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Land Information System (LIS) as a tool for the regional sustainable development in the southern part of Albania

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Abstract

Creation of the Land Information System integrated in the Geographical Information System (GIS) is the main objective of this article in assisting local Government for the sustainable management of land resources. Through this study it was made possible to provide a spatial database at communal level, was also carried out the study of soil and land suitability, data on land use, analysis on land use changes and agricultural land urbanization. The geographical space, in which LIS is set, which is also the objective of this study is Shales commune, Elbasani district. To provide data on agricultural land and elaboration of this database the most important qualities and characteristic of the soil are taken into account, as well as it has been made the classification of land suitability into four suitability classes (S1-S4) and an unsuitable (N). About 60% of the land surface in Shales commune is classified as unsuitable and the rest is classified in S1, S2, S3 and S4, respectively, 2%, 19%, 16%, and 3% of the surface. Based in the land use information before and post 1998 it is analyzed the change of land use in communal level. The main changes have been occurred on the agricultural land fund. In this class the diversion of agricultural land use by arable crops in vineyards, olive groves, orchards were found, as well as changes are observed within agriculture land where 281.8 ha or 12.6% of suitable land is left fallow. The data show that the surface occupied by buildings outside the yellow line is 13.9 ha. The products of this study are the land suitability map, the use and land-use changes maps in the period 1998-2011. The results of this study suggest urgent measures for a sustainable management of the land and protection from further urbanization.

Key words: GIS, land use, land–use change, land suitability.

1. Introduction

The agriculture land occupies about ¼ of the total Albanian territory. With the system change after 1991, the Albanian economy moved from the centralized for to the market-oriented one. These changes were accompanied by the dissolution of cooperatives and large state-owned farms in the small private economy. Today has been formed about 388,697 farm families with an average area per family of 1.26 ha [6]. This phenomenon brought after strong demographic changes associated with the massive movements of population from the poor rural areas and urban areas to major centers in the lowland area giving an extraordinary impact on land use. The last two decades as a result of the increased buildings without criteria in rural areas and the powerful and faster development of infrastructure in general, considerable area of agricultural land were occupied. What is even more worrying is that generally are occupied the best land and fertile one. Conversion of agricultural land in use into the non-agricultural land (buildings, roads, etc.) has had worrying proportions throughout the country.

Proportions of agricultural land converted to non-agriculture have been difficult to identify. This has made necessary the assessment of the current state of land use for the purpose of necessary planning measures to prevent the negative effects that lead these changes in the development of agriculture. Implementation of GIS technology will make possible the identification of the real situation of agricultural land in our country [3]. Also, through this program it will be realized, the integration of the topographic, hydrographic, land and soil suitability, plant cover / land use data and other data. The application of this technology will help in analyzing the data and will rise the quality of information that derives from it. Likewise it will also enable us the analysis of trends, such as trends in land degradation, land use change, and urbanization of agriculture land. Implementation of this technology will simultaneously help us identify ways to solve problems related to the land use and to design programs on its function, up to the commune level.

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2. Material and Methods

In this study, as a database for the land information at the parcel level has served the digital cadastral information taken from the Immovable Property Registration System. The land use identification for 2011 is derived from the orthophoto and verification on terrain. The topographic maps of scale 1:10000, land parcel and commune boundary and the cadastral book were used as the primary natural database for the commune. In addition is created the database and it is made the digitalization for the land use maps before 1991 (scale 1:5000). For the data organization and creation of the different maps ArcGis 9.3 is used. The land suitability assessment is based on the analysis of climate, land and soil characteristics. Soil augering is carried out in the terrain with slope up to 25%, and grill system in distance 300 m to each other (i.e. a 9.0 ha survey intensity) [2].

For the determination of the soil types, there are taken into consideration the land form (flat, terraces, plain, valley, foot of slope etc.), the deep, the soil drainage class, as well as the classes of topsoil texture and subsoil texture. For each soil type are open the profiles, are described and are taken the soil samples. The samples are analyzed for organic matter content, soil pH, available phosphorous, cation exchange capacity, exchangeable cation (K, Ca, Mg, Na), texture as well.

For the land suitability assessment are take into consideration the exchangeable sodium percent, electrical conductivity, texture, cation exchange capacity, fertility, topsoil and subsoil structures, slope, flood risk, soil depth, topsoil stone content, topsoil and subsoil texture, natural soil drainage, total available water (TAW), actual erosion and erosion risk. For the soil fertility have been considered organic matter, soil pH, available phosphorous, exchangeable cation (K, Ca, Mg, Na), as well as the Ca:Mg and K:Mg ratios.

The land use information is collected according to the land use legend. The land is classified in four main categories on the base of its function: agricultural, forestry and pastures, non-agricultural. Land use categories are distinguished in classes and subclasses by the activity criteria.

In the geo-database have been included land uses in 1998 and in 2011. The land use and the land use analyses have been made using the Land Use Information System Methodology and Land Use Changes Analyses Methodology [5]. Land-use changes have been analyzed at the parcel level. In this study it has been used also the information collected for the buildings built before and post 1991. By overlapping the buildings and parcels is provided the information for areas occupied by the buildings.

3. Analyses and results

The study conducted in Shales commune covers an area of 4250.5 ha. The soil information has been created through the 112 total auger bores made at this area. In this commune five soil types were defined. For each soil type has been made a detailed description and the analysis of the representative soil profile, as cited above [4].

The studied agricultural land is classified in four suitable classes (S1-S4) and one non suitable (N) [1]. Through the GIS, based on the soil data have been derived the map for land suitability (Figure 1).

The agricultural land classified in S1, S2, S3 and S4 classes, occupy respectively 2%, 19%, 16% and 3% of the studied area in Shales commune, while the class N occupies 60% of its territory. The data analyses for the land use shows that there are significant land use changes within this commune. In the figure 2 and 3 is presented the land use in 1998 and 2011 respectively, as well as the land use changes in this commune during this period.

Table 1: Land use of Shales commune in 1998-2011period (in Ha)

Nr	*Land category*	*Year 1998*	Year 2011
1	Agricultural	2222.2	2225.8
2	Pasture and meadow	637.1	617.6
3	Forest	833.2	833.2
4	Non-agricultural	558.1	573.9
	Total area	**4250.6**	**4250.5**

The main trends found in this commune are:

- Steep land-use changes which have been converted into grazing or fallow land
- Change of agricultural land use, which have become urbanized lands, mostly concentrated in the lowland area.

The compared data which present the buildings built before and post 1998 in Shales commune shows the trends of this phenomenon. A GIS application has been developed based in the zoning of land suitability classes and the extension of buildings in agricultural land, which demonstrates that the most part of new

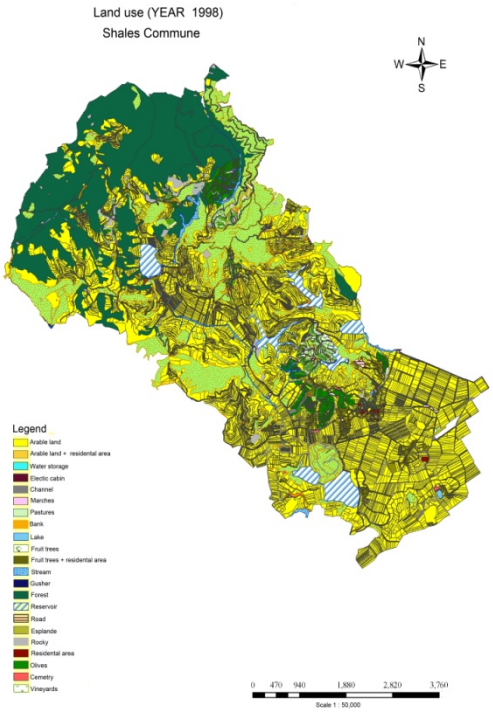

Figure 1: Land Suitability Map of Shales Commune

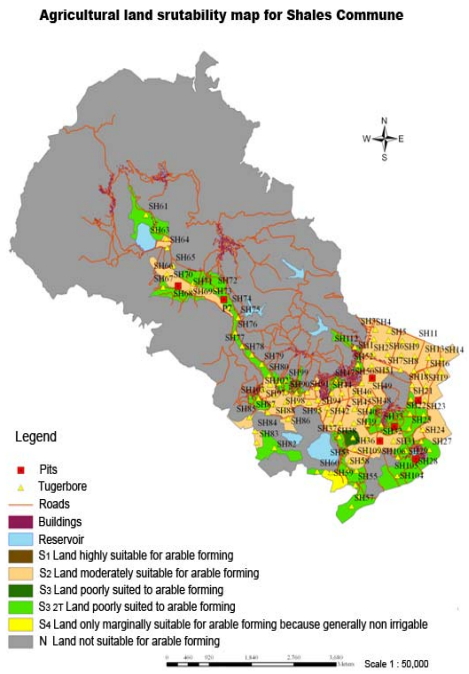

Figure 2: Land use of Shales commune1998

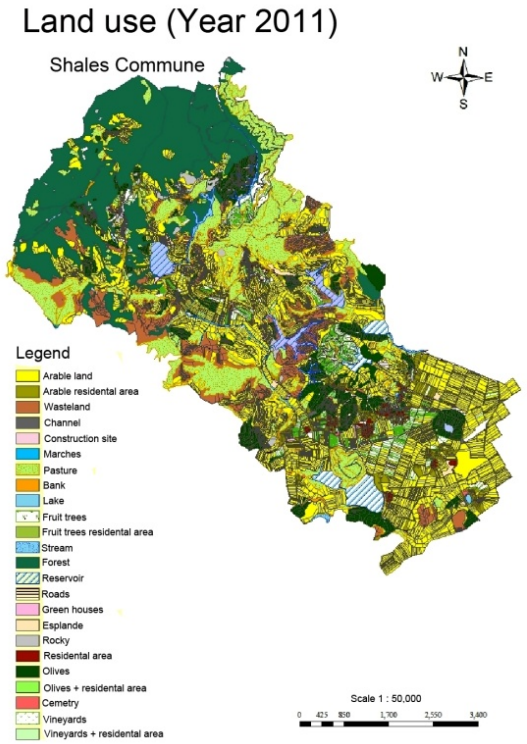

Figure 3. Land use of Shales commune in 2011

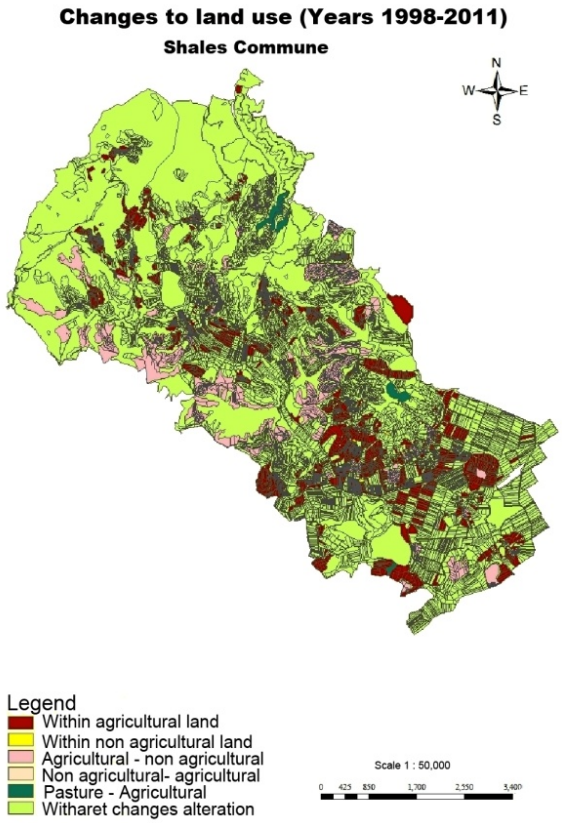

Figure 4: Land use changes of Shales commune (1998-2011)

buildings is built in the most suitable agricultural land of commune. Expansion of the urban area outside the yellow line constitutes an erosion of agricultural land, which affect the reduction of the arable and suitable land surface, it interfere with the mechanization of work in agriculture, irrigation and drainage infrastructure, vehicles crossing roads and infrastructure in general. The data of this study show that the surface occupied by buildings outside the yellow line is 13.9 ha. According to the data presented in Figure 4, is seen that the intensity of land-use change for the period 1998-2011 was not very high. is noticed that there are changes within the class of the agricultural land, where a considerable part of them is left fallow.

Information system for the commune indicates that: changes in arable land surface fund in 2011, compared to the 1998 agricultural land fund goes to 679.3 ha less. Increase of the agricultural land area planted with olives with 219.9 ha, 44.7 ha vineyards has arrived as a result of support policies for these crops. It should be noted that there is an area of 281.8 ha of arable land left fallow. Changes in land fund between agricultural categories, non-agricultural, pasture and forests are insignificant.

4. Conclusions

- Creation of the Information System integrated in the Geographical Information System (GIS) for Shalesi commune results to be valid and can serve as the basis for land-use planning process: analysis of all factors that affect land suitability assessment, design requirements for a more rational use of agricultural land, allocation of these requirements in appropriate areas and assessment of preferable impacts of alternative policy choice of agricultural land use.
- Soil suitability assessment shows a great potential productivity for the soils of Shales commune in Elbasani district.
- The data extracted from this study and their digitization will provide to the commune a valid catalog, for the agricultural land, quality and its potentiality. It will be effective in various applications and land-use planning policies.
- The contribution of this study will serve as a model for the application of this system in other commune in the whole territory of the country.

5. References

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