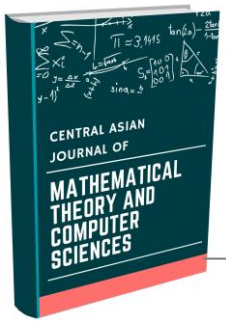

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Using Geospatial Technologies to Detect and Monitor Changes Land Cover and Land Management

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Abstract:

Today, as a result of rapid population growth, there are many cases of unauthorized and illegal occupation of lands used for other purposes, including agricultural irrigated lands, as well as irregular settlements. This is leading to a sharp decline in irrigated agriculture, which is important for the economy and threatens the country's food security in the future. Implementing important issues such as finding and preventing the right solution for such situations through GIS and remote sensing technologies could give high efficiency. That is why this research paper focuses on the use of remote sensing data and GIS technologies in the land-use change analysis in order to study the current state of the residential areas of the Zangiota district of the Tashkent region, Uzbekistan. The analyses NDBI, BUI, BUAEI, NBI, VIBI, BSI, UI carried out by using indices on the basis of Landsat 5-TM and 8-OLI satellite data in order to create a land-use change map during the period of 2000-2020 for identifying changes of build-up areas. As a result, it was found that over 20 years, the population's living space and common land use have increased by 3,402 hectares. It was found that 90% of the total land area of the identified residential is agricultural irrigated land.

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1. INTRODUCTION

Nowadays, changes in land use are associated with changes in land cover. The increase in population is explained by the increase in demand for food, the increase in demand for housing. Constant monitoring of changes in land cover is very important in the proper distribution of land resources and their effective management [1,2]. Land use and land cover changes, especially in and around the city, are a rapid process, and it is important to study changes in their proper distribution and management [3,4]. The main reason for this is that they have an annual database and provide opportunities to study long-term changes [5]. Currently,

land fund management maps are prepared by obtained remote sensing data around the world and used a cartographic basis [6]. Landsat satellite has been position in orbit since its launch in 1972 and continuesly providing long-term satellite imagery today[7]. It is effective to analyze the changes observed in the district land fund through images taken from this satellite. It is also possible to increase the accuracy of making the right decisions on land fund management as a result of the observed changes.

With the increase in satellite capabilities in remote sensing, area monitoring and urban planning are more effective [8,9]. Not only remote sensing data is used in urban and suburban planning, but the description of the observed changes in land use by combining socio-economic, statistical analysis can give the expected result [10].

Uzbekistan's existing land use does not have a high potential for the following main reasons: a certain inconsistency in the use and management of land resources, forecasting the rational use of land, lack of planning, etc. [11]. The chances of solving the above problems with economic analysis are much lower. Through a comprehensive analysis of the area, we can be able to effectively manage land resources [12]. The study of surface cover is important in the effective management of the land fund and the organization of its rational use.

Nowadays, the current state of lands resources in the country has not been systematically analyzed using the above methods. Periodic changes in the land fund are not strictly controlled based on spatial analysis. As a result, today there are disagreements between the state and the population over the use of land resources.In particular, as a result of inspections conducted in the Tashkent region in 2020, violations cases have been identified in five districts.

2. METHODOLOGY

2.1 STUDY AREA

In this scientific research, the Zangiota district of the Tashkent region of the Republic of Uzbekistan was taken as a study area. The district is located at N $41^0$22’39’’ northern latitude and E $64^0$35’07’’ eastern longitude. (Figure 1) The total area of district is 21.692 hectares. The population of the district is 194.8 thousand people. The population is mainly engaged with the cultivation of agricultural products. As a result of district borders with Tashkent city, the most area of irrigated land used by the population is growing from year to year, and it is leading to declining of agricultural land.

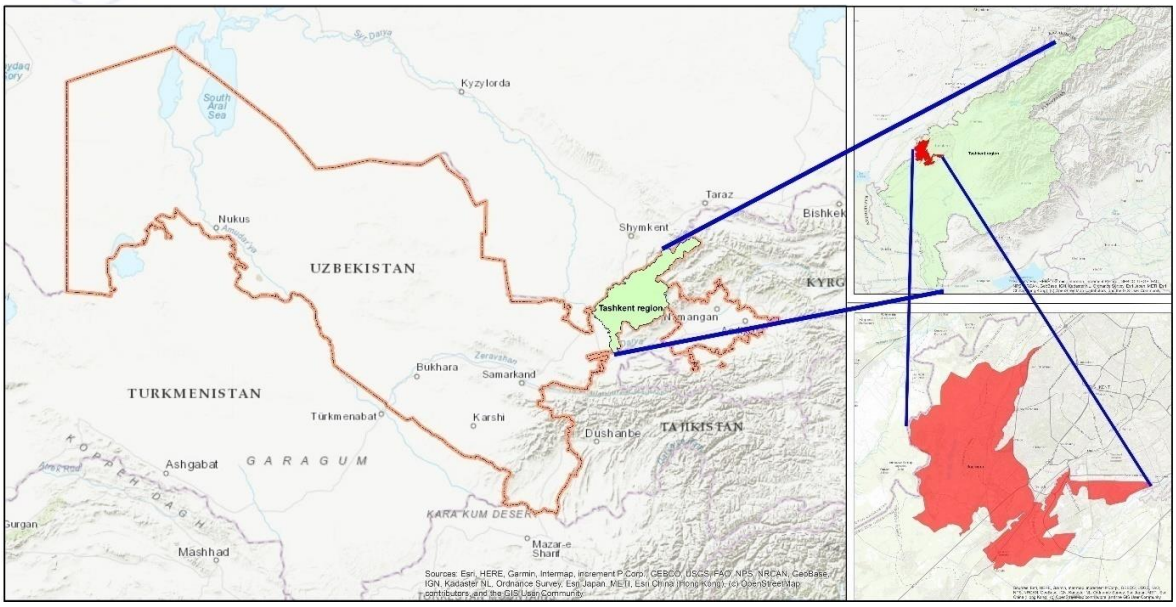

Figure 1. Study area

2.2 METHODS

In order to creating a land cover map of the study area, the same time Landsat-5TM, 8OLI images for 200 and 2020 are were pre-processed and analyzedby different indices in case of developing accuracy of unsupervised ISO clustering method to the periodic changes in the land cover of the. ArcGIS program was used to data preprocessing, raster combinations, calculation of indices and classification functions. It is more efficient to determine identify lands in general use by the population. To this we can visualize lands covered with buildings and structures, engineering structures, social objects using by NDBI analyses.

Table 1. Formulas for determining the residential area

Index name	Formula	Degree of accuracy	References and sources used
Normalized difference built-up index	$NDBI = \frac{(SWIR - NIR)}{(SWIR + NIR)}$	72%	[16]
Built-up index	$BUI = NDVI - NDBI$	85%	[17]
Built-up area extraction index	$BAEI = \frac{(Red - L)}{(Green + SWIR)}$; $L = 0.3\ (d)$	80%	[18]
New built-up index	$NBI = \frac{SWIR \times Red}{NIR}$;	75%	[19]
Vegetation index built-up index	$VIBI = \frac{NDVI}{NDVI + NDBI}$;	63,5%	[20]
Urban index	$UI = \left(\frac{SWIR - NIR}{SWIR - NIR} + 1.0\right) \times 100$;	71,5%	[21]
Bare soil index	$BSI = \frac{(SWIR + R) - (NIR + B)}{(SWIR + R) + (NIR + B)}$;	68%	[22]

Determining the habitats of the population using the above formulas can give good results. But the following formulas are also effective for distinguishing vacant land areas and lands in common use by the population and can give us a clear result. Then NR used as a data for unsupervised classification by ISO clustering tool of ArcGIS. By converting the result into a vector format, we can analyze 20-year changes by doing Intersect, Union, Merge, Dissolve through the Geoprocessing tool.

3. RESULTS

From the BUI, BUAEI, UI indices, which gave the highest results through the indices used, it is possible to see the relatively accurate visualization of the settlements and where the residential areas are being built by the population.

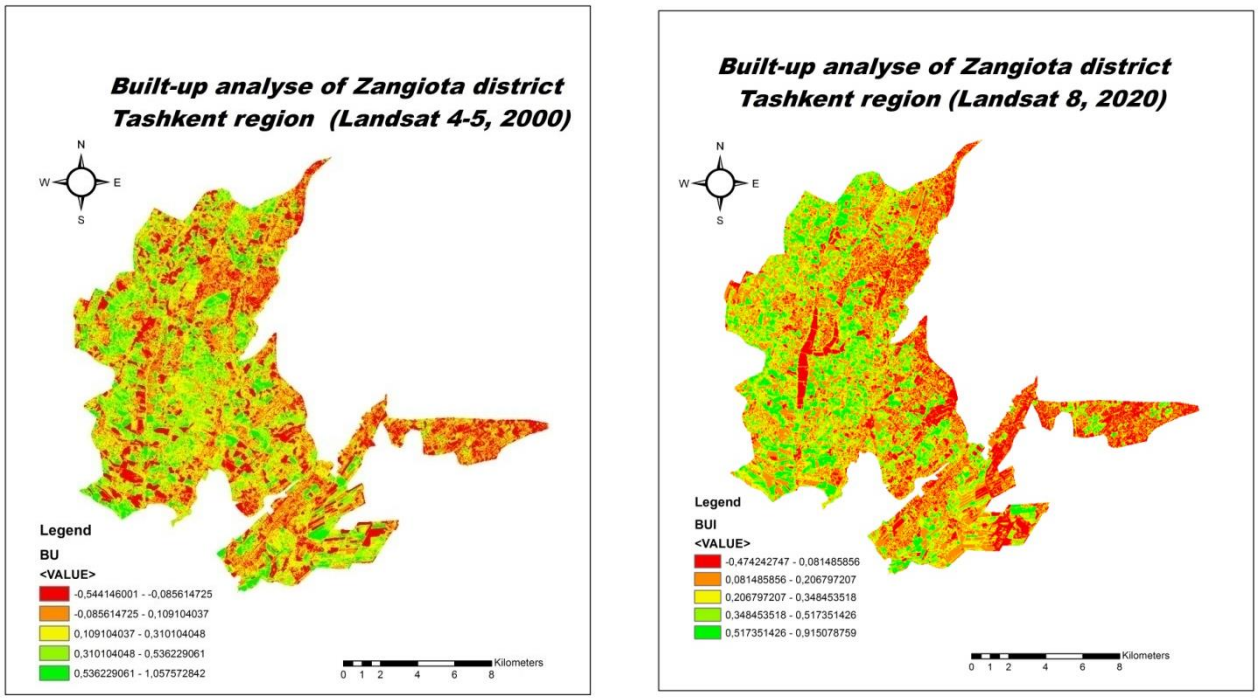

Figure 2. BUIanalysis of the study area

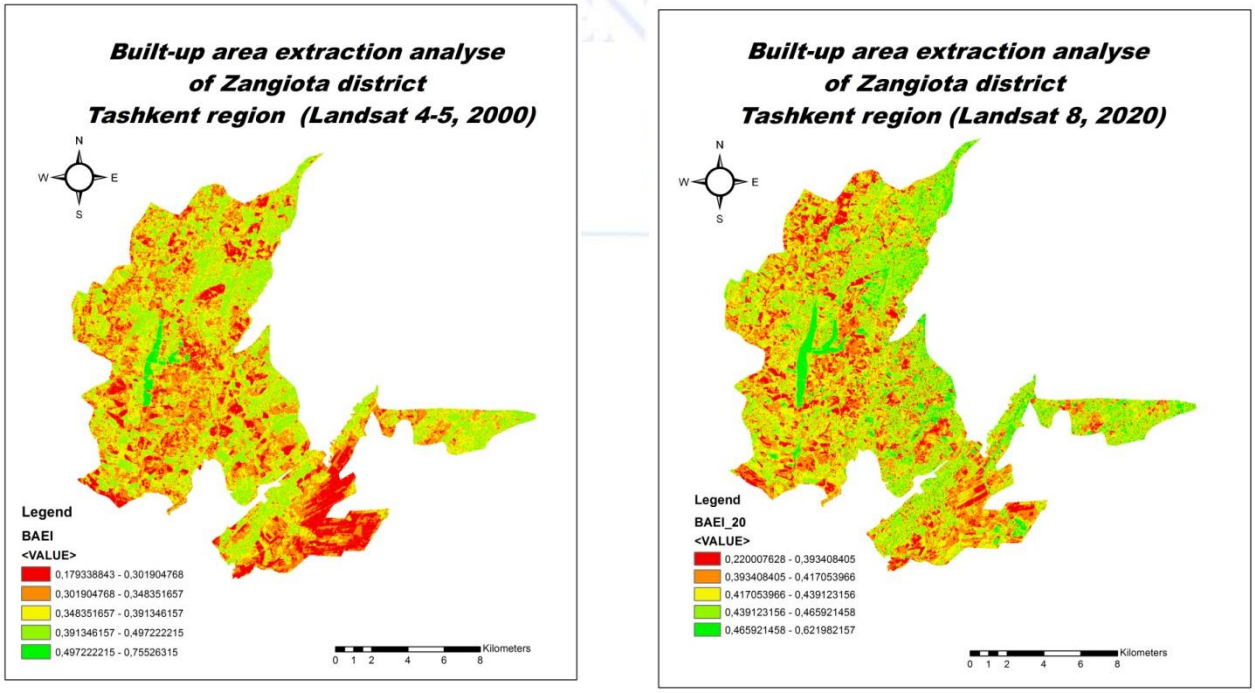

Figure 3. BAEI analysis of the study area

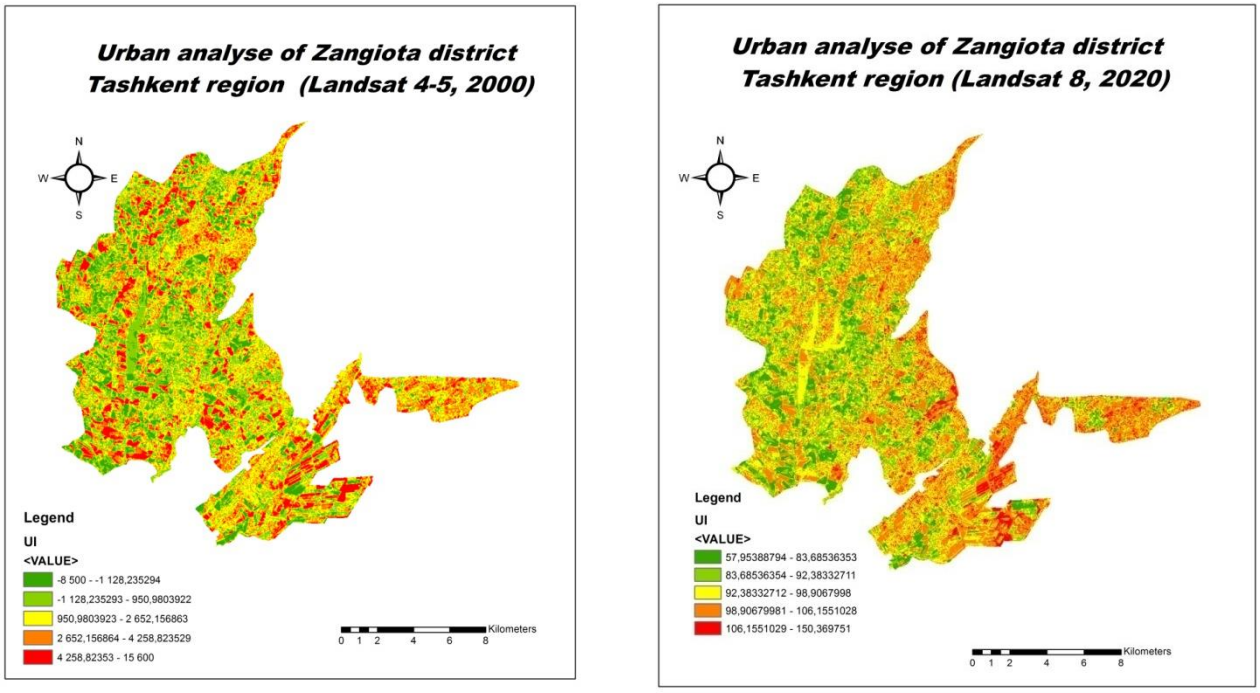

Figure 4. UI analysis of the study area

After completing the above steps, a surface cover map of the area will be prepared. As a result, the changes observed in the surface cover for the period from 2000 to 2020 were analyzed. The reasons for these changes were explored. As a result of the research, the data obtained from land management organizations and the results obtained by processing remote sensing data were compared.

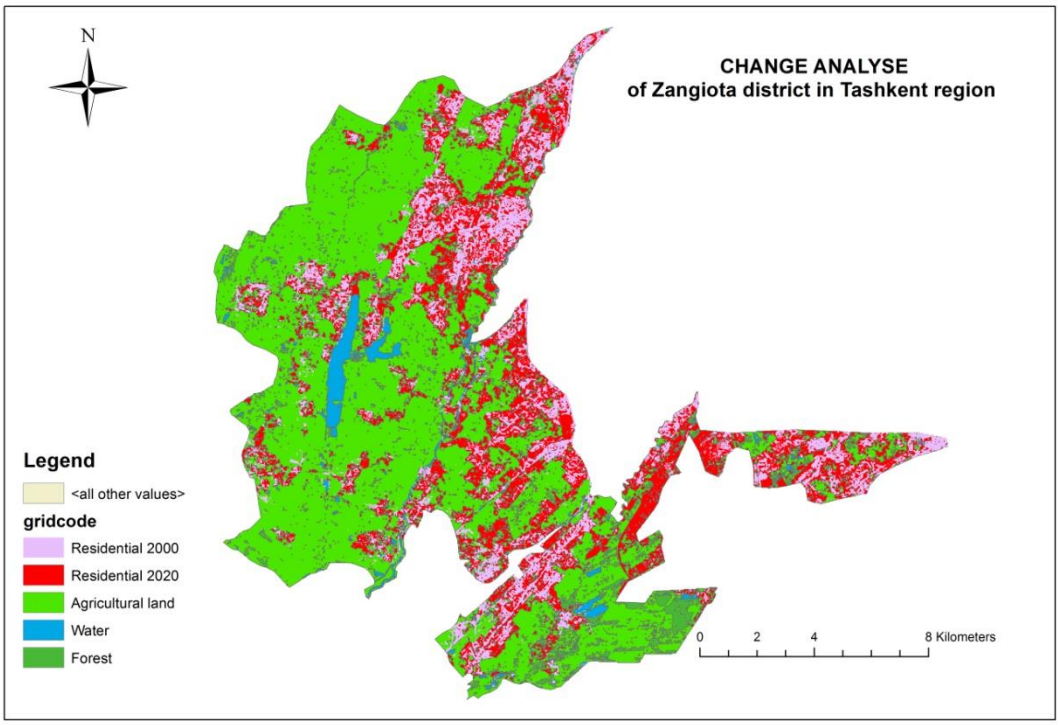

Figure 5. Change analyze 2000 to 2020

Table 2. Statistical data

Land fund categories	**2000**	**2020**	**+-**
Agricultural land	19293	17008	-2285
Residential area	272	416	+144
industrial transport, defense, communications etc.	2645	3425	+780
Recreational purposes	-	-	-
Historical land	-	1	1
Forest land	10	6	-4
Water land	397	406	-9
Reserve land		8	+8
Total area	**22617**	**21270**	**1347***

* Land transferred from Zangiota district to Sergeli district of Tashkent city and land transferred Tashkent district of Tashkent region.

Table 3. Results based on remote sensing data

Land fund categories	**2000**	**2020**	**+-**
Agricultural land	17436	13223	-4213
Reserve land			
Recreational purposes			
Residential area	3637	7039	+3402
industrial transport, defense, communications etc.			
Historical land			
Forest land	10	6	-4
Water land	376	412	-36
Total area	**21460**	**20680**	**780***

* Land transferred from Zangiota district to Sergeli district of Tashkent city and land transferred Tashkent district of Tashkent region.

Statistical data and remote sensing data were compared. As a result, it became clear that there was a big discrepancy between the two data, the main reason for which was the incomplete inventory of settlements. As a result, it was found that over 20 years, the population's living space and common land use have increased by 3,402 hectares. It was found that 90% of the total land area of the identified residential is agricultural irrigated land.

4. DISCUSSION and CONCLUSION

Today, the population is growing not only in the Republic of Uzbekistan, but all over the world. Of course, this process will increase the demand for land. Therefore, today in the study of the demand for land resources not only in Uzbekistan but also around the world, it is advisable to conduct monitoring not only on the basis of statistical analysis, but also on the basis of remote sensing data. Analysis by remote sensing is more effective in maintaining the land balance, monitoring the transformation of the land fund category.

By processing remote sensing data, it is possible to study changes in the earth's crust and determine the changes in the types of land use. This information is a highly effective tool, especially in the study of suburban areas, in the organization and management of their territory [25,26]. It allows to analyze the area using land use and land cover changes and to imagine the most suitable areas for land distribution and redistribution [27,28,29].

The article analyzes the territory of Zangiota district of Tashkent region of the Republic of Uzbekistan by statistical analysis and processing of remote sensing data. It uses images from the satellite platform Landsat 5TM and Landsat 8OLI. Their land fund categories were partially formed by calculating their NDBI, BUI, BUAEI, NBI, VIBI, BSI, UI indixes. The changes observed in the state of the land fund of the studied area in 2000 and 2020 were analyzed. In short, based on remote sensing data, land resources can be managed and monitored on an ongoing basis. Through this, the possibility of arbitrarily occupying lands and using them for purposes other than the intended purpose is much higher. It is advisable to conduct long-term analyzes based on remote sensing data, visualize them and develop recommendations and models for the future.

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