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ANALYZING THE LAND USE AND LAND COVER CHANGING DYNAMICS IN THE MYZEQE PLAIN OF ALBANIA, USING GIS/RS, FOR THE PERIOD 1991-2020

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A B S T R A C T

The political change in Albania in 1990 impacted social and economic activities. As a consequence, it affected the dynamics of Land Use, especially in rural settlements, whose main economic activity is Agriculture. Myzeqeja Pain, located in the south of the Western Lowland region, was also affected by these changes, which are also reflected in its LU/LC patterns.

The main objective of this study is to detect and analyze the dynamics of changes in Land Use and Land Cover of Myzeqeja Plain using GIS/RS. It also focuses on the impact of human and natural factors on these dynamics and patterns. The processing of Copernicus database, through GIS techniques, brings a set of scientific results on the changes undergone and the current state of land use and cover in the Myzeqe Plain.

Over the last 30 years, agricultural land in the Myzeqe Plain has decreased, while uncultivated farmland has increased. Demographic changes, migration, and limited market access are among the primary factors driving this trend. This paper has a new approach to land dynamics in Myzeqe Plain, creating a new database ready to be used in various studies, as well as in preparing for future challenges or for strategic management.

1. INTRODUCTION

Land use and land cover are intertwined concepts in physical and human geography. Land cover refers to the physical characteristics of the Earth's surface, encompassing various forms of vegetation—both natural and cultivated—as well as anthropogenic structures. Meanwhile, land use refers to the organization, activities, and interventions undertaken by humans on specific land cover types, aimed at producing, modifying, or conserving these environments (Zhang et al., 2016). This delineation underscores the direct relationship between

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land cover and human actions, highlighting the influence of human activities on environment.

The advent of Geographic Information Systems (GIS) and the utilization of satellite images have revolutionized geographic research, providing robust methodologies for analyzing spatial phenomena (Jin et al., 2013). Remote sensing serves as a versatile tool applicable across both physical and human geography, facilitating comprehensive assessments of land cover dynamics and use (Pettorelli et al., 2014). Remote sensing, in particular, has emerged as a critical technique for monitoring land cover changes, owing to its capacity to deliver timely, large-scale, and accessible data regarding the spatial variability of terrestrial environments (Lu & Weng, 2007) .

This study aims to implement these advanced methodologies to investigate land use and land cover changes in the Myzeqe Plain of Albania over the past three decades. By employing GIS/RS technology, the main objective of this research is to provide a detailed analysis of the temporal and spatial transformations within this region, thereby contributing to a deeper understanding of the interactions between human activities and land cover dynamics (Ferrelli et al., 2018).

The integration and use of GIS/RS technology have been proven to be essential for monitoring land cover changes. For instance, Wang et al. highlight that remote sensing technology is advantageous for its comprehensive, dynamic, and rapid capabilities, making it an economical and effective means for detecting land cover changes (Wang et al., 2019). Jin et al. further elaborate on the importance of systematic change detection methods for updating national land cover databases, which can be applied to various geographical contexts, in our case in the Myzeqe Plain (Jia et al., 2014).

The application of these methodologies will facilitate a comprehensive understanding of the land use dynamics in the Myzeqe Plain, thereby contributing to effective land management and planning strategies.

2. STUDY AREA AND METHODOLOGY

2.1 Study area

The Myzeqe Plain is part of the physical-geographical region of the Western Lowlands and is the largest surface unit, covering approximately 158,680 hectares. It extends from the Kavaja Cliff to the vicinity of Vlorë, to the hills of the Middle Erzen, the karst area of Dumrea, and the hills of Berat and Mallakastër. The Myzeqe Plain is divided in the Great Myzeqe and the Small Myzeqe, located in the lower sectors of the Shkumbin, Seman, and Vjosa rivers. In the central part, there is also a hilly range oriented in a north-south direction (Figure 1)(Qiriazi, 2011).

2.2 Methodology

The database selected to analyse land cover and land use in the Myzeqe Plain consists of satellite images from various satellite missions. For the period 1991–2005, the data source is the Landsat-5 (TM) satellite, and for the year 2013, the satellite images come from the Landsat-8 satellite of the USGS mission.

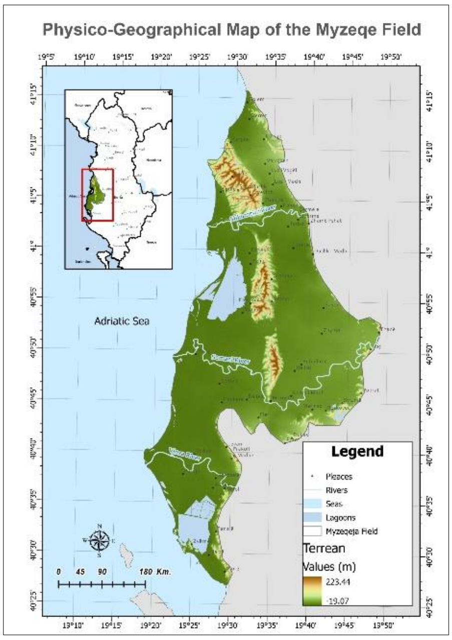


Figure 1. Map of Myzeqe Plain

The satellite images were downloaded from the official USGS website (U.S. Department of the Interior, 2024). The resolution of the satellite images from 1991 to 2013 is 30 meters per pixel.

For the period 2013–2020, the satellite images are from the European Copernicus satellite mission via the Sentinel-2b satellite, with a resolution of 10 meters per pixel(Copernicus_Browser, 2024).

To minimize the atmospheric blurring effect of satellite images, cloud cover was reduced to 10% by selecting cloud-free days. This ensures that the satellite images are suitable for processing, leading to more accurate results. The satellite images were processed using Geographic Information System (GIS) software. After selecting the satellite images, each image, consisting of a specific number of bands (layers), which represent different spectral visualizations, undergoes a composition process where these layers are combined to create a single image. This image allows for the combination of layers, enabling the generation of an "IR - Infrared" image.

Using the infrared image, the data training process begins, where the created polygons, representing specific vegetation types or other selected land cover classes for the Myzeqe Plain, are interpolated across the entire selected image based on point values of the same class.

This interpolation generates the initial land use and land cover image for the Myzeqe Plain.

In Figure 2 are shown the processing steps in GIS for satellite images to produce the land use and land cover map and in Table 1. are the elements that were processed. The processing of satellite images continued with training the data with polygons according to layers is necessary in order to separate the layers based on land cover and land use. Considering the territory of the Myzeqe Plain, in Table 2 is the classification of layers or land use and land cover.

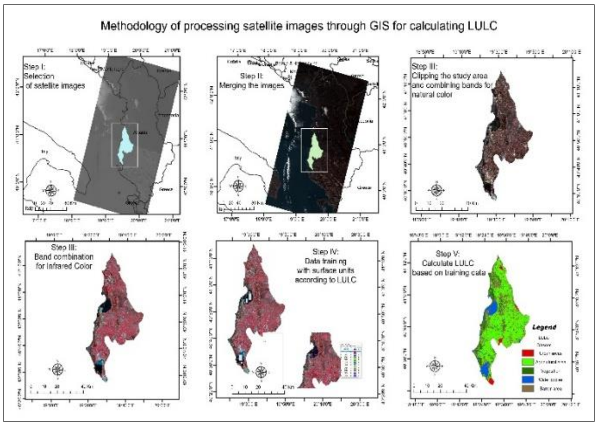


Figure 2. Satellite Image Processing Steps in Geographic Information Systems

Table 1. Elements Processed from Satellite Images

Year	Sateliti	Resolution	Band combination
1991	Landsat 5	30 m	4, 3, 2
1995	Landsat 5	30 m	4, 3, 2
2000	Landsat 5	30 m	4, 3, 2
2005	Landsat 5	30 m	4, 3, 2
2013	Landsat 8	30 m	5, 4, 3
2020	Sentinel 2B	10 m	8, 4, 3

Table 2. Classification of land use and cover in the Myzeqe Plain

Land cover layer	Types of land cover
Water bodies	Rivers, lakes, swamps, reservoirs, etc.
Agriculture land	Land used for agriculture purposes
Vegetation	Forests and bushes
Uncultivated farmland	Bare and unused land areas
Urban areas	Residential and social areas

The accuracy assessment of satellite data is one of the key aspects of obtaining precise scientific results. The satellite image database used has a cell resolution of 30m and 10m. This satellite image resolution has weaknesses, primarily in the identification of urban areas. To address this issue and improve the accuracy of urban area delineation, high-resolution satellite images from the most recent Google Earth platform have been used. Through this approach, the geographic spaces of urban areas have been digitized and integrated into land use and land cover maps using various geospatial techniques.

This method allows for the comparison of processed data with the most recent high-resolution Google Earth images, ensuring greater accuracy in the processed material.

3. RESULTS AND DISCUSSIONS

During the period 1991-2023, land use and land cover in the Myzeqe Plain have undergone significant changes, especially in urban areas, which have progressively expanded. This trend has been driven by population movements, particularly after the 1990s, when political changes in Albania enabled free movement of people. Internal migration dominated the country, leading to population growth in the Western Lowlands of Albania. Cities experienced an expansion of urban spaces, while agricultural areas were affected by unregulated construction, resulting in partial disorganization of land designated for agriculture.

In recent years, due to emigration, a decline in agricultural land has been observed as a consequence of population movement abroad. Vegetated areas and fallow land have continuously undergone sporadic development depending on human activities. In Table 3 are in percentage the values of different areas representing land use and land cover of Myzeqe Plain.

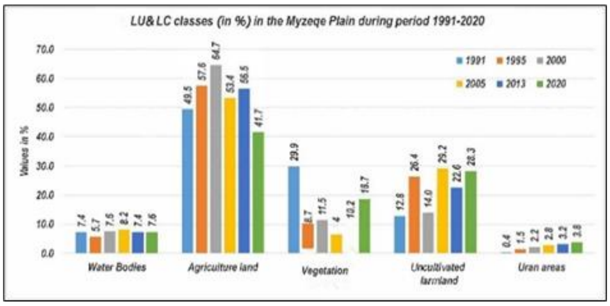
Table 3. Land use and Land cover of Myzeqe Plain period 1991-2020

Years	Water bodies	Agricultural land	Vegetation	Uncultivated farmland	Urban areas
1991	7.4	49.5	29.9	12.8	0.4
1995	5.7	57.6	8.7	26.4	1.5
2000	7.6	64.7	11.5	14.0	2.2
Change in %	**0.3**	**15.2**	**-18.4**	**1.1**	**1.8**
2005	8.2	53.4	6.4	29.2	2.8
2013	7.4	56.5	10.2	22.6	3.2
2020	7.6	41.7	18.7	28.3	3.8
Change in%	**-0.6**	**-11.7**	**12.3**	**-0.9**	**1.0**

As highlighted earlier, the transition in Albania's political system after 1990 led to a significant abandonment of agricultural land. This socio-economic shift accounts for the observed 15.2% increase in agricultural land between 1991 and 2000. However, a contrasting trend is evident from 2000 to 2020, during which 11.7% of this land was lost, reflecting the impact of urban expansion and land-use transformations. The extent of fallow land has remained relatively stable over time.

Vegetated areas have exhibited varying trends over the past three decades, with an initial decline of 18.4% in the first decade, followed by a subsequent increase of 12.3% between 2000 and 2020.

Graphic 1 presents a temporal analysis of land cover and land use changes in the Myzeqe Plain from 1991 to 2020. The graphical representation underscores the continuous expansion of urban areas throughout the study period, accounting for a 2.4% increase in the total physical-geographical extent of the region.



Graphic 1. LU&LC classes (in %) in the Myzeqe Plain (1991-2020)

In agricultural regions, a notable land-use transformation has been observed. The expansion of built-up areas has predominantly taken place on agricultural land. Over the period from 1991 to 2020, agricultural land has decreased by 9%, while uncultivated farmland has increased by approximately 16%. Figure 3 is a map of LULC of Myzeqe Plain in 1991, which shows the distribution of different classes and it is visible that the urban areas are very small and isolated.

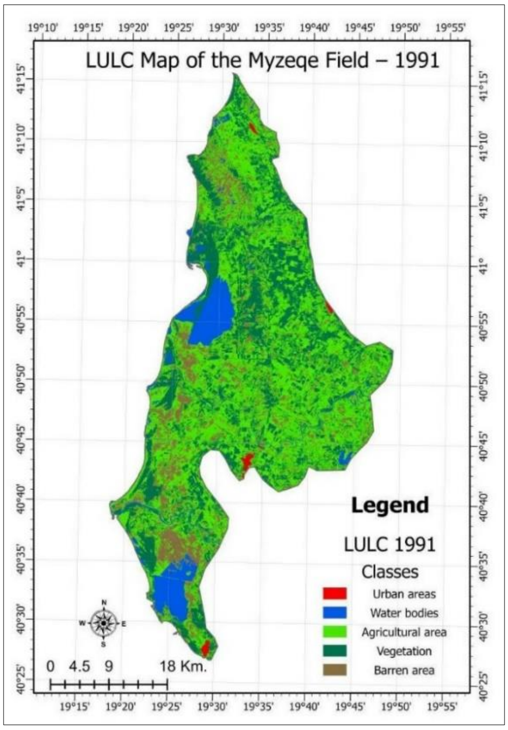


Figure 3. Map of LU&LC of Myzeqe Plain in 1991

Further analysis of the spatial distribution of land cover and land use in the Myzeqe Plain is presented in Figure 4, which displays the LULC map for year 2020. In this map it is evident the urban expansion that has happened in this area, which has been particularly evident in cities such as Kavaja, Lushnja, Fier, and Vlora, with a significant acceleration after the early 2000s. The spatial analysis of urban growth patterns reveals an increase in settlements within rural areas, contributing to higher population density. Many of these new settlements have developed in an unplanned manner, and their emergence is distinctly visible in cartographic representations.

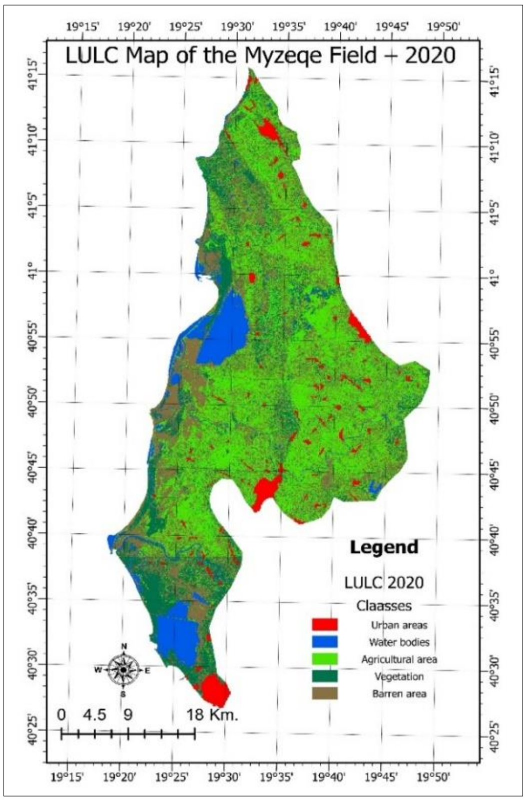


Figure 4. Map of LU&LC of Myzeqe Plain in 2020

The assessment of land cover and land use change in the Myzeqe Plain was done by using satellite imagery and geospatial analysis to evaluate the spatial distribution and directional trends of landscape transformations from 1991 to 2020.

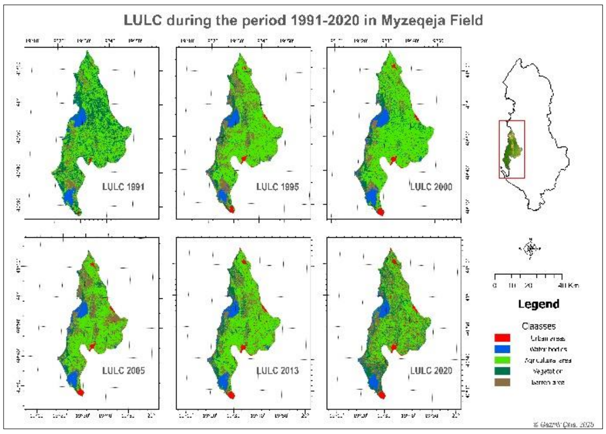


Figure 5. Map of LU&LC of Myzeqe Plain in 1991-2020

Figure 5 presents a collection of maps for different years in the period 1991-2020,which shows the changes in the Landuse and Landcover of Myzeqeja Plain by facilitating the temporal analysis of landscape dynamics across different years and locations of Myzeqe

Plain. The findings indicate a widespread expansion of vegetated areas, alongside a transition from vegetated land to uncultivated farmland. Additionally, both the graphical and spatial analyses highlight the gradual expansion of urban areas, while agricultural land exhibits a persistent contraction trend.

4. CONCLUSIONS

Conclusions are:

- Over the last 30 years, agricultural land in the Myzeqe Plain has decreased by 9%, while uncultivated farmland has increased by more than 15%.
- Demographic shifts, migration, and limited market access are among the primary factors driving this trend.
- Main changes have been noted in the vegetated areas, which have declined by 11% from 1991 to 2020.
- The main driving factors in these changes have been the urban expansion and the increasing allocation of land for road infrastructure.
- The geographical area of the Myzeqe Plain has experienced continuous urban expansion, characterized by spontaneous and unplanned development trends across the region.
- The use of GIS/RS technologies provides an in-depth analysis and predictions for the future, focusing on the administrative territories of the municipalities that comprise the Myzeqe Plain.

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