APPLICATION ON GIS FOR LAND USE PLANNING IN CENTRAL PART OF ALBANIA, MAMINAS COMMUNE

L. DUSHAJ[1], F. SALLAKU[1*], SH. TAFAJ[2], S. RRAPO[3]

[1]Agricultural University of Tirana, Albania

[2]The Center for Agricultural Transferring Technology, Fushe-Kruja, Albania

[3]European University of Tirana, Albania

* Author of correspondence; Email: sallaku@albmail.com

Abstract

New developments in geographic information science and technology are changing the way we apply GIS to developing-world agriculture, creating new opportunities to utilize the technology to address problems of disaster management, climate change, land use change, land degradation, crop analysis and impact assessment.GIS allows data and demographic information to be presented graphically, primarily in maps, but also in business tools such as charts, graphs and other reports. In addition, GIS allows the user to create simulations on future data scenarios to analyze the results of planning, land use and/or business decisions. In this frame, the object of this study has been the use of the GIS application for medium-term land use planning in Maminas commune to assist local Government authorities on the sustainable management of land resources. The study provided not only the basic spatial database at communal level, but also evaluated the land suitability, land use, land use changes, functioning of irrigation and drainage systems as well as the loss of agricultural land to urbanization. The agricultural land suitability assessment showed that the biggest surface in this commune is made of S2 class with a total of 63% of agriculture land, class S3-2S does not count that much since it is only 1% and adjacent to the texture of the lower horizon, class S3-2T takes a surface of about 21 % and has an inclination of 3-12% that classifies these soils in this class. The remaining 10% is classified in S4 class with an inclination of 13-25%. The data collection for the buildings built before and post 1991 shows the trends of this phenomenon, GIS applications have indicated that a part of buildings is built in the best agricultural land. The data showed that class A total area is 954.5 ha, occupied area 130.4 ha (14%), and class B total area 53.2 ha occupied area 21.3 ha (40%), while in the land of class N the urbanization is too little (only 1.2%).

Key words: Land use planning, land suitability, land use, land use change.

1. Introduction

The agriculture land in Albania occupies only 24% of the total land area, so the pressure in this area has increased last years. Land use policy and land use planning development are very important for Albania because many issues have been observed on land use after 1991. During this period many changes occurred in Albania and the economic system changed from central organized into a market-oriented one. These types of change and massive demographic movement have had a tremendous impact on land use. The lack of a sound land use policy has resulted in widespread land degradation and chaotic development causing the loss of the best quality farmland to non-agriculture use. The conversion of agricultural land use in non-agricultural use (buildings, roads, etc) is obviously increased in all the country, especially in arable land. However, it is difficult to get the data for the area of agricultural land converted in urban land. It is a necessity the assessment of the actual state of the natural resources and their risk of degradation in order to plan the measures that are able to prevent any negative effects that could occur from the different uses. The implementation of the National ICT Strategy in Albania is thus creating the required environment for ICT to contribute on the "*consolidation of the public administration and the state's fundamental institutions"* [5]. GIS use will integrate diverse geospatial data, such as topographic, hydro graphic, land and soil suitability, street network, vegetation cover, land use and others in GIS database and their joint analysis. This will increase the quantity as well as the quality of derived information. The use of technologies such as GIS will also enable to

analyze trends such as overgrazing, land degradation, land use change, urbanization of agriculture land and land use planning and the development of some applications [1].

2. Material and Methods

Basically the soil data has been taken from the digital cartel-map information of the Immovable Property Registration System in Albania.

For achieving the field study and evaluation of land suitability, topographic maps of scale 1:10,000 were used. The data for land parcel, commune boundary, road network, and drainage and irrigation system, urban area of villages (yellow line) have been taken from the cadastral book. In addition, for land use before 1991 were digitized and entered into the database as well. ArcGis 8.3.modules ArcTools and ArcMap were used for the joining of the map sheets and their corresponding layers and creation of different maps.

The land suitability assessment for irrigable agriculture is based on the analysis of a number of *climate, site and soil characteristics* matched against the requirements of that land use [2]. The information for soil has been taken from the soil augering and based on that the main types of soils have been determined and description of soil profile and land suitability assessment has been done. Soil augering is carried out in a terrain with slope less than 25% in a grid system in 300 m distance from each other [3].

The detailed information collected during the field survey has been used to determine the soil types. The landform (flat, terraces, plain, valley, foot of slope etc.), the depth, the soil drainage class, as well as the classes of topsoil texture and subsoil texture have been taken into consideration. It has been determined one representative profile for each soil type. Each profile has been described and samples for each layer have been taken. The samples have been analyzed for the main physical and chemical characteristics.

Land suitability assessment has taken into consideration soil profile data and soil and land survey data derived from all site records.

The land use information is collected according to land use legend. The land is classified in four main categories on the base of function: agricultural, forestry and pastures, non-agricultural and others. These land use categories are distinguished in classes and subclasses based in the activity criteria. All the information is collected in parcel level based in cadastral information. In the geo-database two land-use data sets have been included describing land uses in 1991 and in 2004.

The land use change analyses have been made using the Land Use Information System Methodology and Land Use Changes Analyses methodology [11]. Land-use changes have been analyzed at the level of the spatial extent (i.e. in Ha) of the area that suffered changes.

The reference unit for all the data collected has been the cadastral parcel. Spatial data have been grouped into Datasets in order to ease the management of different logical sets of data. To group data into datasets, the INSPIRE (Infrastructure for Spatial Information in Europe - http://www.dublincore.org/) standard has been adopted [4].

Table 1. Classification of best agricultural soils

Land suitability class	Functioning irrigation	Inside non-functioning irrigation scheme	Outside irrigation scheme
S1 + S2	A	C	D
S3 + S4	B		

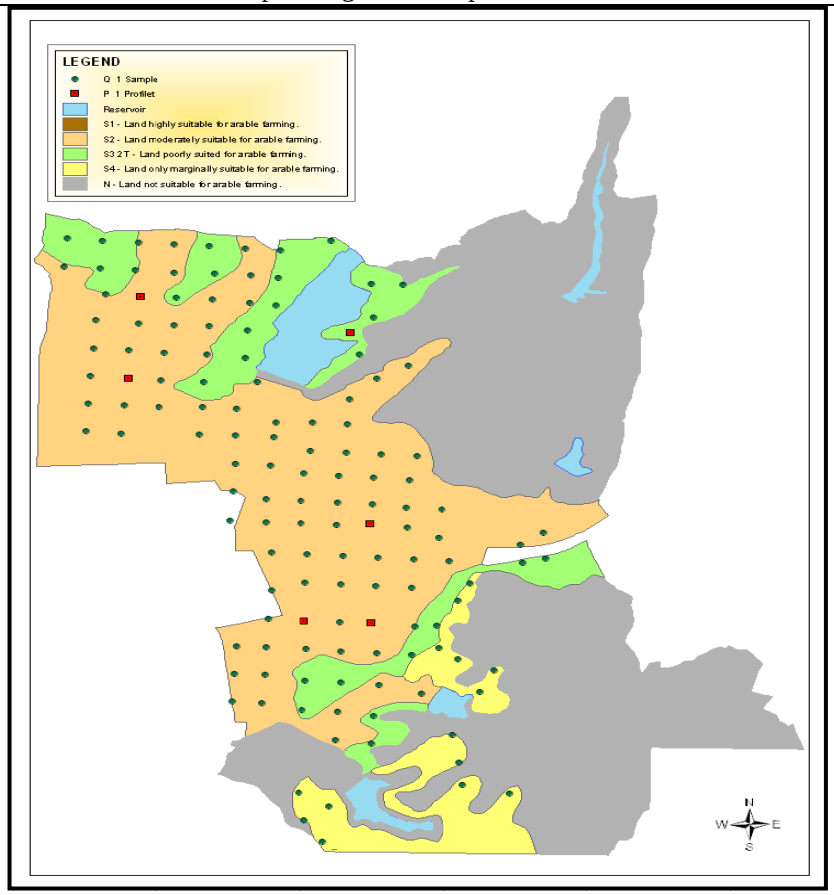

Figure 1. Land Suitability Map of Maminas Commune

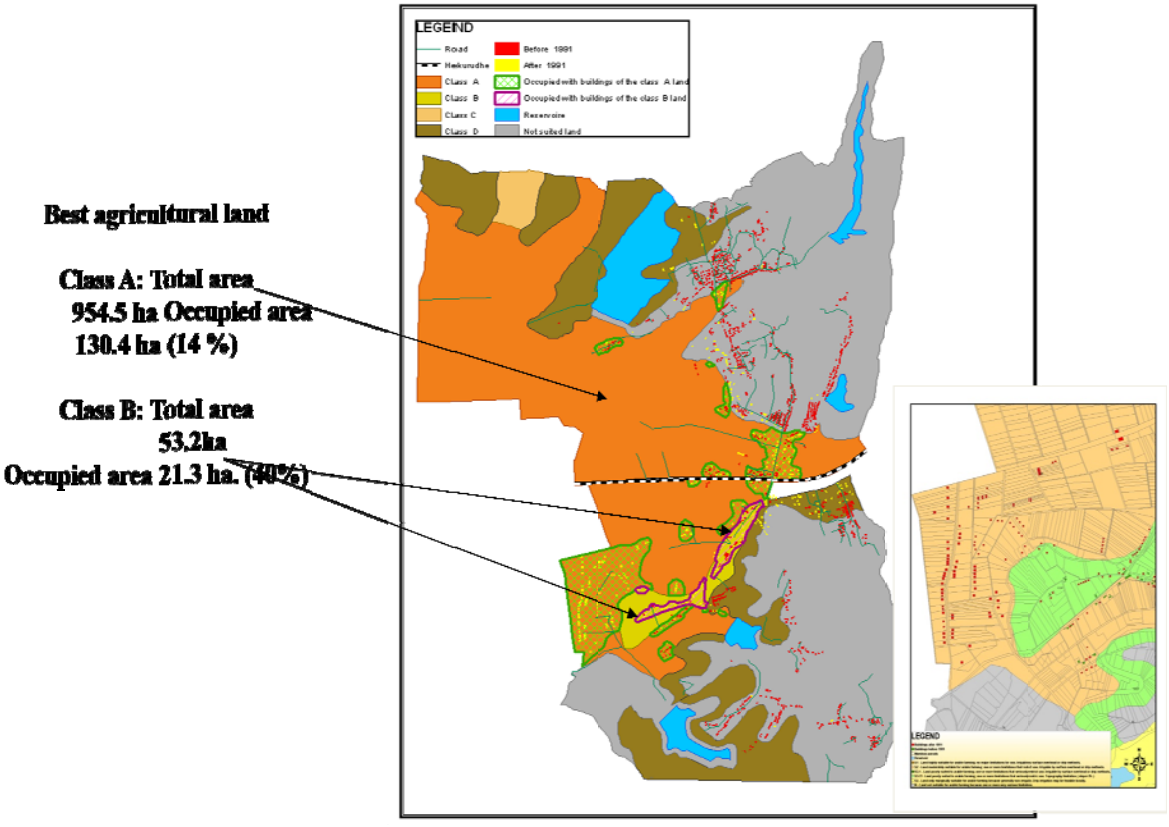

Figure 2. The zoning of urbanized agricultural land

Information for yellow line area (existed urban area) and *the buildings* built before and post 1991 has been collected. A spatial association between the parcels and buildings provides information for the zones occupied with buildings.

Baseline data for land use planning are population, climate, physiographic, soils, land suitability, vegetation and land degradation.

The GIS applications have consisted on zoning of the best agricultural land, zoning of urbanized agricultural land, as well as the GIS-based preparation of land use planning in commune level.

3. Results and discussions

The study has been carried out for an area of about 1224 ha in Maminas commune. The soil information has been collected through the 136 total auger bores.

The agricultural land suitability assessment is classified in three suitable classes (S2-S4) and one non suitable (N) [11].

The biggest surface in this commune is made of S2 class with a total of 63% of agriculture land and is adjacent to the texture of upper horizon and fertility. Class S3-2S does not count that much since it is only 1% and adjacent to the texture of the lower horizon. Class S3-2T takes a surface of about 21 % and has an inclination of 3-12% that classifies these soils in this class. The remaining 10% is classified in S4 class with an inclination of 13-25% [8].

One of the applications in GIS for Maminas commune has been developed based in the zoning of land suitability classes and the extension of buildings in agricultural land (Figure 2.), which demonstrates that the most part of new buildings is built in the most suitable agricultural land of commune. The best agriculture land is ranked into four categories, A to D (Table 1). Land of suitability classes S1 and S2 plus S3 and S4 class that have well-functioning (and sufficient) irrigation, either by an irrigation scheme or through informal abstraction from a river or reservoir are considered the best agriculture lands.

During the last years the conversion of agricultural land use in non-agricultural use (buildings, roads, etc) has obviously increased in all the country, especially in arable land. It is difficult to get the data for the area of agricultural land converted in urban land. The data collection for the buildings built before and post 1991 shows the trends of this phenomenon, GIS applications have been indicating that a part of buildings is built in the best agricultural land [7]. The data showed (Figure 3.), that class A total area is 954.5 ha, occupied area 130.4 ha (14%), and class B total area 53.2 ha occupied area 21.3 ha (40%), while in the land of class N the urbanization is too little (only 1.2%).

The purpose of defining best agriculture land is to protect it from urban developments when land of poorer quality is available and to prioritize agriculture investments or irrigation rehabilitation on the basis of returns on investment will be greater on good land.

The collection of land use data is carried out according to the land use legend structured on the base of two main criteria: the function criterion to distinguish land-use categories followed by the activity criterion within the category [9].

The analyses of the data for land use shows that land use changes are different within commune. The figure 3 and 4 present the land use in 1991 and 2004 respectively, as well as the land use changes of Maminas commune in Figure 5.

The intensity of changes in the period mid 1990s-2004 is high (Figure 5). Arable land is converted into Fallow or Non-Agriculture, whereas Fruit trees are converted into Fallow (Table 2). There seems to be a shift in land-uses because agricultural land is lost in one place and gained in another, so this change affects different parts of the commune territory [6].

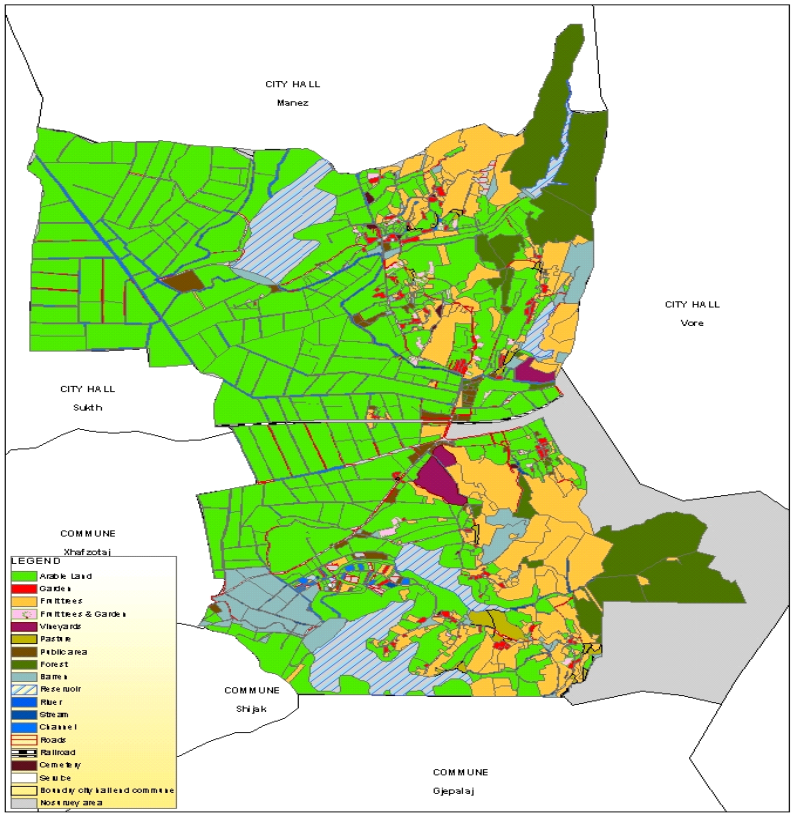

Figure 3. Land use of Maminas commune 1991

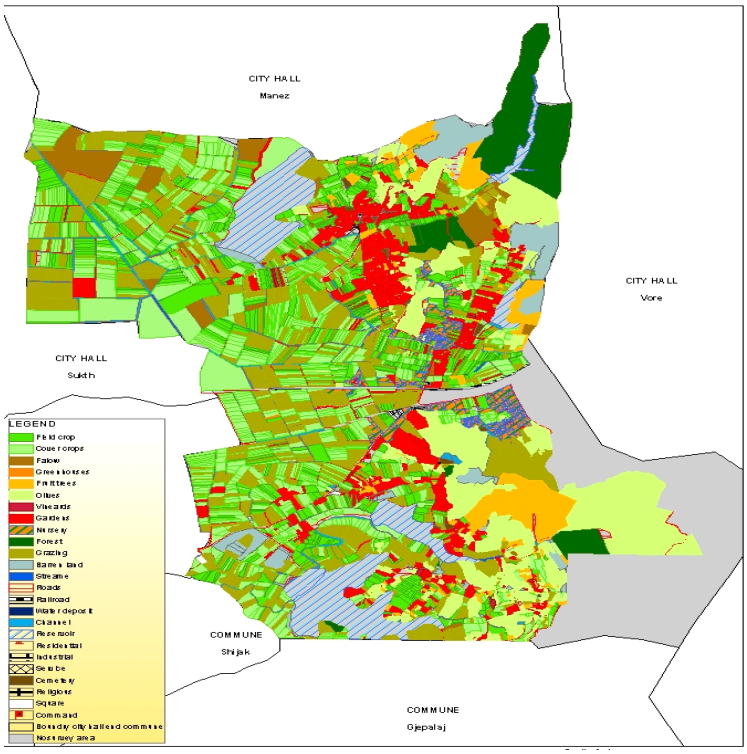

Figure 4. Land use of Maminas commune 2004

3.1 Medium-Term Land Use Plan

The units of the legend of land use planning:

Urban

- The center of commune (actual)
- Residential-urban management
- Urban saving (actual)
- Urban industry (actual)
- Residential-urban development (planned)
- Business-residential development (planned)

Agriculture

- Low value of rainfall for the plants (low investment)
- High value of the irrigated plants (high investment)

Horticultural – residential mix (medium to high investment)

- Low scale of mixed farms in the valleys (low investment)
- Preservation (integrated management of watersheds)
- Natural protection of rivers
- Protection of mixed agriculture
- Protection of forests and mixed pastures
- Protection of not good soils and forests
- Plantations of forests
- Watersheds

Urban development in the mid-term period will take a considerable place as well as the short term development, which is the continuity of hills and the areas along the main road. The part of unit seven with low rainfalls for the cultures will change from residential to horticultural. The residential part and the businesses will become more compact. There are fewer chances for changes in the hills since they are mainly dominated by sloppy relieve.

The chances for changes in the agriculture land are mainly in the parts that have problems with drainage, allowing the land to improve partly for the first class. The land improvement will attract and present high productivity of cultures and these changes will be present at unit eight. The changes in land use will affect unit eight. A considerable part of land will have a residential-mix character and will change at unit number eight. It is thought that at the same time the high value of produced cultures will intensify and attract more investments. Many intensive investments can produce the same production in the same or less land. It is also possible that the enlargement of scale and the land market in some periods will get stabilized and become more active and qualitative. This might encourage the agricultural production. By taking into account that the improvement of infrastructure in hills and valleys is already present there is opportunity for improving the production of agricultural cultures and horticulture. The conditions in general are favorable for extending the irrigation and high productivity.

Due to these, the lower part of the valley can improve in unit 8. For the remaining part of the hills there have not been many changes in terms of surface improvement.

4. Conclusions

1. Geographic Information System (GIS) is a new technology widely used to survey the land use problem. (GIS) plays an important role in soil survey and land evaluation for land use planning.
2. The analyses of land use before and post 1991 show some undesired changes in land use and need for possible intervention and development in the future.
3. Soil and land suitability assessment shows a great productivity potential of soils in this commune.The agricultural land suitability assessment showed that the biggest surface in this commune is:
    - class S2 with a total of 63% of agriculture land;
    - class S3-2S does not count that much since it is only 1% and adjacent to the texture of the lower horizon;
    - class S3-2T takes a surface of about 21 % and has an inclination of 3-12% that classifies these soils in this class;

- Class S4 takes 10% of the surface and has an inclination of 13-25%.
- The data collection for the buildings built before and post 1991 shows the trends of this phenomenon and they are as follows: da
- Class A total area is 954.5 ha, occupied area 130.4 ha (14%);
- Class B total area 53.2 ha occupied area 21.3 ha (40%);
- Classs N the urbanization is too little (only 1.2%).
- A GIS-based decision support system would provide an invaluable tool for all aspects of the land use planning process: conducting a land suitability analysis, projecting future land use demand, allocating this demand to suitable locations, and evaluating the likely impacts of alternative policy choices and assumptions.

4. The present contribution is an example of the system that should be applied in communal level, taking into consideration the systematic catalogue of Albanian's agricultural land quality, potential and land use, the system resulted very effective in different applications in the land use policy and planning.
5. GIS facility should serve as an *assistance tool* to Albanian Government. Individual government department's usually hold only narrow collections of data that serve for their own highly specific operations.
6. The GIS facility should be considered also as an *assistance tool* that can provide a comprehensive national data base on land and agriculture (and forestry, urban, commercial, tourism), [10] to assist the following functions of government:
    - to monitor the progress of policies, strategies and projects;
    - to collect, process, organize and continuously update data;
    - to monitor benefits of policies, programs and projects;
    - to change, develop and plan policies;
    - To improve changes and procedures, etc.

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