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Original Research

Spatiotemporal Change Analysis of Land Cover on Soil Resources in Kosova Plain

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Abstract

Land Use and Land Cover (LULC) are the main components that indicate the coverage of land and its use. Kosova Plain, a flat and gentle plain with an altitude between 450-600 m, is one of the central plains in Kosova, where the human impact and environmental changes are very high. As a terrain with land with high-quality soils, it was one of the main areas of agricultural production in the past. With the industrialization of Kosova especially with coal surface mining, began an era of employment in other sectors rather than in agriculture, and its consequences were population migration inside Kosova, which is shown by the rising urban population and extension of artificial surfaces towards agricultural areas. Population migration inside Kosova is made mostly towards plain areas where most of the settlements are found, but also where high capability land is found. The article analyzes natural conditions of agricultural land in Kosova Plain and spatial and temporal changes in land cover as one of the consequences of pressure on the environment, especially in soil resources, where with GIS/RS analysis was made possible to use topographic maps and aerial images of different years, to analysis these changes. In 1990, the total area of artificial surfaces in Kosova Plain was 7,157 ha, while in 2020, it was increased to 15,881 hectares. There is an increase of artificial surfaces in urban fabric, mineral extraction sites, and road infrastructure, mostly done on agricultural land. Agriculture areas experienced a decrease of 8.76%. The extension of artificial surfaces was primarily made in an unplanned way. The results show that in the future, zoning of built-up areas is needed.

Keywords: Land Cover/Land Use, Kosova Plain, artificial surfaces, soil resources

Introduction

Since the beginning, humans have transformed the environment, and the amount of changes, according to some authors, paved the way to the Anthropocene [1]. Land use for residential and related purposes has been part of human civilization since the beginning; however, land cover by settlements was minimal until the appearance of industrialization, when urbanization processes came into issue [2]. Soil type and quality were a driving force of human migrations, while as the outer skin of the Earth's land, it serves as a medium for terrestrial biological activity [3]. It is the basis for agricultural activities and production. Its creation is

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attributed to different natural factors, but its quality has human influence. Different soil forming factors are described, and five of them are accepted by soil science: parent material, time, climate, topography and relief, and organisms. Soil quality depends on various factors determining "soil's capacity to function" [4]. Observer's interest determines soil function. Thus, a land manager sees the soil's capacity to sustain, while a conservationist sees it in terms of environmental protection. Another view has a consumer who sees food production, and an environmentalist sees its capacity to maintain biodiversity, water quality, etc. [5]. Scientists see land use differently. A geographer and others who studies human societies interpret land use as changes within the ecosystem [6], while ecologists and conservation scientists see land use as a disturbance affecting terrestrial ecosystems [7]. Economic expansion and population growth result in substantial changes in land cover and land use [8], where urbanization becomes the primary driving force behind environmental transformation [2].

Environmental changes in terms of land use and land cover have become critical issues of global change [9], which increased academic attention. LULC is an essential element in an environment to understand relationships between human activities and the natural environment [10]. The current trend in the environment shows a degradation of the environment [11] where fragmentations of the landscape are done, and humans perceive Earth's surface components.

The general degradation of the environment dominates the current change trends [11] and substantial fragmentation of the landscape. It is estimated that 17% of the Earth's land surface has changed at least once from 1960 to 2019 [14]. Numerous studies globally noted the rapid pace of LULC resulting from population growth, intensive land use, and loss of natural areas. Land use is the oldest anthropogenic environmental intervention [15].

Agricultural landscapes in Europe have changed dramatically since the 1950s when farming was intensified, where flows and values of ecosystem services have changed, while in post-socialist countries in Europe, land transformations have led to the fragmentation of agricultural land [16, 36]. Soil, a non-renewable natural resource, sustains life and supports 95% of global food production [17], and changes in land resources have consequences on soil degradation. LULC changes have resulted in the interaction of many factors.

According to physical features, the territory of Kosova (10,905 km²) is dominated by hilly mountainous areas, while in the European Union, more than 35% of the total area is agricultural land [18]. While the European Union has 0.52 ha/inh., in Kosova, agricultural land per capita is 0.25 ha, while the critical threshold for providing enough agricultural products for a country is 0.17 ha/inh. [19]. Soil provides goods and services which contribute to human well-being. Changes in soils have accelerated soil degradation in Europe, where erosion, declining organic matter, compaction, and salinization are identified as the main factors [20].

Built-up areas (artificial surfaces) are increasing rapidly. According to Angel et al. [21] the annual increase of built-up areas in developing countries is 3.6%, which generally results in land consumption, changing of landscape patches [34], land suitability [35, 37] etc. In Europe, the growth of urban land between 2015-2030 is forecast at a 3% level in industrialized areas, while nearly zero in remote rural regions [20]. In Kosova Plain, the annual rate of built-up area extension was made by 4.87%. Globally, according to the latest studies, land use changes are four times greater than previously estimated [14]. As is estimated globally, the urban population will increase to 70% by the end of 2050 [22], which will affect Kosovo too. Based on the trend of Kosova's population urbanization, artificial surfaces will increase, where pressure will be placed on agricultural lands.

Materials and Methods

In order to analyze the changes, our research is based on GIS methods as a modern analysis technique that makes possible comparisons in a spatiotemporal way. In addition, simple or multiple regression methods are used to forecast changes in Kosova Plain. Land Cover datasets from Copernicus Land Monitoring Service (CLMS) were downloaded and analyzed for Kosova Plain. Digital Elevation Model with 10 m spatial resolution was used to analyze the physical-geographical features of Kosova plains. Land quality map of Kosova [38], where different soil classes are classified by the production capability intersected with artificial surfaces downloaded Copernicus Land Monitoring Service, where the project CORINE (Coordination of Information on the Environment) is ongoing. Based on the data of topographic maps for the year 1990, artificial surfaces were extracted, which are used to compare the distribution of artificial surfaces in 2006 and 2018. Population data for settlements in Kosova during 1948-2011 were downloaded from the Statistical Agency of Kosova, where the spatial and temporal distribution of settlements and human population in Kosova Plain was analyzed. At the end of our observation, an intersection between artificial surface and agricultural land was made to extract the results.

Geographical Features of Study Area

Kosova Plain was chosen as the study site, while environmental transformation is enormous, and human impact is very high. As one of the main plains in the Republic of Kosova, it experienced industrialization that later inducted population migration, so with

Table 1. List of datasets used for case study.

Data/maps	Resolution/scale	Source
DEM (altitude, slope)	10:00 PM	Kosovo Cadastral Agency
Soil map	1:50,000	Kosova soil database
Soil quality map	1:200,000	Hydroeconomy atlas of Kosova, 1983
Geology	1:100,000	KPMM
Land cover 1990	1:25,000	Former Yugoslavia topographic maps
Land cover/land use 2000, 2006, 2018	100 m	Copernicus Land Monitoring Service
Population statistics	-	Statistical Agency of Kosova

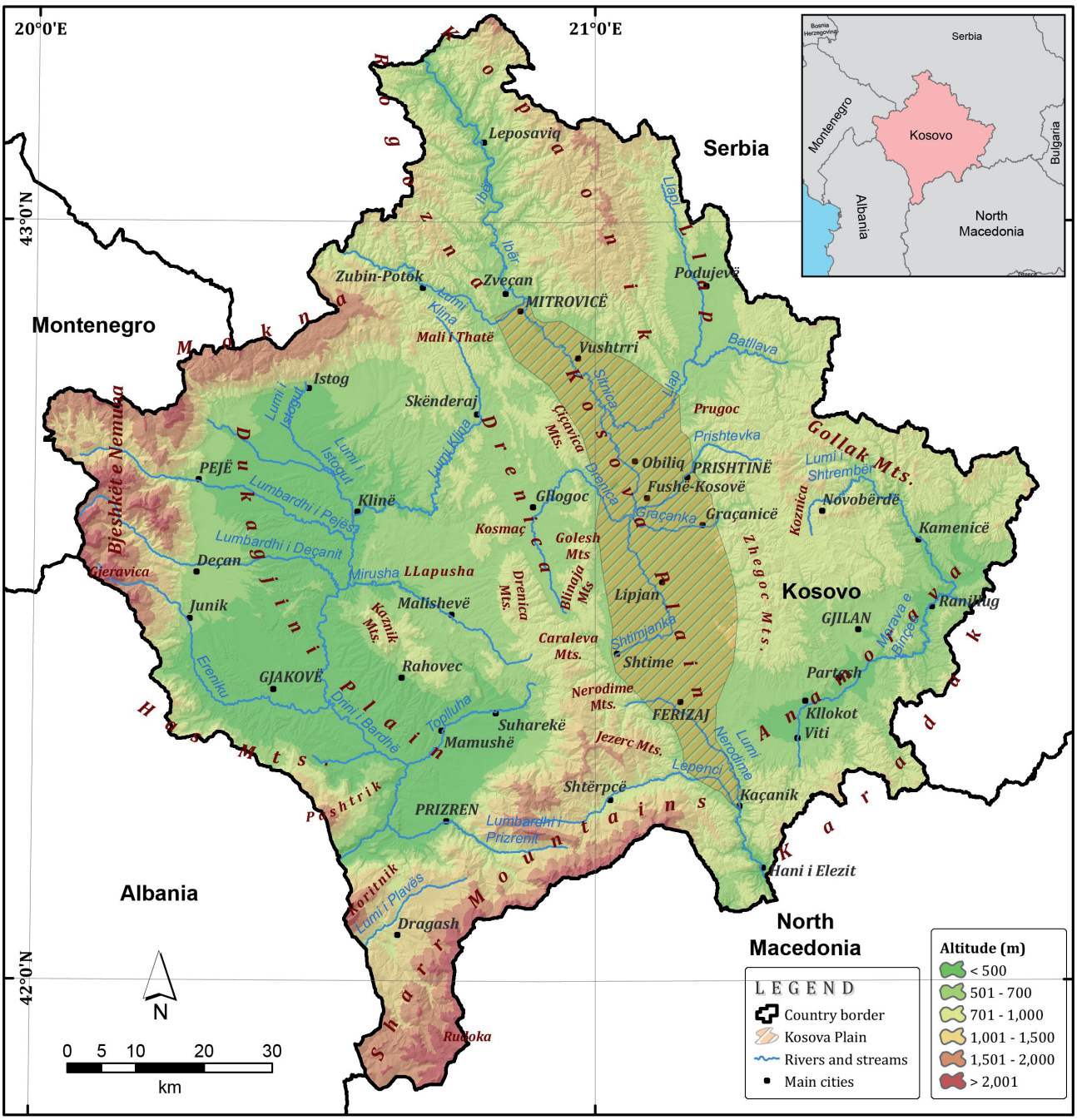

Fig. 1. Location of Kosova Plain.

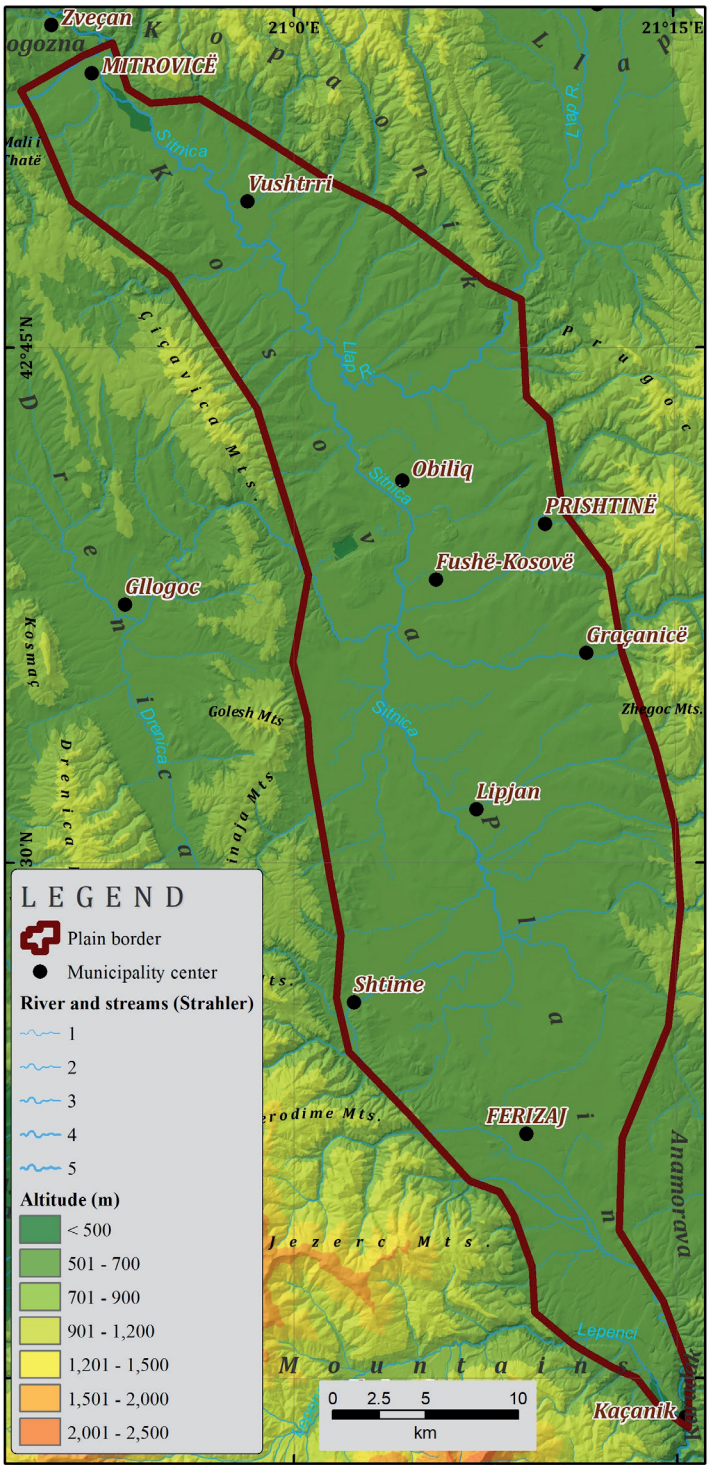

Fig. 2. Altitude of Kosova Plain.

the extension of settlements and coal extraction processes, it became one of the most transformed areas in Kosova. With a total population, according to the last census (2011) of 535,535 inhabitants [23], it is a very densely populated area with 526 inh./km², and compared to the national level (163 inh./km²) it is considered densely population region not only in Kosovo but in European level. Currently, based on statistics from the Agency of Statistics of Kosovo [23], at country level, there are 420,210 ha of agricultural land [40], of which 80% of that are in 1-4 land quality classes (out of 8), while Kosova Plain has 81,663.1 hectares1 of agricultural areas (15.9%). Out of total agricultural land, 188,372 hectares are arable land, while only in Kosova Plain there are 70,369.4 hectares.

Kosova Plain is one of the five plains, which lies in the central-eastern part of the country. Just the plain has an area of 1,017 km², which includes the bottom

of plains with adjacent slopes of surrounded hilly-mountainous areas, which in geological terms represents fault plane and fault scarps. It has a meridional stretch of 83 km long and 18 km maximum width. It is a tectonic plain, surrounded by medium to high-altitude mountains, which later, during the newest geological time, was a Neogene lake, where loose sediments are deposited in the lacustrine environment [25, 26]. Later, after the tectonic uplifting of the Balkan Peninsula, the main geological processes in action were fluvial and slope processes, where mainly alluvial soils were created.

At the national level, Kosova Plain has been the subject of several studies, which include geological settings [24, 25], climate and water resources [26, 27, 28], sustainable use of agricultural land [29], which included specific studies. Later, a general study of the settlements of Kosova included not only the main physical features but also migration, labor, and other socio-economic elements that distinguished each settlement (Lexicon of Settlements of Kosova, 2020). With the increasing population in settlements, the human impact on the natural environment has increased, too. Kosova Plain, one of the plains in the country, has 205 settlements, where 137,243 inhabitants lived in 1948. As a region with high fertility soils and coal deposits of nearly 12 billion tons, which generated most of the electricity in Kosovo, the ecological stability began to reduce. With a total population of 535,535 inhabitants according to the last census [23], it is a very densely populated area with 526 inh./km², and compared to the national level (163 inh./km²), it is considered a dense population region not only in Kosovo but in European level. Sitnica River is a central river system, where its water sources are in the confluence of the Shtimjanka River with the Sazlia Stream. South of Kosova Plain, a rare hydrological feature was created – the Bifurcation of Nerodime River, where Nerodimja River, with human influence, flows its water towards the surrounding seas of the Balkan Peninsula; its south (right) tributary flows towards Aegean Sea, while its north (left) tributary flows towards Sitnica River [26].

Results and Discussion

Analysis of Topographic Parameters in Kosova Plain

Relief and Climate

Land elevation has an insightful impact on agriculture, as altitude is a climatic factor. Agriculture has a positive relationship with low to medium altitude, while with increasing altitude, the climate is changed, and landforms are rugged and not suitable for agriculture. The bottom of Kosova Plain lies between 500-580 m, while adjacent areas stretching in the scarps or fault planes of the tectonic field have an altitude of 820 m. 82.8% of the total area of Kosova Plain lies under altitude 600 m, while only 17.2% lies above 600 m altitude. By altitude analysis, Kosova Plain is a flat and gentle plain with minor differences in altitude and a gentle slope, very suitable for agricultural production. Low altitude represents the bottom of Kosova plain, and according to processes that influenced them, they have a fluvial and lacustrine origin, where alluvial plains, river, and lake terraces are the primary genetic landforms. The climate is the main feature which is influenced by altitude. Most of Kosova Plain is surrounded by a 10ºC yearly mean isotherm that shows continental climate features (Map of rainfall and air temperature, 1983; Pllana, 2015). Sitnica and Lepenci Rivers are the main running waters. They contain small tributaries flowing from hill-mountainous areas surrounding the Plain. Their position in the central part of Kosova Plain has indicated tributaries to create valleys with slight altitude differences by slopes with different aspects (exposure). Compared to the main biggest Plain in Kosova (Dukagjini Plain), this one is mainly oriented towards the north, along the Sitnica River, while from the city of Ferizaj, it has south-oriented primarily slopes towards the Lepenci River. The orientation towards the north has influenced a colder climate than the western plain of Kosova.

Table 2. Slope categories in Kosova Plain.

Slope (degree)	Description	Area (km²)	%
<2	Flat to very gently sloping	562,18	55.28
2-5	Gently sloping	231,52	22.76
5-10	Sloping	161,20	15.85
10-15	Strongly sloping	43,43	4.27
15-30	Moderately steep	13,52	1.33
>30	Steep	5,18	0.51
		1 017,02	100.00

Slope

One of the main topographic parameters related to the agricultural use of land is the slope. Even if it is plain, the action of geomorphic agents has created different geomorphological features, with the dominance of flat to gentle sloping (55%). However, in adjacent areas that lie in the periphery of plains, different slopes are created by denudation, whereby fluvial processes have made an intersection of alluvial plains and smooth ridges to make diverse topography, where land use types are distinguished.

According to FAO classification [30, 39], slopes are categorized into six categories. Slope as a leading factor is related to the distribution of potential zones for agricultural production. In Kosova Plain, flat to gently slopes are dominant and suitable for agricultural use. They are found at the bottom of the plain and lower

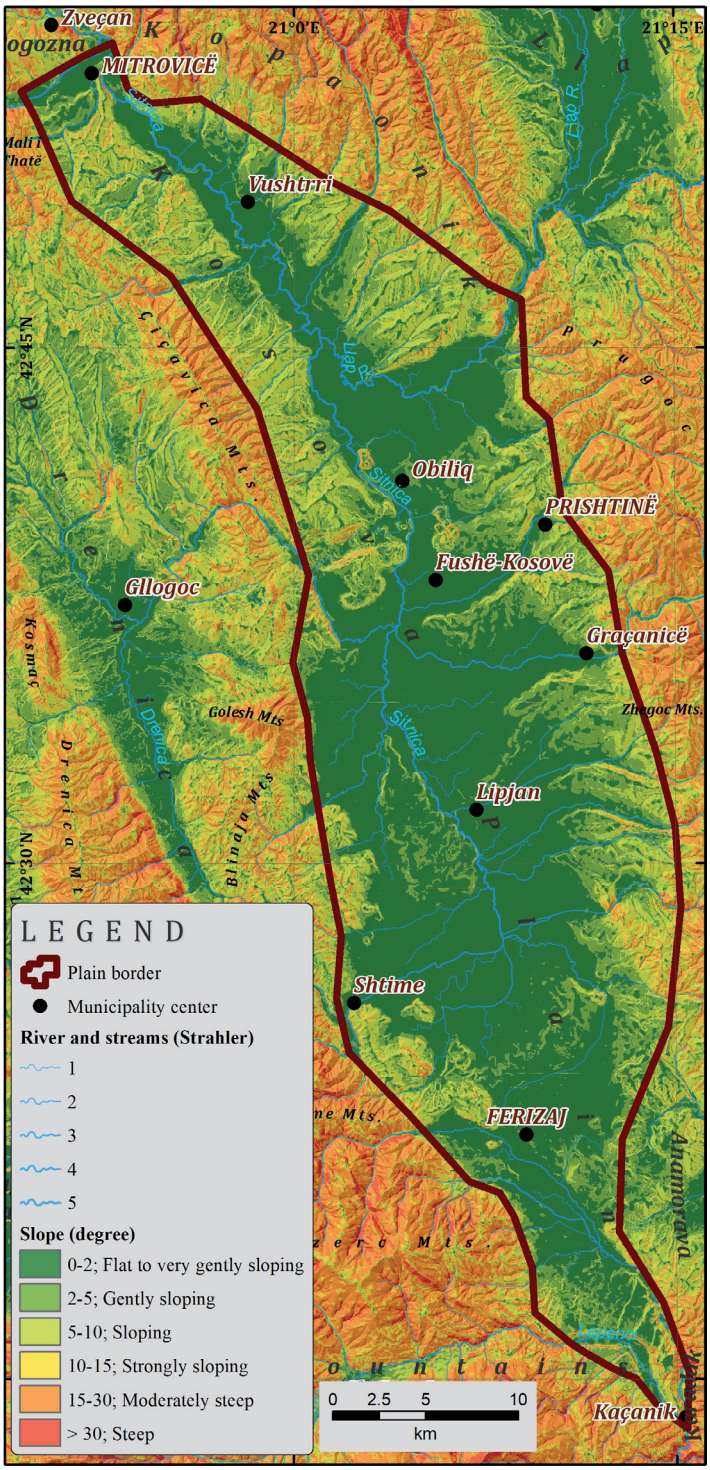

Fig. 3. Slope map of Kosova Plain.

sector of adjacent valleys. The area of the category consists of 55.3% of Kosova Plain. Slopes with angles between 2-5 degrees are considered gentle slopes and are distributed in 231.5 km² of the plain. They are found mainly on gentle slopes of river and stream valleys running from hilly-mountainous surrounding areas, whereas at their foothills, gentle slopes are found. As a distinguished category of slopes, they have medium to high land quality. The first two categories of slopes make 78.04% of the plain's total area, while the others (≈22%) are the category of sloping until steep slopes, found primarily on scarps or fault plane, representing valley slopes in the middle sector of flowing streams from hilly-mountainous terrains.

Based on soil forming factors and geographical features, Kosova Plain found different soil types, which are distinguished in their physical, chemical, and texture. Through river processes, mainly Sitnica River, different subtypes of alluvial soils (fluvisol), where loamy, sandy-loamy, and clayey alluvium dominate. Other subtypes of alluvial soils found in Kosova Plain are leached and gravely alluvium. Smonitsa (vertisol) has a wide distribution in Kosova Plain, covering 38% of the total area. They have fine to medium textures. Fluvisol and vertisol were the main bases for agriculture production in Kosova Plain. In the areas with the dominance of Pliocene age sediments and through faults plane and scarps of Kosova Plain with hilly-mountainous areas are low-quality soil where main forming factors were influenced by topography and parent rocks.

Based on soil properties, in Kosova, the map of soil quality, where soils are divided into eight categories, represents their capability (quality) for agricultural production. Dominant soil quality classes are 2nd and 3rd category, which together comprise 67% of the total land in Kosova Plain. The first and second classes of soil quality need moderate or minor management input and are ideal for agriculture production. The 3rd and 4th categories of agricultural land have more production cost, which needs to be invested because of soil characteristics. According to the law for agricultural land, the top four categories are considered lands with the primary agricultural destination, and their distribution in Kosova Plain is around 84.5% of soils. The main factors in such high distribution are gentle slopes, which originated from fluvial processes and loose sediments of the Pliocene age. The remaining 15.5% of soils are low-quality soils stretched mainly in steep slopes found in escarpments and lake sediments in the region. Based on soil quality statistics, Kosova Plain has a considerable potential for agricultural production, which in the past and future should be a pillar or basis for agriculture. According to the land suitability map for Kosovo, in Kosova Plain, 66.6% of land is strictly reserved for agricultural production, 31.8% of land needs preservation, and the other 1.6% is land where no mechanized arable agriculture is possible or is a poor land.

Due to human impact, land cover changes are evident in Kosova Plain. As a flat region with gentle slopes, it is an attractive area for human activities. Over the years, the expansion of artificial infrastructure has settled down, which had a significant impact on the natural environment [31].

In Kosova Plain, there are 205 settlements of different sizes stretching from Mitrovica in the north to Kaçanik in the south. In the period between the census of 1948 in those settlements, 137,243 were living, while the population in the last census (2011) was 535,535 (Agency of Statistics of Kosova, 2013), with an increase of 3.9 times. The population in 2011 represented nearly 30% of the country's population. Distributed in 205 total settlements in Kosova Plain, their demographic size is different but also differ in function and other activities. Some of them, located near power plants, had their fate to be abandoned due to coal extraction for energy production. With the increasing population number, settlements located on the edges of the plain were extended toward the plain, which contributed to an increase in built-up areas and a decrease mainly in agricultural land.

Table 3. Soil quality classes in Kosova Plain.

Soil quality class	Area (km²)	Sum (km²)	%	Sum %
I	76.37	859,11	7.51	84.47
II	479.87		47.18	
III	201.53		19.82	
IV	101.34		9.96	
V	113.80	157,92	11.19	15.53
VI	39.83		3.92	
VII	3.93		0.39	
VIII	0.35		0,03	
	1 017.02	1 017,02	100.00	100.00

Kosova Plain is an attractive environment for living with its soil resources, diverse topography, healthy climate, and industrial activities. Even though they were from coal extraction, they created new jobs, and the population migrated toward cities. During 2000-2018, nearly all categories of CORINE Land Cover experienced changes in their destination. In general, there was an increase in artificial surfaces, which decreased agricultural land. This is the main conclusion of changes in recent decades.

In Kosova Plain, every category, except peat bogs and water bodies, changed between 2000-2018. There is an uneven shift of land cover due to rapid urban expansion, which is a decreased agricultural land, which is a crucial asset at the national level. Kosova is very diverse in morphography, with hills and mountains surrounding the plains in the middle.

Most changes happened to artificial surfaces (+87.84%), forests and semi-natural areas (-18.91%), and agricultural areas (-8.76%). Significant changes

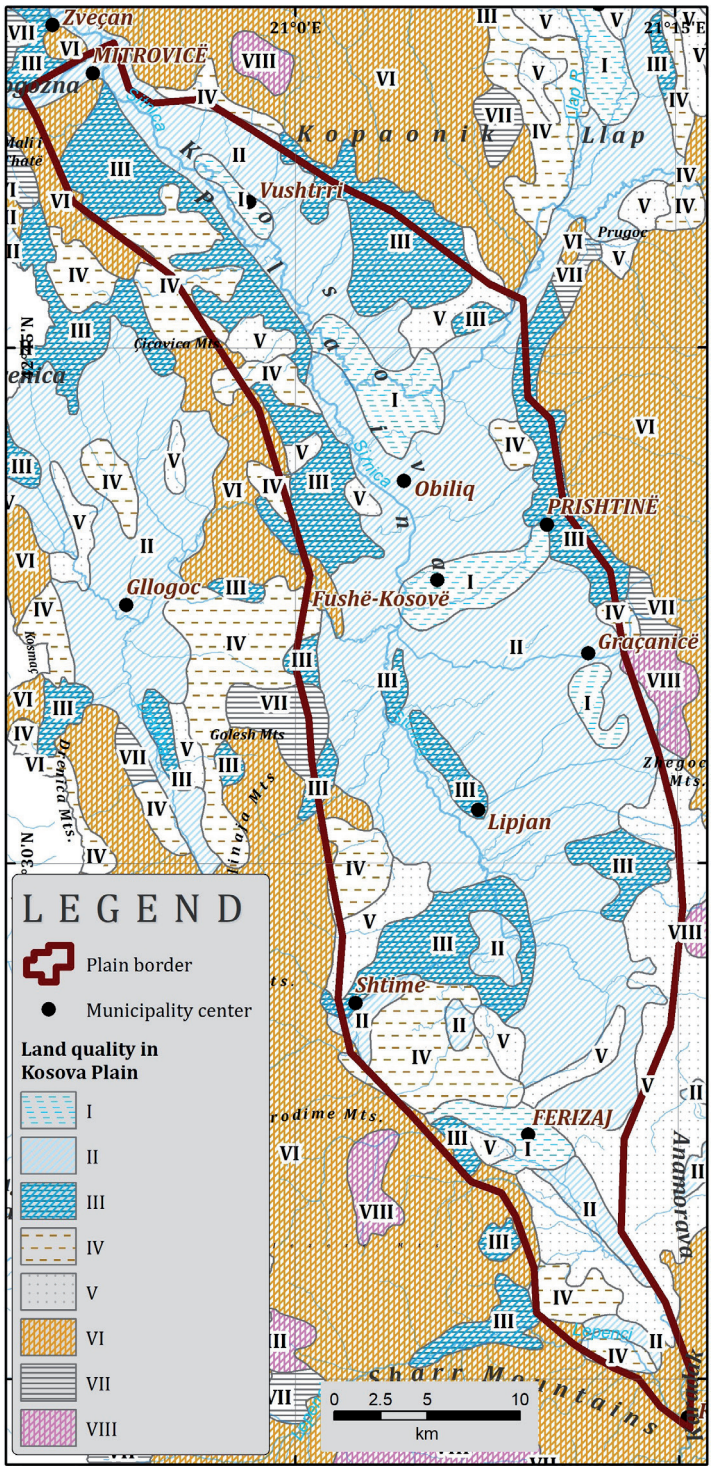

Fig. 4. Land quality map of Kosova Plain.

in artificial surfaces are made due to increased built-up areas in continuous and discontinuous urban fabric. Urban expansion shifted land cover with increasing impervious surfaces from 7,157 ha (1990) to 8,001 hectares (2000) to 14,655 hectares (2018) and 15,881 hectares in 2020 (Table 4). Extension of settlements in terms of new housing units and infrastructure have been seen as attractive areas for new investments. During the war in Kosovo (1999), many settlements were burned, and after that, new housing units on existing land were made. Municipality centers in terms of urban areas were most attractive for population migration,

Fig. 5. Ash dumps and barren land created in agricultural land for coal extraction.

Table 4. Land Cover classes through years in Kosova Plain.

CLC group	CLC description	2000	2006	2018	Changes 2000-2018
		Area (ha)			
Artificial surfaces	Continuous urban fabric			80,6	80,6
	Discontinuous urban fabric	8 001,8	10 677,3	14 574,7	6 573,0
	Industrial or commercial units	814,7	1 641,4	2 310,0	1 495,3
	Road and rail networks and associated land	25,9	25,5	191,3	165,4
	Airports	115,7	115,7	356,1	240,5
	Mineral extraction sites	959,7	635,1	961,7	2,0
	Dump sites	157,3	434,4	443,3	286,0
	Construction sites			51,7	51,7
	Sport and leisure facilities	41,2	32,7	32,7	-8,5
Agricultural areas	Non-irrigated arable land	47 670,9	47 322,5	49 743,9	2 073,0
	Vineyards	153,9			-153,9
	Fruit trees and berry plantations	244,7	282,1	231,9	-12,8
	Pastures	2 691,9	3 570,6	3 910,2	1 218,3
	Complex cultivation patterns	22 531,3	20 423,7	14 283,6	-8 247,7
	Land principally occupied by agriculture, with significant areas of natural vegetation	8 370,4	7 969,0	6 341,9	-2 028,5
Forest and semi natural areas	Broad-leaved forest	4 056,2	4 107,5	4 265,2	209,1
	Coniferous forest	169,8	171,9	186,5	16,8
	Mixed forest	181,1	255,0	247,7	66,6
	Natural grasslands	1 579,8	775,8	590,0	-989,8
	Transitional woodland-shrub	3 786,6	3 134,2	2 556,3	-1 230,3
	Burnt areas	93,8		155,8	62,0

Table 4. Continued.

Wetlands	Inland marshes		36,1	95,2	95,2
	Peat bogs		36,1	36,1	36,1
Water bodies	Water bodies	55,8	55,8	55,8	0,0
	Sum:	101 702,4	101 702,4	101 702,4	

which contributed to the extension of artificial areas, like Prishtina (capital) and suburb, Mitrovica, Ferizaj, Fushë-Kosova, Lipjan, Obiliq, Vushtrria, Shtime, Kaçanik, etc., where they experienced an increase of population number when in 2011 they contained 62% of the total population of Kosova Plain. When analyzing the specific category of artificial surfaces, discontinuous and continuous fabric had a significant increase from 83.15%, and it is essential to emphasize that these categories of land cover contain 76.7% of artificial surfaces. As studies revealed in many countries [31], agricultural land has lost its compactness and is fragmented. The area of built-up areas could be fewer if zoning maps were created and settlement extension was made by spatial planning.

Industrial and commercial units were the second category of artificial surfaces, with the highest increase in the last twenty years (+183.5%). Their distribution is mainly on both sides of the leading regional streets, which connect municipalities and regional centers. Their increase from 814 hectares in 2000 to 2,310 hectares in 2018 was made in agricultural lands where existing roads were constructed in the past. Most of the mineral extraction sites in the CORINE land cover category are made for the needs of power plants in Kosovo. Two main power plants, "Kosova A" and "Kosova B" are responsible for energy production for the whole country, while they work based on coal (lignite) extraction. Throughout the years, the existing coal mine was depleted, and a new coal extraction site was extended. A few hectares of mineral extraction sites are found near Gadime, where limestone is extracted, and west of plain magnesite and nickel is extracted for the needs of the Fe-Ni smelter in the Gllogoc factory. Dump sites were increased in the area, while most of them originate from Pb-Zn extraction near Badoc/ Kishnicë and coal extraction in Obiliq. Other categories of artificial surfaces that experienced an increase were road networks, airports, and construction sites, which cover 599 hectares. As a young country, it was a necessity to construct new roads to connect not only the settlements but also the regional road network. Prishtina International Airport, the only airport in the country, constructed a new runway, which was made on agricultural land. Anthropogenic landforms are created during coal mining, which can be distinguished in the Digital Elevation Model. The most distinguished are surface mining, ash deposits, and wasteland hills.

In Kosova Plain, the annual rate of built-up area extension was 4.87%, which, compared to Europe, is more significant. The main driving forces in Kosova Plain were extensive urbanization, especially for a country that was devastated during the war (1999), and the absence of construction zoning in urban and rural areas.

On the contrary, artificial surfaces, which experienced an increase in area, and agricultural areas had a decrease by -8.76%, or compared to the years 2000 and 2018, a decrease of 7,151 hectares. All three categories of agricultural area have changed throughout the analysis period. While non-irrigated arable land in 2018 increased by 4.35% compared to 2000, complex cultivation patterns and land principally occupied by agriculture decreased by 36.6%, respectively 24.3%. Non-irrigated arable land is distributed across Kosova Plain and is the leading category in Land Cover, covering 48.9% of the plain. Complex cultivation patterns are associated with the near-settlement areas, which are used as cultivation land for inhabitants of settlements or export. Their decrease in area is associated with the extension of built-up areas. Settlement located in plain areas in Kosovo has experienced a population increase, which resulted in the building of new houses and infrastructure. Of the total number of settlements in Kosova Plain (205), only 24 had experienced a decrease in population number, most of them are associated with coal extraction for energy production.

During the last century, but also today, its importance is in agricultural production, while at the national level, the area of agricultural land is declining. The main factor of decline is urban extension and road infrastructure. As mentioned above with built-up area analysis, the region as a plain with highly fertile soil was subject to population migration and industrialization based on coal extraction, which contributed to the decrease of agricultural land.

Pastures increased by 45% compared to the year 2000. Recently, their area in the region of Kosova Plain has been 3,910 hectares, and its trend shows an increase. The increasing pasture areas are linked with the central part of the plain, mainly in the sources of the Sitnica River (confluence of Shtimjanka R. and Sazlia stream), where in the past, it was like a marsh, but with decreasing groundwater level, it began to dry. Fruits and berry plantations have decreased by 12%. Favorable climatic conditions do not exist for vineyards. In the past, there were some 154 hectares of them, which have gone with time. Kosova Plain has more continental climate features than the western part of Kosova (Dukagjini Plain), where the impact of Mediterranean

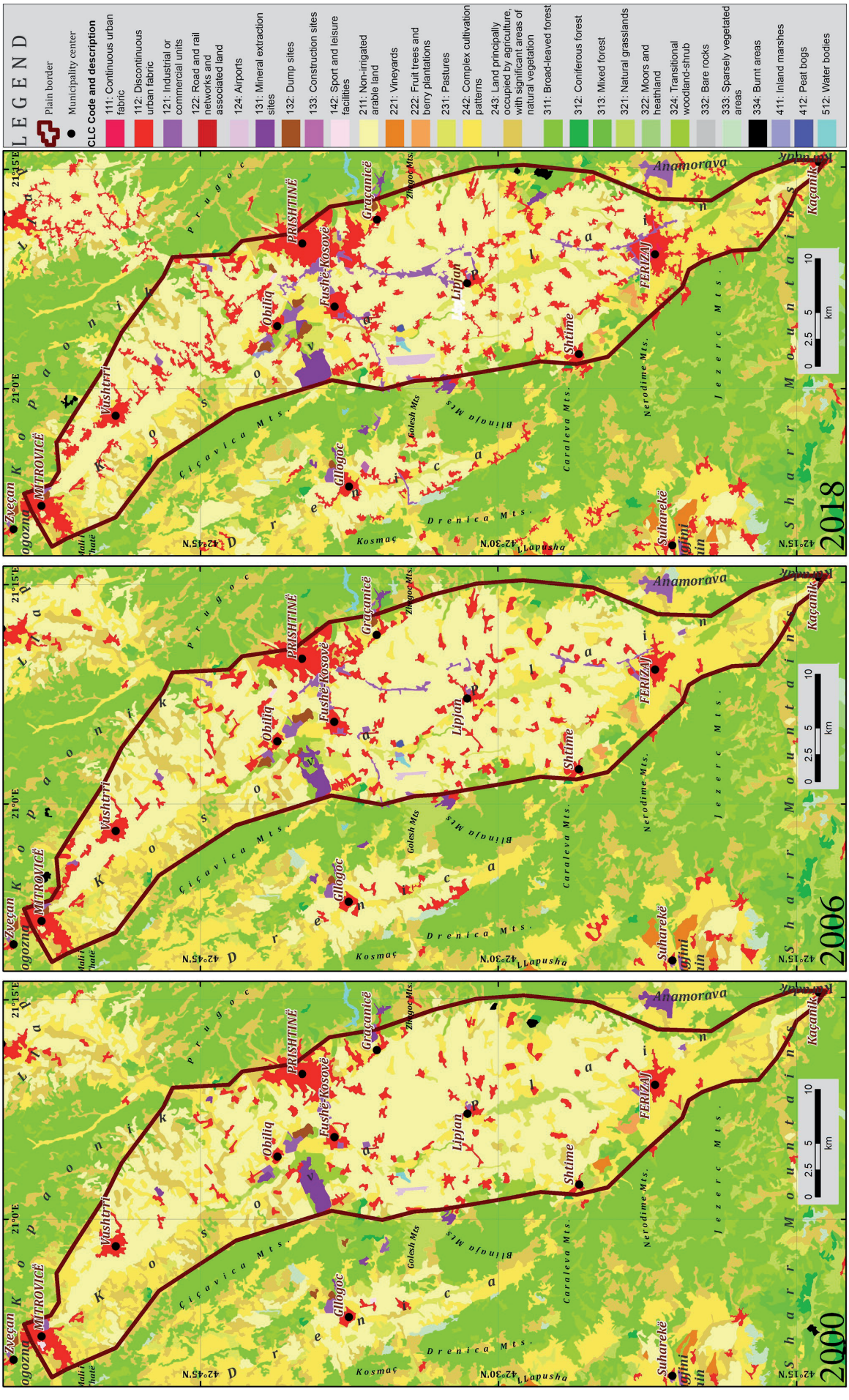

Fig. 6. Land cover changes in years 2000, 2006 and 2018.

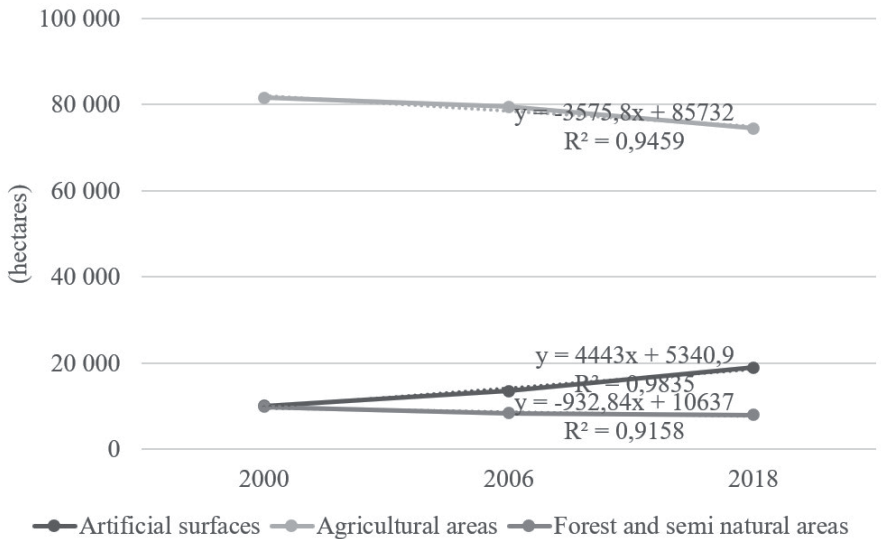

Fig. 7. LULC changes trend and statistical prediction.

climate conditions is observed.

Forests and semi-natural areas have changed by -18.91% over the last two decades. Broad-leaved, coniferous, and mixed forests are found in the periphery of the plain, mostly in isolated hills and on the foothills of surrounding mountains. Burnt areas compared to the year 2000, in 2018, increased during the forest fire. Compared to the two periods, the most affected were broadleaf forests, which account for more than half of the total at the national level [33]. During the analyzed period, they had a slight increase. Most changes appeared in transitional woodland shrubs and natural grasslands. This category of land cover has a wide distribution on Kosova Plian. In natural conditions, it is located on a small hill as an area between agricultural land and foothills. However, some areas are found near coal extraction open mines. Barren land removed from upper layers above coal deposits is transferred near the mine.

In the past, in Kosova Plain, wetlands in the form of inland marshes were common on both sides of the Sitnica River, which has a small longitudinal profile throughout its flow. With cultivation techniques, inland marshes were transformed into agricultural land, and only small patches are found today near the Sitnica River.

Globally, the 21st century marked an era with intensifying urbanization processes that have altered natural habitats and changed landscape layouts. In Kosovo, urban growth and settlement extension will continue to increase in areas, while agricultural land will decrease, jeopardizing the environment and food security. Nowadays, at the country level, some agricultural products are imported from another country, and with future projections, the situation will worsen. Most transformations were made in all plain areas in Kosova, which were densely populated in the past and now have increased the population by migration from hilly-mountainous areas, which resulted in the extension of built-up areas in the plain. Statistical analysis made R-squared shows that artificial areas will increase with 98% reliability. In comparison, agricultural land will decrease with 94% reliability (Fig. 7). Compared to data from the CORINE Land Cover program for 2018, the analysis made for 2020 shows an increase of artificial surface by 8.36%, mostly done towards agricultural lands.

Conclusions

In this study, spatiotemporal changes in Land Cover in Kosova Plain in the Republic of Kosova were analyzed based on the changes in CORINE Land Cover data for 2000, 2006, and 2018 and compared with some existing data for 2020. As one of the five crucial agricultural lands in the country, Kosova Plain has experienced changes throughout the analyzing period (2000-2018). As a result of fast urban growth, a process intensified by population migration, building infrastructure, and coal extraction, agricultural land decreased by 8.76% for the analyzed period. In comparison, artificial surfaces were increased by 87.84%, or with an annual rate of 4.87% above the European level. It is a well-known fact that in Kosova Plain are found 3 out of 7 regional centers of Kosova, which experienced an increasing population in the last 20 years. Because of coal deposits found in near-surface mines, coal extraction is made by removing barren land, which at the same time is transferred near the mine area, and has a double negative contribution to agricultural land: firstly removing for coal extraction, and secondly in the creation of barren land (dump site). Main regional roads stretched through agricultural land in Kosova Plain, and they were attractive for road and commercial units, as it was for airport runway extension.

At the national level, Kosova has 0.25 ha/inh., near the threshold for agricultural land per capita (0.17 ha/inh.). With the latest trends of increasing artificial surfaces and decreasing agricultural land, food security for the future will be a national concern. For the future, from the national level to the municipality level, agricultural and development policies should be adapted and implemented in the field in order to protect agricultural land while saving its sustainable ecological status. Zoning of construction sites will help reduce the rate of increasing artificial surfaces.

Conflict of Interest

The authors declare no conflict of interest.

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