Comparison of the land uses on the Island of Skiathos, Greece

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Abstract— ***The island of Skiathos has a total area of 50 sq. Km, accounting for 1.6% of the area of the prefecture of Magnesia and 0.28% of the Region of Thessaly, Greece. The land is hilly and attributed to farmland, meadows, woodlands, on land covered by water and land occupied by settlements and roads. Also, a large part occupied by burnt areas resulted from the fire of 2007. The aim of this paper is to present the progress of the existing land uses at the Island of Skiathos for the last decades. With the contribution of Geographic Information Systems (GIS) and the orthophotomaps, the spatial planning of the land uses can be evaluated for all these years and the total area can also be calculated. Our results are important for understanding the impacts of land uses on ecosystems in the frame of sustainable development. In the past there wasn't other research about the land uses of Skiathos Island and also is the first digitization of the area.***

***Index Terms*— GIS, land uses, area, Island, thematic maps**

I. INTRODUCTION

Over the last decades, European ecosystems have altered substantially as a result of socio-economic and political changes [2], while future transformations are also expected to occur [5]. European Mediterranean landscapes, have experienced major land cover/land use (LCLU) changes as a result of relocation of people to coastal areas, forest fires, rural depopulation, open mining, logging, rapid expansion of activities related to tourism, and intensification of agriculture [1,4,6,8,9]. Environmental and ecological consequences of landscape transformation are more evident in natural ecosystems where their sustainability, multi-functional role and values are threatened [3,7]. The purpose of this article is to apply the changes of land uses for the last decades for the Island of Skiathos and also make a prediction for the land uses change for the year 2020. The comparison of the land uses have been made with the tool of GIS and orthotophotomaps. Moreover, for making the prediction, we have been used the model of cellular automata and two indicators. Our results are important for understanding the impacts of land uses on ecosystems in the frame of sustainable development. In the past there wasn't other research about the land uses in Skiathos Island and also is the first digitization of the area. Finally, in the future we would use these results for making the spatial plan for the Island of Skiathos.

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II. MATERIALS AND METHODS

A. Study area

The island of Skiathos belongs to the territorial unity of the Northern Sporades and the capital is the city of Skiathos. It is 2.4 miles from the coast of southern Pelion and 4 miles from Skopelos. The area is about 49,89 Km^2 while the length is 12 Km and the width is 9 Km. Within the administrative boundaries of Skiathos island including smaller islands Tsougria, Small Tsougrias, Repio, Aspronisi, Maragos and Arcos. The population of the island, in 2011, was 6.088 and the density was 122people/km2. Mediterranean climate prevails in Skiathos with cold winters and pleasant summers. There is almost complete absence of rainfall during the summer months. The temperature during July and August often exceed 30 degrees Celsius, while in June the weather is somewhat cooler. As in most islands, from July to mid-August we encounter the phenomenon of Meltemi, quite throwing the night temperature.

A large part of the island is covered by woodland and the rest of the island is dominated by olive trees. In Skiathos there is one area identified as Area of Community Interest (Sites of Community Interest) and was included in the European ecological network Natura 2000 (Directive 92/43/EEC). That area is the island of Skiathos (code: GR1430003, 32 ha). Around the island there are about seventy (70) beaches. The town of Skiathos is connected with the island of Skopelos, Alonissos, Volos, Ag. Konstantinos and Evia, via the trade - Passenger port. It also has air connection through the National Airport which features and located in the northeastern part of the island. Administratively the Municipality of Skiathosis part of the Magnesia Region of Thessaly.

B. Methodology

For the needs of the research digital orthophotomaps of the area were used. We also used the forest management plan of Skiathos Island for the last decades and we utilized factors such as crops, grass land, forest and urban areas. Thus, the land uses were digitized with the tool of GIS and finally, we extracted measurements that regard the area of each factor. We digitized the factors for the years 1945, 1996 and 2007.

Also, for the prediction of lands uses for the island of Skiathos for the year 2020 has been used the model of cellular automata. We used artificial neural networks to create the dynamic transition maps which would be introduced in the model of cellular automata.

Five parameters were used in neural networks:

- Neighborhood: size 2 (ie. 5x5 = 25 cells)
- Learning rate, momentum and max iterations number (0.1, 0.05, 1000). These parameters define the neural network training process. Large learningrate and momentum leads to rapid learning. Small learningrate and momentum provides slow but more stable learning. The stability has to do with the large variations in the graph.

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- Hidden levels: we defined one hidden layer with 10 nodes - neurons.

Finally, in the above results have been applied two indicators: the distance from roads and the distance from the coastline.

III. RESULTS AND DISCUSSION

For the year 1945 we have digitized the land uses for the Island of Skiathos. In the Figure 1, the thematic map which has been resulted from the digitization is presented.

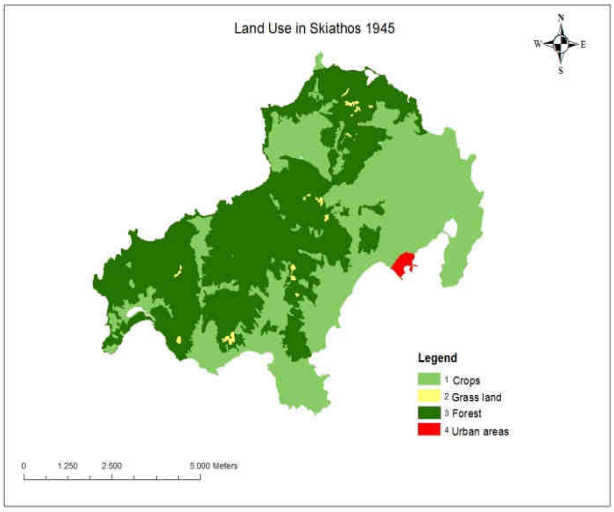

Fig. 1. Land uses in Skiathos Island for the year 1945

In the above figure we could see the digitization and the categorization of the land uses for the year 1945. Also, the area percentage for each category is presented in the next Figure 2.

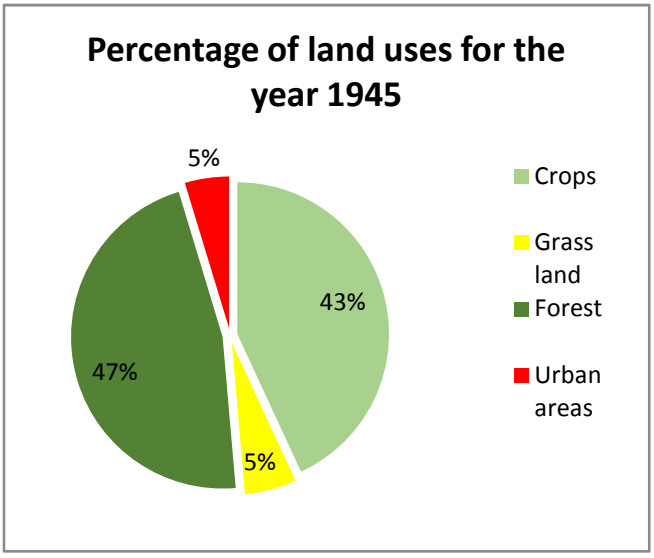

Fig. 2. Percentage of the land uses area in Skiathos Island for the year 1945

From the above chart, we could notice that the land use with the greater area is the forest (47%) and continue the crops (43%) with close difference. Finally, the categories grass land (5%) and urban areas (5%) have occupied the same percentage and also very low from the other two categories.

In the next figure is presented the thematic map for the year 1996 for the island of Skiathos.

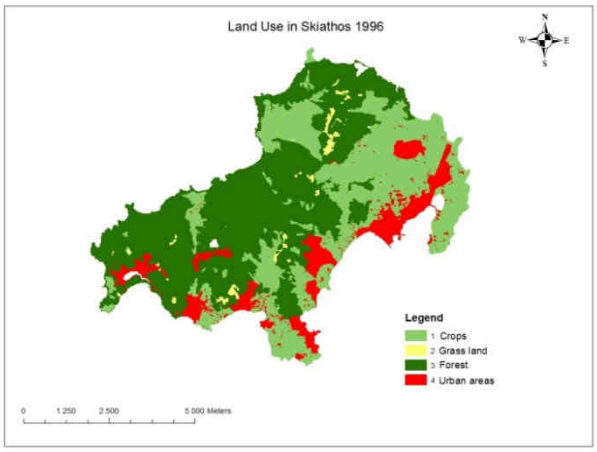

Fig. 3. Land uses in Skiathos Island for the year 1996

The growth of urban areas is evident from the above map. This means the reduction of the rest categories of land uses with the exception of the grass land. More especially, the percentage of each category is presented in the next chart.

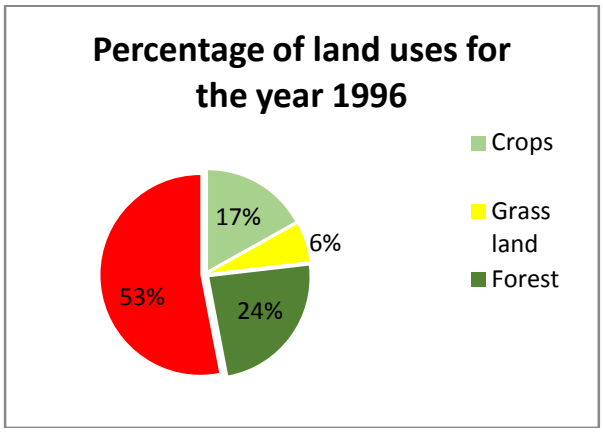

Fig. 4. Percentage of the land uses area in Skiathos Island for the year 1996

As we have noticed above, for the year 1996 we have increase of the urban areas (53%). Then followed the forest (24%), crops (17%) and finally the grass land (6%).

In the next figure is presented the thematic map for the year 2007 for the island of Skiathos.

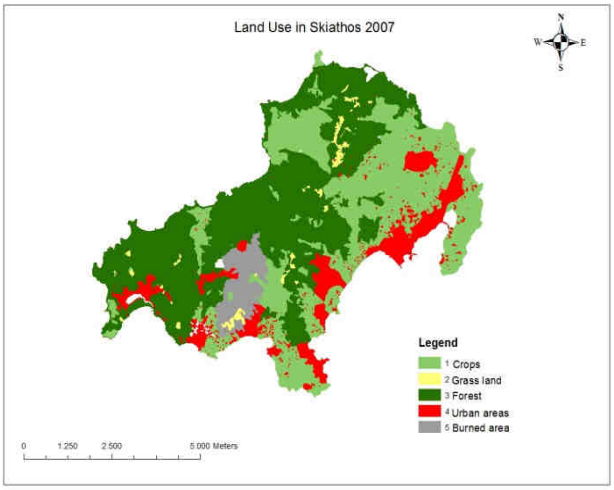

Fig. 5. Land uses in Skiathos Island for the year 2007

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In the year 2007 from the above thematic map, we could notice a burned area. This has resulted from a fire which took place in the Island of Skiathos in 2006. The area which burned was previous forest area. This means that the percentage of forest area has been reduced in the total area of the Skiathos Island. This is shown in the following chart.

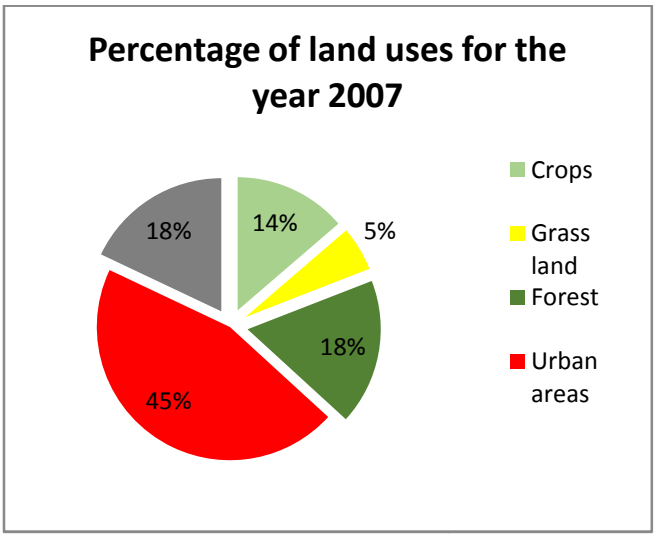

Fig. 6. Percentage of the land uses area in Skiathos Island for the year 2007

From the above chart, we could notice that the land use with the greater area is the urban area (45%) and continue with the same percentage, the land use of forest (18%) and the new category of burned area (18%). The percentage of the land use of crops (14%) has been reduced from the previous thematic map. Finally, the category with the lower percentage is this of the grass land (5%). In the next figure is presented the thematic map which revealed from the model cellular automata and makes the prediction for the land uses in the Island of Skiathos for the year 2020.

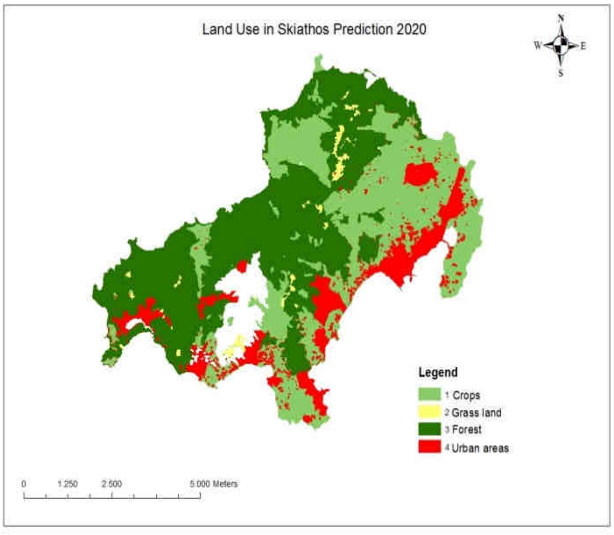

Fig. 7. Land uses in Skiathos Island for the year 2020

As we could notice from the above thematic map, in the model we don't take into account the burned area, we leave it to reforest naturally. In the next chart, we present the percentage for each category of land uses, according to the model of cellular automata.

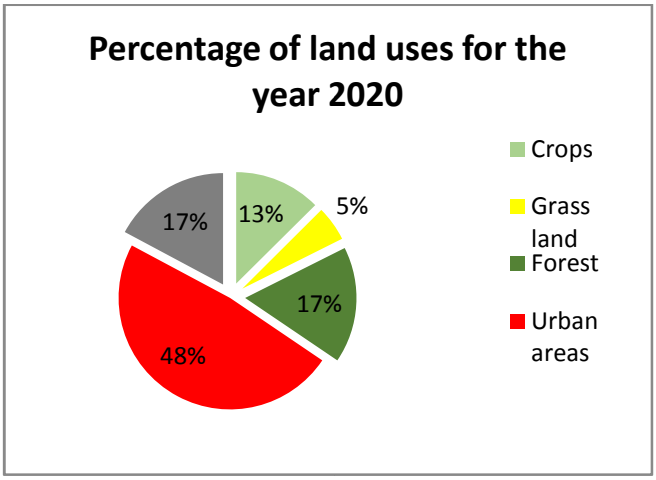

Fig. 8. Percentage of the land uses area in Skiathos Island for the year 2020

All the categories would be reduced except from the urban area which would be increase. Also, the land use of grass land is stationary all the years, so and in the prediction it would has the same percentage as in the previous years (5%).

In the next table we could make a comparison between the land uses and the years.

Table I. The area of each land use for the years 1945, 1996, 2007 and 2020

Year / Land uses	1945	1996	2007	2020
Crops	22298	16975	16754	16014
Grassland	2854	6282	6607	6482
Forest	24136	23982	21693	21571
Urban areas	2429	53293	55387	61834
Burned area	0	0	21983	21983

The difference between the categories of land uses over years is more obvious in the next chart.

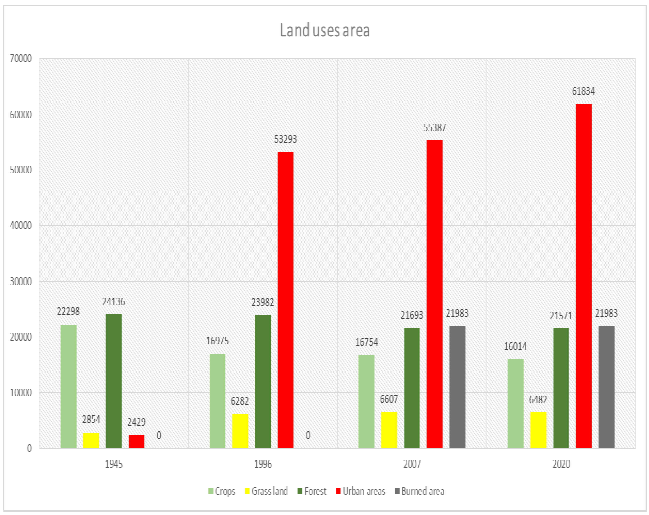

Fig. 9. Comparison of the area of each land use for the years 1945, 1996, 2007 and 2020

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From the above chart we could see the huge increase of urban areas over years and the appearance of burned area in the last two periods of time.

IV. CONCLUSION

The diversification of land uses is a result of human activities in the Island of Skiathos. More specifically, it depends on the economic situation, the development and the population of the Island. Also, another parameter is the human factor. From the above analysis regarding land uses over the years, we could notice that there was a great difference between categories of land uses. What should be mentioned is the increase of urban areas at the expense of the forest and crops areas. This happened due to an increase of the population in the island and the number of tourists who arrived in the island in the last summers. The aim of this research is to propose, in the future, a rural plan for the Island of Skiathos. The most important factors that should be taken into account during the sustainable planning for the island of Skiathos are the changes of land uses and the population.

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