – Cirrius	1375	60
Band 11	SWIR	1610	20
Band 12	SWIR	2190	20

2.2 Methods

As previously mentioned, the format of all bands in the software should be converted into TIFF. Then the imageries was united by mosaicking in ENVI 5.3, at the processing stage, an object-based classification method was used that was based on a set of spectral, texture and contextual indicators. The most significant step of the object-based classification is segmentation. Segmentation algorithms are divided into two groups: bottom-up algorithms (chessboard, quad-tree and multiresolution segmentation) and top-down algorithms (contrast split, spectral difference and multi-threshold segmentation). First we used a bottom-up algorithm, multiresolution segmentation, which creates objects using an interactive algorithm. This technique based on certain criteria (e.g., scale, shape, and compactness criteria). The scale parameter determines the size of objects and it is related to the size of the segments. As well, Compactness describes the closeness of pixels clustered in an object by comparing it to a circle [11]. The appropriate segmentation scale and the parameters associated are indicated in Table 2. The second segmentation, spectral difference segmentation, is a merging algorithm where neighbouring objects with a spectral mean below the given threshold (in this case 100) are merged.
We used the following indexes to classify and extract the salt class.

$$SI_{modified}{}^{1} = \sqrt{Red^2 + NIR^2}$$

$$NDSI^2 = \frac{(Red - NIR)}{Red + NIR}$$

$$BSI^3 = \frac{(SWIR1 + Red) - (NIR + Blue)}{(SWIR1 + Red) + (NIR + Blue)}$$

Feyisa et al. extracted pure pixels of water and various land features from a Landsat 5 TM image at Addis Ababa through AWEI method. Addis Ababa included all the main challenging features influencing water extraction accuracy: shadow and all low albedo surfaces such as black soil, therefore, they chose this area [2]. AWEI method uses a completely different strategy to extract waterbodies compared with the other known water indices. The formulas of AWEI are expressed as follows:

$$AWEI_{nsh} = 4 \times (\rho_{green} - \rho_{SWIR1}) - (0.25 \times \rho_{NIR} + 2.75 \times \rho_{SWIR2})$$

$$AWEI_{sh} = \rho_{blue} + 2.5 \times \rho_{green} - 1.5 \times (\rho_{NIR} + \rho_{SWIR1}) - 0.25 \times \rho_{SWIR2}$$

AWEInsh is an index formulated to remove non-water pixels, including dark built surfaces in areas with urban background and it's suitable for the situation where shadows are not a major problem. As well, AWEIsh is formulated for more improvement of accuracy by removing shadow pixels that AWEInsh cannot powerfully eliminate, while this index can be applied for the areas with shadow or dark surfaces.
Finally, we used the Overall Accuracy (OA) and kappa coefficients (κ) to assess the performance of selected surface water extraction methods for Lakes in the study area. Accuracy validation is essential for results in each research.

Table 2. The multi-Resolution Segmentation parameters

Scale parameters	shape	Compactness	Layer weights
20	0.7	0.9	1,1,1,3,1,1,1,3,1,1,1,1,1

[1] Modified Salt Index
[2] Normalized Difference Salt Index
[3] Bare Soil Index

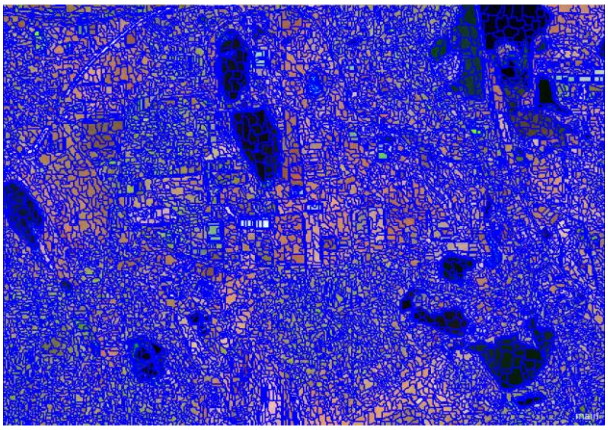

Figure 2. Multi Resolution segmentation

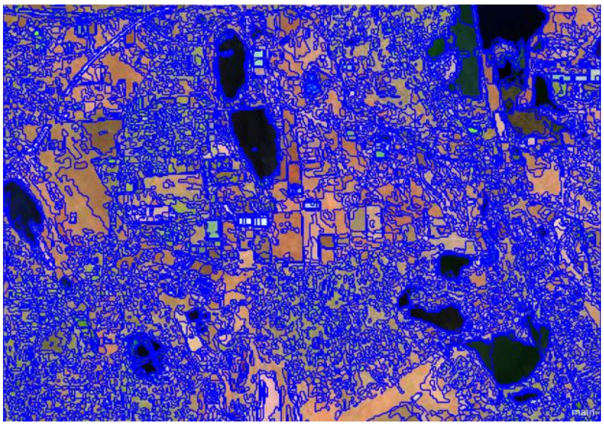

Figure 3. Spectral Difference Segmentation

3. RESULTS

As we have mentioned we applied an object-oriented image analysis of eCognition software for extracting water bodies and salty areas on sentinel-2 image on 2018. The results of MNDWI and AWEI algorithms are shown in the Figure 4. The outputs of extraction was investigated by using several test sites. Visual inspection indicated that AWEI resulted in better accuracy of surface water mapping compared to MNDWI and NDWI. The results of the MNDWI analysis show that when the threshold is greater than 0.1, shadows will be suppressed, but small waterbodies cannot be extracted.

In contrast the new index (AWEI) is effective in extracting surface water in the presence of shadow and other non-water surfaces.

The accuracies for AWEI and MNDWI over the test sites are shown in Table 3, from which it can be clearly observed that the AWEI achieves better accuracy than the MNDWI at all test sites. Overall, the means of the Kappa achieved by AWEI over the test sites are more than 91%, which improves the results provided by MNDWI (Kappa= 80%). Since the MNDWI considers only a few bands, the Automated Water Extraction Index (AWEI) performs better than the MNDWI in the extraction of pure water pixels.

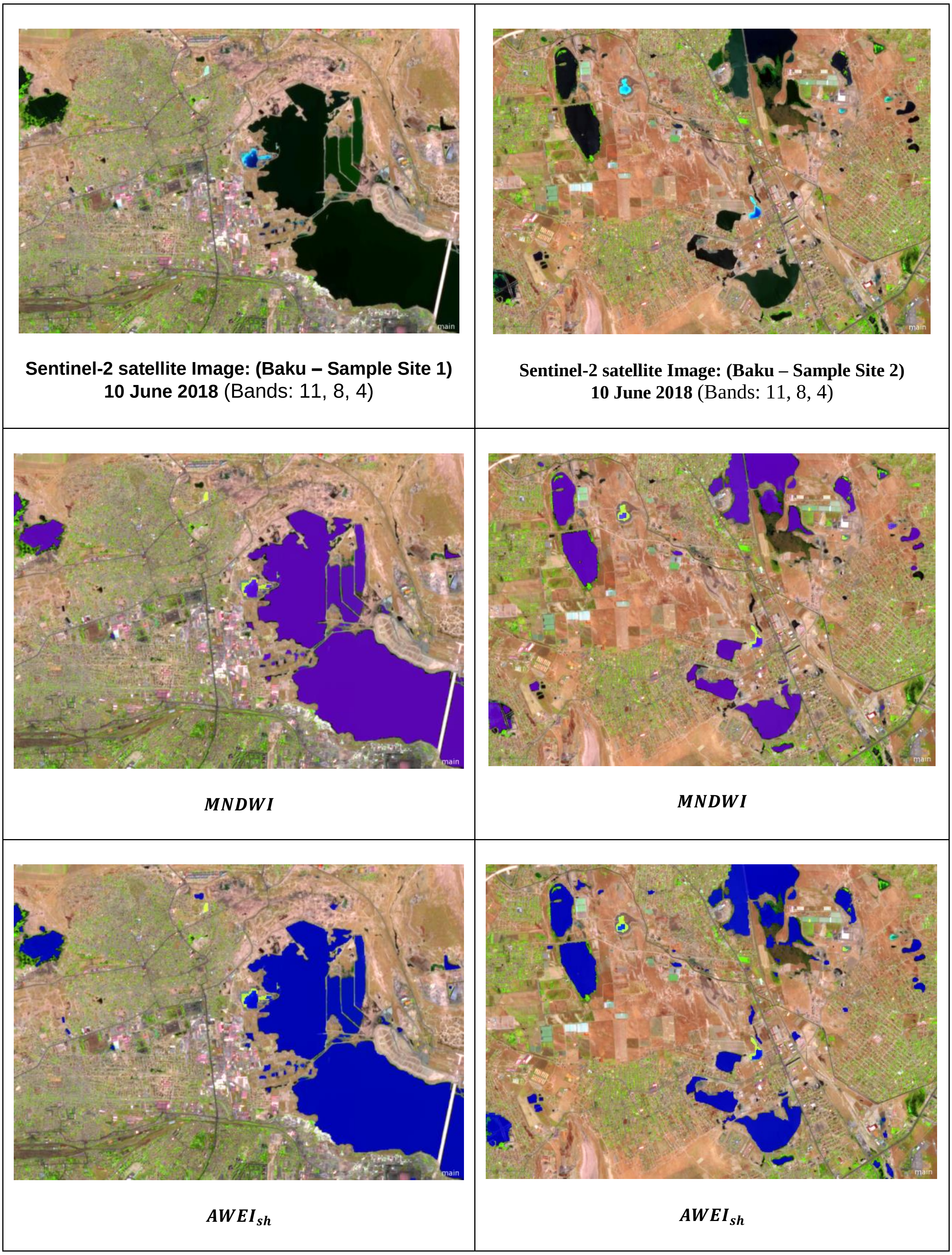

Figure 4. Comparison of water extraction results using two classifiers at the 2 test sites

4. CONCLUSIONS

The main purpose of this study was to devise a method that improves water extraction accuracy by increasing spectral separability between water and non-water surfaces, particularly in areas with shadows and urban backgrounds that are often major causes of low classification accuracy.

Using Sentinel-2 data, we introduced a new automated water extraction method (AWEI) and compared its accuracy and threshold stability with that of the MNDWI classifiers. AWEI significantly improved accuracy in areas where shadow and other dark surfaces were the main sources of classification errors. Therefore, AWEI is proposed as an alternative and improved water index, especially in extracting water information from areas where noisy results are expected because of the presence of shadows and built-up surfaces. This new method would also be suitable for surface water change detection studies since it classifies edge pixels with high accuracy and with a stable threshold.

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THE CONDITIONS OF FORMATION OF CLOUD VORTEX ON THE CASPIAN SEA

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ABSTRACT:

The paper considers the possibilities of using space information in assessing weather conditions under a cloudy vortex over the Caspian Sea. Cloudiness is one of the most important factors determining the nature of many physical, as well as climate-forming processes occurring in the Earth's atmosphere. Since the formation of clouds depends on the nature of the atmospheric circulation, the orography of the terrain, various physical parameters, etc., they carry information for estimating the weather conditions. It was found that the formation and conservation of mesoscale cloud vortices requires the presence of low inversion, the existence of a steady stream in the lower troposphere, and the presence of isolated obstacles (mountains, islands) rising above the lower inversion boundary and generating inertial oscillations.The greatest interest is cloudiness for aviation.

Key words:atmosphere, **c**loudiness, sea, vortex, stratus-cumulus, boundary layer, turbulent exchange.

İntroduction. Cloudiness is one of the most important factors determining the nature of many physical, as well as climate-forming processes occurring in the Earth's atmosphere. Since the formation of clouds depends on the nature of the atmospheric circulation, the orography of the terrain, various physical parameters, etc., they carry information for estimating the weather conditions. Cloudiness is an important element in studying the issues of thermal balance of the underlying surface, pollution of the lower layers of the atmosphere, construction of high-altitude structures and a number of other operational and economic tasks. The greatest interest is cloudiness for aviation.

As is known, ground-based observations are not devoid of some shortcomings, so they are discrete in nature, both in time and in space and are very limited in height. Observation of the state of the atmosphere from artificial Earth satellites (AES), unlike discrete ground-based observations, has many advantages and substantially compensate for their shortcomings [1, 3-7]. In the last decade, information received from the satellite has opened up unique prospects for obtaining a variety of data on the state of the atmosphere, including clouds.

Analysis of space information shows that on certain days over the Caspian Sea one can observe the formation of cloudy vortices. Despite the considerable difference in the scale of the motions, the cloud vortices in the atmosphere are analogous to the vortex chains of Karman observed in laboratory experiments [2, 8, 9]. In this paper, the possibilities of using space information in estimating weather conditions under a cloudy vortex over the Caspian Sea are considered.

Materials and methods

The method of statistical analysis of observational data of upper-air and ground-based meteorological stations located on the western coast of the Caspian Sea, as well as space images of the Caucasus-Caspian region, was applied.

Practical part

Cloud vortices in most cases consist of stratus-cumulus clouds, somewhat less often layered. The main feature of these clouds is that they are formed in the boundary layer of the atmosphere, the properties of which are determined by the thermodynamic interaction of air with the underlying surface of the Earth.

From the analysis of aerospace information it follows that cloud vortices are usually observed in the zone of the Middle Caspian, north of the Absheron peninsula, where the orography peculiarity can significantly affect the nature of atmospheric circulation and weather conditions, including cloud formation processes. On the coast of this zone there are mountain ranges - the Main Caucasian and Side Ranges with the peaks of Bazar-Dyuzi (4480 m) and Shahdag (4250 m). Absheron peninsula, deeply entering the Caspian Sea, is the continuation of the Main Caucasian ridge, its extreme extremity, sharply reduced to the sea (Fig. 1). The west and south-west of the peninsula represent elevations 300 ... 350 m high, and the eastern part - lowland.

The cloud formation resulting from condensation and sublimation of water vapor is mainly due to an increase in moisture content or a decrease in temperature in a given layer. These factors are in turn determined by advection, vertical movements, turbulent exchange, phase transformations of water in the atmosphere.

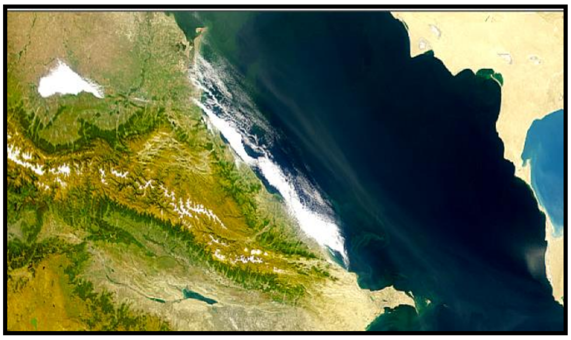
In the cold air mass, the formation of low cloudiness is due to three main processes: evaporation from a more humid or water surface; turbulent transfer of heat and water vapor from the underlying surface into the lower layer of the cold air mass; heating the underlying surface by solar radiation in the daytime and cooling it, by effective long-wave radiation, at night.

Pic. 1. Fragment of the satellite image of the Caucasus-Caspian region (NOAA, Terra). 11.12.2009, 1350 X 1700 [10].

An analysis of aerological data shows that, usually with theobservation of low clouds over the Caspian Sea,north-west and north winds prevail. It should be noted that in cases of low clouds, the frequency of south-west winds is extremely low. This is explained by the negative influence on the cloud formation of the mountainous region of the Lesser Caucasus, which causes a phonon effect in the winds of the south direction [6].

It is established that on the days when clouds of the lower tier are observed, vertical movements in the boundary layer, most often, have a velocity of 0.1 ... 0.2 cm / s. Even such velocities, in the presence of an inversion in the upper part of the boundary layer of the atmosphere and small dew-point deficiencies, contribute to a more rapid onset of condensation of water vapor or to the intensification of this process.

Analysis of radiosonde data shows that the appearance of inversions is a kind of the first sign of the formation of cloudiness of the lower tier during the cold period of the year during the daytime hours of the day. At this time of year, inversions are mainly formed due to the transfer of warm air due to the subtropical anticyclone developing in the south. The passage of southern cyclones above the study area creates favorable conditions for the supply of cold air in the lower troposphere from the northern regions through the Northern Caucasus and the Middle Caspian to Azerbaijan [1, 6]. The main Caucasian ridge is the main obstacle to the direct invasion of cold masses from the north, due to the insufficient capacity of cold air when it reaches the North Caucasus. The cold air that accumulates in front of the Main Caucasian Range flows around it from the east and a powerful stream along the western coast of the Caspian Sea comes to the Apsheron Peninsula. When advection of cold air from the north (often with a negative temperature), it is enriched with moisture evaporating from the warmer water surface as it cools. The surface inversion is destroyed, but at some altitude the inversion is still preserved, limiting from above a certain layer of air (the forming layer), where the formation of cloudiness occurs. The interaction of air lowers the temperature in the lower part of the inversion layer, which leads to air condensation and the formation of cloudiness, most often of the lower tier (Pic. 2).



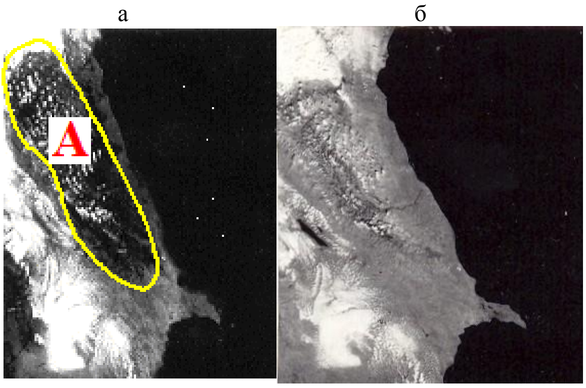
Pic. 2. Fragment of the satellite image of the Caucasus-Caspian region (NOAA, Terra). 02.10.99, 1174X1624 [10]

From the analysis of cosmic photoimages it follows that before forming a cloudy vortex over the Caspian Sea in the northern part of the Main Caucasian ridge, one can observe wavy clouds, which often have the appearance of winding bands, with cloudless lumens. The formation of undulating clouds is mainly promoted by the following factors: the orientation of the mountains relative to the prevailing wind direction, the stability of the temperature stratification in the lower and middle troposphere, and the high humidity of the air. As a rule, leeward waves are formed in the air stream (speed about 7 ... 15 m / s), quasi perpendicular to the main mountain range.

In the picture for June 23, 1995 (Pic. 3a), it can be seen that in the northern part of the Main Caucasian ridge there were undulating clouds on this day, and in the south part - closed convective cells consisting of clouds of the Sc type (stratocumulus). An analysis of the aerological information for this day shows that during the evening and night hours, the cooling of the earth's surface occurred, and at the altitudes, advection of warm air took place. This led to the formation of an inversion layer and the formation of wavy clouds of the type Sc (circuit A). Examination of this image in the range 0.7 ... 1.0 mkm revealed that small waves are not visible in the picture, and only those with cloud elements and the distances between them exceed the dilution capacity of the equipment are seen from closed convective cells. The next day (June 24, 1995) to the north of the Main Caucasian ridge on the Caspian Sea coast a cloudy vortex (Picture 4) formed, whose diameter is several tens of kilometers.

The space video image for 12.01.87 is shown in Pic. 5. It can be seen that in the morning hours before the mountain ridge to the north of Absheron peninsula also there was a cloud mesovortex consisting of layered cumulus clouds (Cc). The formation of such a vortex was facilitated by the presence on this day of a surface inversion layer in the high-pressure region, a stable airflow from the north and a mountain obstacle above the lower inversion boundary.

а б

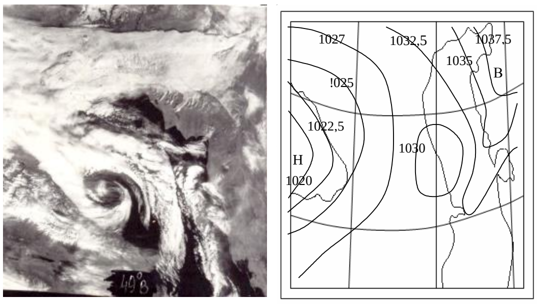


Pic. 3. Fragment of the satellite image of the Caucasus-Caspian region. "Meteor", June 23, 1995, in the spectral range a) 0.5 ... 0.7 mkm; b) 0.7 ... 1.0 mkm.

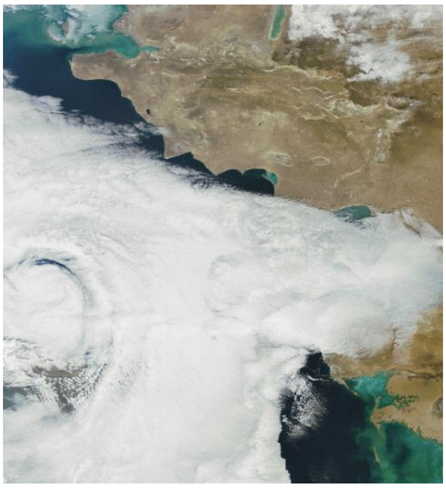
Pic. 4. Fragment of the space image of the Caucasus-Caspian region. "Meteor", June 24, 1995, in the spectral range of 0.5 ... 0.7mkm.

In the space image for February 25, 2009, a continuous cover of low clouds is visible, which covered most of the Caspian Sea (Fig. 6). On the northern part of the Absheron peninsula, a cloudy vortex is also visible, which formed under a powerful uplifted inversion.

а б



Pic. 5. Fragment of the space image of the Caucasus-Caspian region. "Meteor", 12.01.87, in the spectral range a) 0.5 ... 0.7mkm; b) surface pressure field for 9 hours

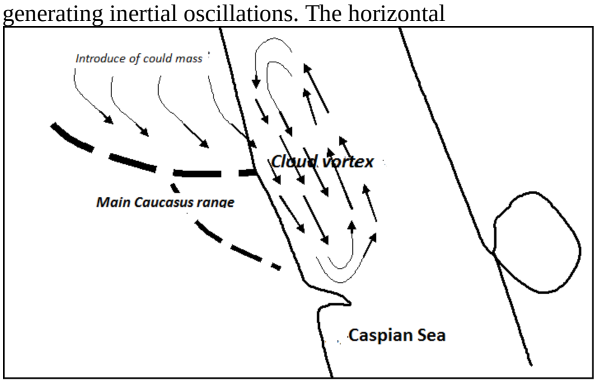


Pic. 6. Fragment of the satellite image of the Caucasus-Caspian region (NOAA, Terra). 25.02.2009, 1100X1400 [11].

Aerosynoptic data show that until 24.02.2009 warm southern winds prevailed in Azerbaijan, cloudless sky was observed, with cooling of the earth's surface and formation of inversions in the evening and night hours. But, since the evening hours on February 24, 2009, there has been a steady flow of cold air from the north. This contributed to the formation of a cloudy vortex with low layered clouds. In Pic. 7. an approximate scheme for the formation of a cloud vortex in the zone of the Middle Caspian is presented.

As the cloud vortex moves away from the obstacle, the intensity of circulation in it weakens under the effect of horizontal turbulent exchange, and the horizontal dimension increases. After the cloud vortices reach such dimensions, they quickly collapse (Picture 8).

From the foregoing it follows that the formation and conservation of mesoscale cloud vortices requires the presence of low inversion, the existence of a steady stream in the lower troposphere, and the presence of isolated obstacles (mountains, islands) rising above the lower inversion boundary and generating inertial oscillations. The horizontal



Pic. 7. An approximate scheme for the formation of cloud vortices in the zone of the Middle Caspian

exchange of momentum and turbulent viscosity play an important role in the mechanism of formation and destruction of cloud vortices. The obstacle must rise above the lower boundary of the inversion, so that only horizontal exchange occurs, and the vertical one is absent. In addition, it is necessary that there is a steady (stationary) air flow.

Pic. 8. Fragment of the space image of the Caucasus-Caspian region (NOAA, Terra). 05/28/2002, 1100X1400.

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THE CONDITIONS OF FORMATION OF CLOUD VORTEX ON THE CASPIAN SEA

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The paper considers the possibilities of using space information in assessing weather conditions under a cloudy vortex over the Caspian Sea. It was found that the formation and conservation of mesoscale cloud vortices requires the presence of low inversion, the existence of a steady stream in the lower troposphere, and the presence of isolated obstacles (mountains, islands) rising above the lower inversion boundary and generating inertial oscillations.

ANALYSIS OF THE RELIEF ROLE IN THE KUR-ARAZ LOWLAND SOILS SALINITY BASED ON GIS TECHNOLOGY

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ABSTRACT
The reasons of the Kur-Araz Lowland soils salinity have been investigated in the article. An intensive development of the irrigative farming causes growth in agricultural crops production and strongly affects the salts migration of soils in these zones. To the most specialists' mind the large zones underwent the salinity process as a result of incorrect fulfillment of the irrigative regime, agro technical rules and water losses in irrigation system. But, besides these reasons, there is an enough impact of the relief in salinization process and this factor wasn't sufficiently investigated. One of its main causes connects with non-existence of the appropriate geoinformation technologies to perform geospatial analysis before. From this point of view the geoinformation technologies present large opportunities to investigate a relation of the soils salinization characters, spreading legitimacies, potential salinization danger with the relief at present. First of all, the digital salinization map of the Kur-Araz lowland soils was compiled on the basis of GIS to study a relief role in the soils salinization process. Then digital elevation model (DEM) was built. It was known that the relief of the research object zone changes at -28 m and +50 m intervals. A comparative analysis of the DEM with the digital salinization map of soils was performed. The obtained consequences indicate a close correlation of the relief factor with the salinization process of soils to some or other degree.

KEY WORDS: GIS, soil salinity, DEM, digital map.

1. INTRODUCTION.

An intensive development of the irrigation agriculture causes growth in agricultural crops production and strongly affects the salts migration in the soils. The large zones underwent the salinity process as a result of incorrect fulfillment of the irrigative regime, agrotechnical rules and water losses in irrigation system. According to the statistical information of the last years 3 470 823 hectares of the soil resources in the Azerbaijan Republic underwent erosion to some or other degree. 661 937 hectares of 1 421 634 hectares irrigative plain soils exposed to salinization, but 480165 hectares to salonetzificationin the Republic. A total plot in the agricultural areas in the Republic is 4 531 326 hectares and 565 511 hectares from these plots underwent salinity. 152892 hectares are weak, 146235 hectares – mean, 223838 hectares – strong salinized areas. Besides it 42 510 hectares of the plots consist of saline lands. In all the plots exposed to salinity form 12,5% of the total agricultural areas. 508270 hectares of the agricultural fields underwent solonetzification.

The given figures show a great importance of the soils in need of the melioration measures in a total share of the agricultural areas. That’s why preparation of maps based on exact and substantial information is an important problem to prepare measures which will be applied for the purpose of specifying such soils borders and their normality. On other hand the large-scale field and laboratorial works performance is necessary to obtain important information on soil cover. It is possible by using only from the modern technologies to economize time and financial expenses over and again in fulfilment of this work. Therefore using of the GIS opportunities to study salinization process, to prognosicate and perform monitoring in soils, is one of the actual themes (.Mehdiyev A.Sh, Ismayilov A.I., 2011). Thats’s why a quick development of the information technologies, especially GIS technology, increase of the RS data punctuality and opportunities created a large condition for DEM establishment and their application fulfilment. DEM establishment is widely used in morphological (geomorphological), geological, hydrological research of the earth’s surface, in composition of the relief maps and physical models, in soil utilization, Landscape planning, infrastructural projection and other areas. One of the superior characters of the DEM information conveyance parts is a presence of Z coordinate besides X and Y coordinate.

2. MATERIAL AND METHODS.

A research object is the Kur-Araz Lowland. The soil-cover of the Kur-Araz lowland underwent intensive antropoghenic effects and one of its main reasons consists of more attraction of these zones to the agricultural production. An important part of lowland exposed to salinity, water and wind erosion, here various antropoghenic effects heaviness substantiates to consider these zones inconstant ecologically and inevitable negative processes can be happened in future. Just study of salinity rate, salinity reasons of these soils and spreading of this process inside space is considered on of the actual ecological problems because of the above mentioned reason. The utilization method of the relief digital elevation model was used to investigate a relief role in soils salinity process of the Kur-Araz lowland. DEM is widely used in soil utilization, soil surface research, especially soils salinization. DEM is an unexampled means in an investigation of the soils salinity distribution according to the height. The different terms are used in “Digital Elevation Model” equivalent of the English scientific references. It is possible sometimes to meet with the same and conflicting facts among the models. Digital Elevation Model (DEM) is mostly found among these terms. The Digital Terrain Model (DTM), Digital Surface Model (DSM) terms are also used besides DEM in the scientific literatures. In some cases DSM reflects buildings, trees and other objects on the earth besides the earth’s surface. Unlike DSM, the DTM is only attracting earth’s surface, here buildings, trees and other objects on the earth’s surface aren’t taken into account (Li, Z., Zhu, Q. and Gold, C. 2005). Generalizing of DEM and DSM terms, the DTM term is often used, so the height information is presented without any information about the earth’s surface (Waibel M, 1995). On the other hand the DEM and DTM terms are identified or the DEM term is presented as a structural part of DTM (Peckham R.J., Jordan G., 2007). The DEM and DSM terms are identified in some sources (Tomaz Podobnikar, 2009). DEM is noted as GRID with a regular interval and DTM as three dimensional model TIN (Triangular Irregular Network) in the Internet pages.

As is shown in the scientific literatures, generally DEM can be presented as GRID with a regular interval or DTM – three – dimensional model. The data providers are used like USGS, ERSDAC, CGIAR, SPOT Image, in general the DEM term as DSM and DTM terms. DEM can be in both raster and vector formats. GRID is in raster, but TIN in the vector form. The tecnical means like DEM programmetry, Lidar, if SAR, Land Surveying and etc. can be obtained. DEM is mainly established on the basis of the information obtained by the Remote Sensing methods, but sometimes it is built as a result of the field – research works. DEM is often used in GIS and it forms a basis of digital maps preparation of the relief. DSM is mostly used for the landscape modelling, urban modelling and visual programs. But DTM is used in stream, flood and drainage modelling, soil utilization researches, geological and such investigations. An aim of the research is to analyse a relief role in soils salinization. For this purpose a salinity map of the Kur-Araz lowland soils (s 1:100 000) was compiled on the basis of GIS.

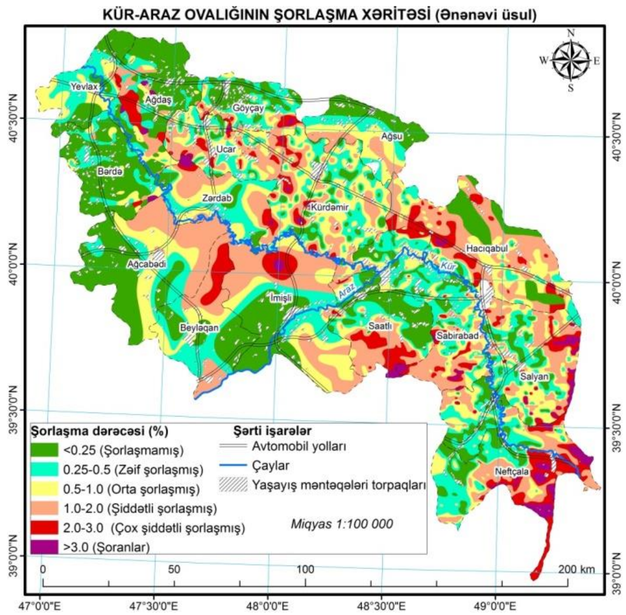

Figure 1. Salinity map of the Kur-Araz lowland soils (s 1:100 000)

An area of the Kur-Araz lowland soils was given by hectare and percentage salinity degrees on the table.

№	Salinity degree	Dry residue	Plot on gradation	Plot by percentage
1	Unsalinized	<0.25	3509.2	18.3
2	Little salinized	0.25-0.5	4071.5	21.2
3	Mean salinized	0.5-1.0	4799.1	25.0
4	Strong salinized	1.0-2.0	5017	26.2
5	Very strong salinized	2.0-3.0	1434.3	7.5
6	Saline soils	>3.0	334.8	1.7

Table 1. Areas table on soils salinity degrees

DEM must be established to study a relief role in soils salinity process. For this purpose morphometric indices of relief (height, slopes exposition, indication) must be determined, the hydrological net must be built, watershed net must be constructed, the size of the plane and surface areas in the relief must be calculated. A role of DEM and definition of their chances have been investigated in these problems solution. The usage opportunities of the various methods have been revealed for DEM establishment of the Kur-Araz lowland. The sources which are widely used for the scientific researches are considered National Aeronavtic and Space Administration (NASA) of the USA. ASTER GDEM (Advanced space borne Thermal Emission and Reflection Rediometer, Global Digital Elevation Model) which are products of Japan Ministry of Economy, Trade and Industry (Adrian W. Graham, Nicholas C. Kirkman, Peter M. Paul, 2007). One of the main proprietaries of this source is availability for the users. The investigative ability of ASTER GDEM is 1 arcsecond. Arcsecond changes on geographical latitudes depending on the earth form. One pixel width on the ecvator can be calculated by (1) and height by (2) formula if we take into account that a length of the ecvator circle is 40076 km (E), but a length of the meridian circle is 40009 km (M).

$$X = \frac{E}{360^0} * \frac{1^0}{3600} * 1000 \quad (1)$$

$$Y = \frac{M}{360^0} * \frac{1^0}{3600} * 1000 \quad (2)$$

We find from the formula that $X = 30.92m$, $Y = 30.87m$. (here 3600 is a quantity of seconds in one degree).

Not depending on geographical latitude Y is always constant, but X changes. X quantity can be calculated by (3) formula if we take account that the Ku-Araz lowland center is situated in the 400 north latitude.

$$X_{40.5^0} = X * \cos 40^0 \quad (3)$$

In this case an availability of ASTER GDEM for Kur-Araz lowland will be X=23.69 m, Y=30.87 m.

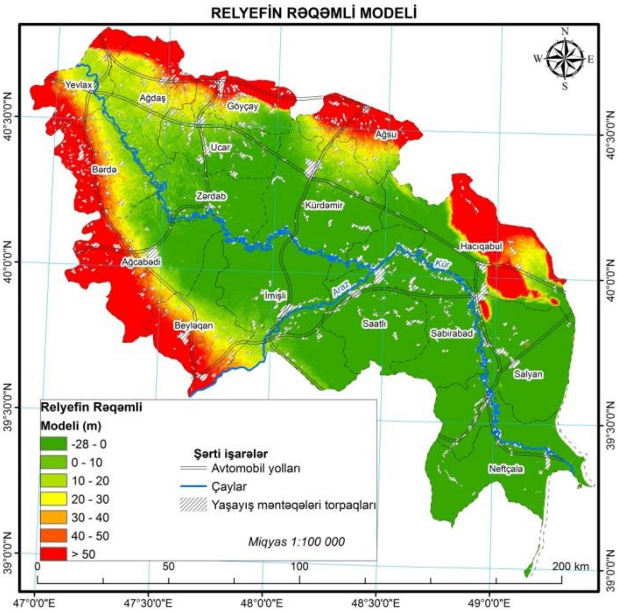

Figure 2. DEM of Kur-Araz lowland.

The obtained analysis of DEM shows by the GIS program that an area of the research object is 19161.6 km. 59,4% (11383.1 km2) of this zone is situated below sea-level, 40.6% (7778.5km2) above sea-level. The areas of which absolute height is higher than 0-50 m form 8,5% (1627.7km2), the areas which are situated higher than 50-100 m form 19,5% (3737.6 km2), the areas of which absolute height is higher than 100 m metre form 12,6 % (2413.2 km2) of the zone.

№	Height gradation	Plot on heights	Plot by percentage
1	<-10	8863.5	46.3
2	-10-0	2519.6	13.1
3	0-50	1627.7	8.5
4	50-100	3737.6	19.5
5	>100	2413.2	12.6

Table 2. Areas spreading table for the relief height

The indications by the salinity map of the Kur-Araz lowland and DEM model obtained as a result of the analysis based on GIS are given on the following table. The obtained consequenses visually demonstrate an intensiveness of the soils salinity process in comparatively low levels of the relief.

№	Salinity rate	QQ	<-10	-10-0	0-50	50-100	>100
1	Unsalinized	<0.25	833.4	211.6	249.9	1162.6	1051.2
2	Little salinized	0.25-0.5	1853.6	449.1	324.6	952.2	491.7
3	Mean salinized	0.5-1.0	2162.6	816.1	488.7	943.4	387.5
4	Strong salinized	1.0-2.0	2706.7	858.4	429.7	561.3	457.6
5	Very Strong salinized	2.0-3.0	1016.1	164.4	117.5	111.2	24.4
6	Saline soils	>3.0	290.6	19.9	17.2	6.8	0

Table 3. Spreading of salinity rate for the relief height

3. CONCLUSION

The relief role has been revealed in exposing the Kur-Araz lowland soils to the salinization in the article. With this purpose a salinity map of the Kur-Araz lowland soils has been composed on the basis of GIS. Then DEM of the zone was established. A comparative analysis of the salinity indications in soil areas with the height indices of the relief have been performed on the basis of GIS. It was visually grounded that the relief is one of the main factors in exposing of the soil plots to salinization.

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