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Investigation of temporal changes of green field changes using image processing and geographic information systems: The case of Bayburt Province

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ABSTRACT

Today, the environment is moving away from its natural structure mainly as a result of human-induced effects and environmental resources continue to be depleted rapidly. These human-induced changes in the environment should be determined and necessary precautions should be taken. Contrary to other time-consuming methods, Geographic Information Systems used for this purpose provide great convenience in determining these changes in the environment. In this study, basic image processing techniques were used to determine the changes in the land cover in Bayburt province and its surroundings. The temporal change in the land structure was determined by using Landsat satellite images obtained every 5 years between 2000 and 2020. The change in the multi-time Landsat satellite images has been interpreted with the help of the prepared software, and in this context, various suggestions for the future have been listed.

Introduction

In addition to the rapid population growth in the last century, agricultural activities, industrial production, etc., in order to meet the needs of the increasing population, is growing and diversifying rapidly. As a result, the environment we live in is moving away from its natural structure as a result of human-induced effects and environmental resources are rapidly depleted [1-2]. In Turkey, where land use changes very rapidly, lands are irreversibly destroyed as a result of the destruction of forests and pastures and the uncontrolled and uncontrolled use of fertile agricultural lands [3-5]. Today, in order to meet the basic food needs of the increasing population, forest areas are opened to agriculture, meadow and pasture areas are under uncontrolled pressure with the increase in the number of animals, and ecological destructions often occur in the lands with the proliferation of residential areas. As a result of this sequence of events, ecological stress increases and the rate of renewal of forests decreases and the yield of grass decreases [2,6]. Knowing what form this change will take will help determine the population and its needs in the future. Therefore, it is necessary to monitor these changes on the land and take the necessary precautions [7]. For this purpose, when compared to classical methods, monitoring studies using satellite images give more successful results in a shorter time [8]. In this study, Landsat satellite images were used and it was aimed to determine the temporal change in the land structure with the help of image processing. The change in the multi-time Landsat satellite images has been determined with the help of the prepared software, and various suggestions for the future have been listed in this context.

Material and method

Location and climatic conditions of the study area

Bayburt is located between latitudes 40° 37' north and 39° 52' south and longitudes 40° 45' east and 39° 37' west, and the study area is shown in Figure 1. In Bayburt, a transitional climate prevails between the Eastern Black

Sea climate and the Eastern Anatolian climate, dominated by terrestrial characteristics. For this reason, summers are hot and dry, and winters are cold and rainy. However, the climate is mild compared to Eastern Anatolia, thanks to the low average altitude and the microclimate created by the valleys system. Summer days usually appear between May and September. The number of rainy days in Bayburt is 102, and the average precipitation is 433.4 mm. The highest temperature is 36.2°C and the lowest temperature is -26.2°C, and the average temperature is 7°C. Although Bayburt is diverse in terms of vegetation, it is not rich. 27% of the provincial land is arable land, 2% is meadow, 3% is forest, 49% is pasture and plateau, and 19% is rocky and steppe [9].

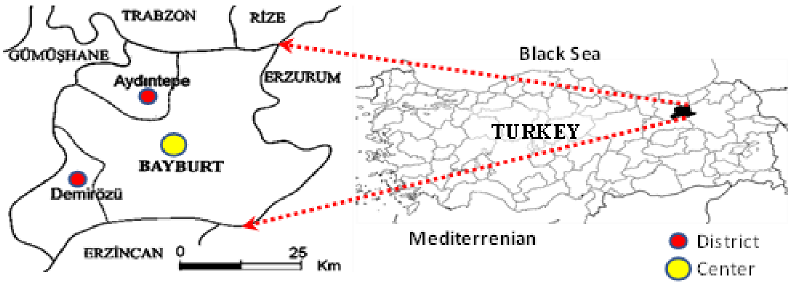

Figure 1. Location of the study area

Evaluation of the Study Area

Satellite images obtained from the Landsat satellite program were used in the study. Satellite images were taken from the same location at five-year intervals in the same month between 2000 and 2020. Matlab 2020b version was used to process the obtained images.

Results

In the study, satellite images obtained for every 5 years between the years 2000-2020 were obtained. Using satellite images, the study area in which Bayburt and its surroundings are located was determined as 6879 km^2. Then, the images obtained were used in the image processing stage by using the codes prepared in the Matlab 2020b program. In the image processing stage, firstly, satellite images obtained using RGB (red, green, blue) color space were converted to HSV (hue, saturation, value) color space for ease of operations. Then, the process of determining the green areas in Bayburt province and its surroundings by Color Tresholding method was carried out. This process was carried out by applying a mask to all colors except the color components in green tones. Then the images were converted to black and white to ensure the separation of green and other colors. In this way, the total number of pixels representing green areas was calculated. In addition, the original, masked and black and white transformed images by years are shown in Table 1.

Discussion

After the image processing stage, the amount of green and non-green areas obtained by years and the percentage distribution of green areas are given in Table 2.

When Table 2 is examined, 5246 km^2 of green areas and 1633 km^2 of non-green areas were calculated in 2000. When these figures are calculated, it is seen that green areas accounted for 76.26% of the total working area in 2000. In the following years, this rate is seen to be 75.35%, 74.59% and 72.21% in 2005, 2010 and 2015, respectively. By 2020, this rate was calculated as 73.90%. From 2000 to 2020, the total green area decreased from 5246 km^2 to 5084 km^2.

Conclusion

When the results obtained in the study are examined, it is seen that the green areas in Bayburt province and its surroundings have been in a continuous downward trend for the last twenty years. In order to prevent or slow down this decline, in summary, factors that may cause climate change should be reduced and uncontrolled meadow pasture grazing should not be done.

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Conflicts of interest: The authors declare no conflicts of interest.

Table 1. Original, masked and black and white satellite images by year

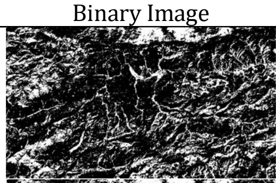
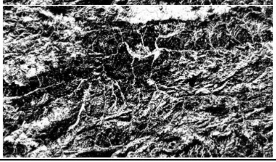
Years	Satellite Images	Color Treshold (Masked Image)	Binary Image
2000			
2005			
2010			
2015			
2020			

Table 2. The amount of green and non-green areas obtained by years and the percentage distribution of green areas

Years	Green Zones (km^2)	Non-Green Zones (km^2)	Green Zones (%)
2000	5246	1633	76.26
2005	5183	1696	75.35
2010	5131	1748	74.59
2015	5105	1774	74.21
2020	5084	1795	73.90

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