Intercontinental Geoinformation Days

http://igd.mersin.edu.tr/2020/

The application of GIS in the selection of suitable areas for afforestation of Konya

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Keywords
GIS
AHP
Afforested

ABSTRACT

In order for the land management to be applied correctly and effectively, importance should be given to the location selection studies. Determining the most suitable area according to the purpose and initiating studies will provide social and economic gain for our country. As forest areas occupy large lands, it is actually a necessity to determine the areas to be afforested by site selection. In the study, Konya province, which has an arid and semi-arid climate, afforestation area selection was made using Geographical Information Systems (GIS) and Analytic Hierarchy Process (AHP) method. Six different criteria were determined as precipitation, land use capability (LUC), large soil groups (LSG), rainfall, slope, aspect, and erosion. It has been determined that 15% of the study area is the most suitable for the afforestation area, 25.52% is suitable, 28.95% is medium, 12.76% is low and 17.77% is very low. The fields obtained were presented to the public with the help of the website created. The spatial appearance of these areas, which are deemed suitable for tree planting, is expected to increase tree planting activities.

1. INTRODUCTION

With the beginning of the 2000s, technology has made a rapid entry into our lives and the existing industrialization has increased. With these developments, technology and industrialization have increased the comfort it provides to human beings while increasing the damage to nature and the environment. Problems such as global warming, depletion of the ozone layer, increase in environmental and air pollution, noise pollution, climate change, and the increase of greenhouse gases in the atmosphere have started to threaten nature. These problems are solved directly or indirectly with the help of afforestation studies. Therefore, some researches have been carried out under the name of afforestation studies (Hossain and Lin, 2003; Gilliams et al 2005; Eslami et al.; 2010, Kantarcı et al 2011; Çelik, et al, 2016; Tonguç et al, 2017; Muğla and Türk, 2020). In these studies, it was emphasized that many current problems can be solved by increasing afforestation studies. The primary goal of afforestation studies is to maintain sustainability. To ensure sustainability, the site selection of the area to be planted is very important. Therefore, in this study, afforestation area selection was made using Geographical Information Systems (GIS) and Analytic Hierarchy Process (AHP) method in Konya. Within the scope of the study, six different criteria were determined as precipitation, land use capability (LUC), large soil groups (LSG), rainfall, slope, aspect, and erosion. As a result, suitable areas for afforestation map for Konya province was obtained. Next 10 sample areas were selected from among the most suitable areas to be afforested spatially, attribute information was integrated into these areas and a questionable platform was created on the web.

2. MATERIALS and METHODS

2.1 Study Area

Konya is the biggest city of Turkey with respect to the surface area which covers 5% of the total surface area of Turkey. Konya is geographically situated between 36.51 and 39.51 north latitudes and 31.51 and 34.51east longitudes. Since it has an agricultural area of approximately 3.5 million ha and the annual average rainfall is around 300-350 mm (Yılmaz, 2017).

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Cite this study

Yağcı C. & İscan F.(2020). The Application of GIS in the Selection of Suitable Areas for Afforestation of Konya. Intercontinental Geoinformation Days (IGD), 204-207, Mersin, Turkey

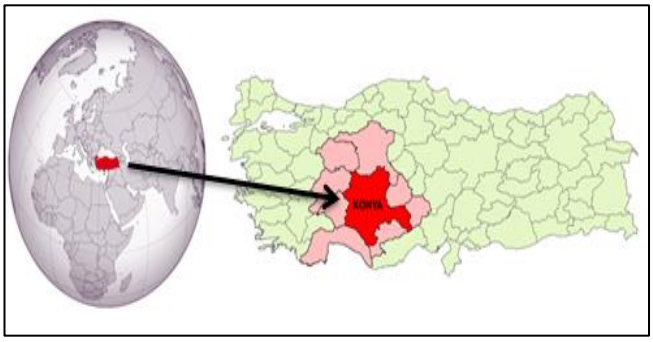

Figure 1. Study Area

2.2 Spatial Database

Land Use Capability (LUC)

Lands are divided into 8 classes according to their ability to use. It is classified between the 1st and the 8th grades according to the decrease of their suitability for agricultural production starting from the 1st grade to the 8th grade. 1st class, 2nd class, 3rd class and 4th class areas are considered suitable for agriculture and these areas are not used legally for afforestation studies.

Large Soil Groups (LSG)

In Konya, there are five types of soil in density: alluvial soil, brown soil, brown forest soil, lime-free brown forest soil, chestnut colored soil .An evaluation has been made among these soil groups**.**

Rainfall

If there is no rain and irrigation activities do not take place, the yield and growth of plants and trees will decrease. Since Konya is a region with low precipitation, the regions with 430-530 mm of precipitation where precipitation is ideal have been taken as the most suitable areas for afforestation works.

Aspect

In terms of geography, aspect is generally defined as the part of a slope, a surface facing the sun or the direction of receiving sunlight in mountainous areas. The sun rays in Baku were taken as the northeastern, north and northwestern ones that are the most suitable for afforestation or among others**.**

Slope

Slope is very important in terms of agricultural and afforestation works. In places where the slope is very low, it can have a negative effect in terms of drainage. According to the researches, slope intervals between 4% - 9% slope values have been determined as suitable for afforestation studies. It is not desired that there is no slope and the slope value is more than 30%.

Erosion

Two types of erosion have been investigated, namely water erosion and soil erosion. Separate classification has been made for erosion degrees and wind erosion.

2.3 Determination of the most suitable areas to be afforested using AHP method.

The AHP (Saaty, 1980) has found its way into various decision areas. It compares alternatives pair-wise, finds a complete ranking of the alternatives, and provides an overview of the complex relationships between decision elements (i.e., criteria and alternatives) by structuring them into hierarchies. An important step in this method is the construction of an evaluation matrix for each criterion, within which the values of the attributes of the different alternatives are compared amongst each other in pair-wise fashion. Each comparison is based on a verbal or numerical (ranging from 1 to 9) scale.

Table 1. Comparison matrix and weights of layers

LAYERS	1	2	3	4	5	6	Ağırlıklar
LUC	1						0.36
(LSG)	1	1					0.36
Rainfall	1/5	1/5	1				0.14
Aspect	1/7	1/7	1/5	1			0.05
Slope	1/9	1/9	1/7	1/3	1		0.03
Erosion	1/7	1/7	1/3	3	5	1	0.08
(CR)				0.08459			

The weights of each criterion (Table 1) were calculated using the paired comparison matrices created. The consistency rates of paired comparison matrices were found below 0.10. The map of the study area was produced by collecting all layers by using the weighted sum overlay method in ArcGIS software with the obtained weights (Figure 2).

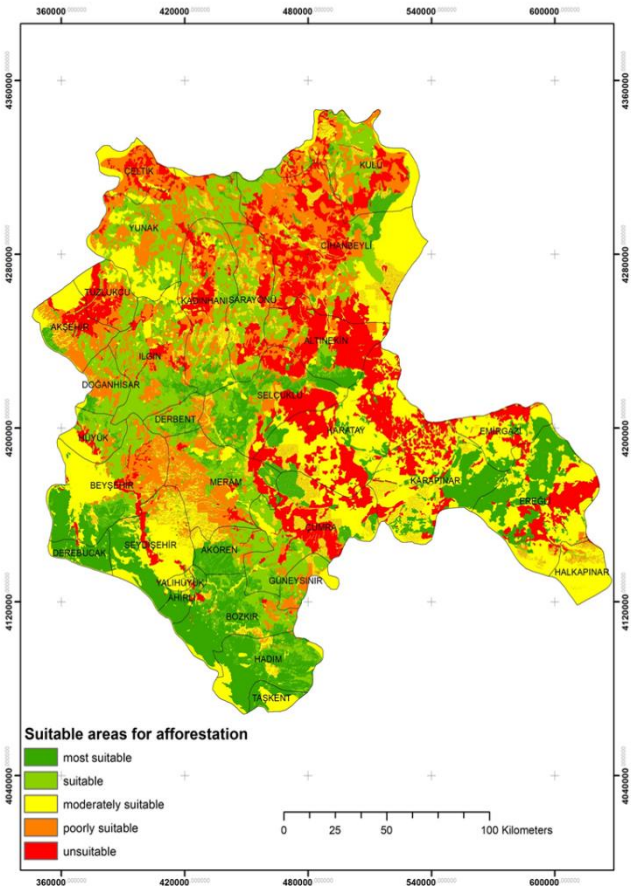

Figure 2: Suitability map of the area to be planted with trees produced using AHP

2.4 Website design

After the determination of the areas to be afforested in Konya the information on the suitable areas for afforestation obtained as a result of the study was displayed on the website with the "html code" created using the blogger website. The location of the suitable areas, the capacity of the fields, which type of saplings are suitable for planting, and when the planting begins, is made available to everyone at https://konyagac.blogspot.com/.In addition, information about the transition to the websites of the General Directorate of Forestry and TEMA (The Turkish foundation for combating erosion reforestation and the protection of natural habitats) and the sapling planting stages were shared with the public in order to get information on the site (Figure 3).

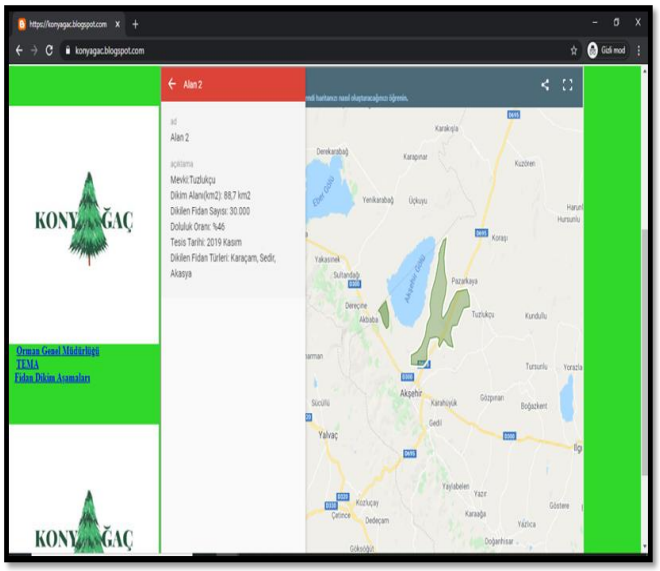

Figure 3: Sample view from the website

3.RESULTS and DISCUSSION

Afforestation studies have gained importance in recent years in order to reduce the negative effects of industrialization and urbanization on the environment in cities. While developing technology causes the relationship with the environment to shake, on the other hand, it helps to eliminate this negativity. One of these Technologies is GIS it is a powerful tool for environmental data analysis and planning. In this study, the suitable location selection of the areas that can be afforested in Konya is determined by GIS and presented on the web. In the evaluations made in the areas that can be afforested according to the AHP method for Konya province, it has been determined that 15% of the study area is the most suitable for the afforestation area, 25.52% is suitable, 28.95% is medium, 12.76% is low and 17.77% is very low. The map showing these determined areas and the boundaries of Konya district were overlapped (Figure 2) and the distributions of the areas that can be afforested in the districts of Konya were determined. Derebucak, Ahırlı, Bozkır, Hadim, Akören, Derbent districts, south of Seydişehir, south of Seydişehir, south-east of Karapınar and north-facing areas of Ereğli were found to be suitable for afforestation. In the central districts, it was observed that the west of the Selçuklu district, the north and north east of the Meram district were suitable for afforestation, and the Karatay district was moderately suitable and unsuitable for afforestation. By determining the areas to be afforested, and combining the information of the sample areas among the areas deemed appropriate positionally, a platform open to everyone was created on the web. With this platform, which is broadcast on the internet, it has been ensured that different users can access other services and other platforms simultaneously. A web map is more than just any map because it makes GIS more accessible, more affordable and more common.

4.CONCLUSION

In this study, the map of the areas to be afforested in Konya province was produced by using AHP method and GIS. This map was created from, land use capability (LUC), large soil groups (LSG), rainfall, erosion, aspect and slope map using 6 factors. The map produced was classified in 5 categories as "most suitable, suitable, moderately suitable, poorly suitable and unsuitable areas. As a result of the study, it was observed that the south and south west of Konya are more suitable for afforestation. In the second stage of the study, 10 different areas determined from these maps were presented to those who wanted to plant trees on the internet. It is thought that this pilot application theme can be further developed with the participation of the Ministry of Forestry and local people in such studies.

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