

APPLICATION ON GIS FOR LAND USE PLANNING: A CASE STUDY IN CENTRAL PART OF ALBANIA

ZBATIMI I GIS-IT PER PLANIFIKIMIN E PERDORIMIT TE TOKES: NJE RAST STUDIMOR NE PJESEN QENDRORE TE SHQIPERISE

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Abstract: In this article it is presented a case study of GIS application for medium-term land use planning in communal level. The study provided not only the basic spatial database in communal level, but also evaluated the land suitability, land use, land use changes, function of irrigation and drainage systems and agricultural land urbanization as well. It has been collected all land information for Xhafzotaj commune located the centre of Albania. During the land data collection in parcel level and its processing are found out the most important soil characteristics and qualities, as well as is accomplished the agricultural land suitability assessment for irrigable agriculture classified in four suitable classes (S1-S4) and one non suitable. The majority of agricultural land is classified in S1 and S2 classes, respectively 37.9 % and 33.4 %, while the land in S3, S4 and N classes occupied small area, 12.5 %, 6.2 % and 10.1 % respectively. Based in the land use information before and post 1991 it is realized a change analysis of land use in communal level. About 43.6 % of arable land and 48.7 % of orchards are converted in fallow land, whereas 12 % of arable land is converted in non-agricultural land. The data shows that 18.9 % of the agricultural land is occupied with the new buildings from which 21.6 % within S1 class and 21.2 % within S2 class, while only 1.2 % are built in non suitable agricultural land (N class. Zoning of the best agricultural land, zoning of urbanised agricultural land and medium-term land use planning in communal level are developed. The results demonstrated the potential of GIS application for land use planning.

Abstrakt: Ne kete artikull prezantohet nje rast studimor i zbatimit te GIS-it per planifikimin afat-mesem ne nivel komune. Studimi siguron jo vetem te dhenat hapesine ne nivel komune, por dhe vleresimin e pershtashmerise, perdorimin, ndryshimet si dhe urbanizimin e tokes bujqesore. Janë mbledhur të dhenat per tokën dhe dheun në nivel parcele për komunën Xhafzotaj. Është bere vleresimi i pershtatshmerise se tokes bujqesore per bujqesi te ujtishme, te klasifikuar ne kater klasa pershtatshmerie (S1-S4) dhe nje te papershtatshme (N). Pjesa me e madhe e tokes bujqesore klasifikohet ne klasa S1 dhe S2, respektivisht 37.9% dhe 33.4%, nderkohe qe toka e klasave S3, S4 dhe N ze hapesira me te vogla respektivisht 12.5%, 6.2% dhe 10.1%. Analiza e ndryshimeve në përdorimin e tokës tregoi se 43.6 % e tokes se punueshme dhe 48.7% e pemtove jane konvertuar ne toke djerr, ndersa 12% e tokes se punueshme eshte kthyer ne toke jo-bujqesore. Te dhenat treguan se 18.9 % e tokes bujqesore eshte zene nga ndertesat e reja nga te cilat 21.6% brenda klases S1, dhe 21.2% brenda klases S2, nderkohe qe vetem 1.2% jane ndertuar ne toke bujqesore te papershtatshme. Zonimin i tokes me te mire bujqesore, zonimin i tokes bujqesore te urbanizuar si dhe planifikimin afat mesem i perdorimit te tokes ne nivel komunal kane derivuar nga aplikimet e bazuara ne GIS. Rezultatet treguan potencialin e GIS-it per planifikimin e perdorimit te tokes.

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

Fjale kyce: Planifikimi i perdorimit te tokes, pershtatshmeri toke, perdorim toke, ndryshim i perdorimit te tokes.

INTRODUCTION

It is known that the agriculture land in Albania occupies only 24% of the total land area, so the pressure in this area is increased enough the 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 organised into a market-oriented one. A fast transition from 550 large farming cooperatives to some 450 000 small private farms occurred. 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 able to prevent any negative effects that could occur from the different uses. In the recent years in Albania it is established a GIS-based Land-use Policy tool to support land-use policy formulation and planning. The establishment of this GIS 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, increases the quantity as well as quality of derived information. The use of technologies such as GIS will also enable us the analysis of trends, such as trends in overgrazing, land degradation, land use change, and urbanization of agriculture land. This will be a powerful tool to get solution of problems and building a land use planning in commune level.

MATERIAL AND METHODS

The cadastral information of the Immovable Property Registration System in Albania is digitally entered into the geographic database and is used for the collection of land information in parcel level. The topographic maps of scale 1:10,000, land parcel and commune boundary, road network, drainage and irrigation system, urban area of villages (yellow line) and the cadastral book were used as the primary natural database for the commune. In addition, the thematic maps for land use before 1991 (scale 1:5000) were digitised 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]. It consists in the gathering of land and soil information in details through the soil augering and description of soil profile and land suitability assessment. Soil augering is carried out in a terrain with slope less than 25% in a grid system in 300 m distance from each other (i.e. a 9.0 ha survey intensity).

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 deep, 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 are analysed 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 2005. 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 analysed 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]. 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.

RESULTS AND DISCUSSION

The study has been carried out for an area of about 2,540 ha in Xhafzotaj commune. The soil information has been collected through the 223 total auger bores. In this commune six soil types were found out. Each soil type has been characterised by the detailed description and analysis of representative soil pits [3]. The agricultural land suitability assessment is classified in four suitable classes (S1-S4) and one non suitable (N). Land suitability for each soil and land survey is determinate by asking the GIS to display all sites having particular combination (s) of parameters. The map for land suitability is based in soil data collection and GIS application. As it is seen in Figure 1 the biggest part of the soil situated in this commune are of S1 and S2 class respectively with 37.9 and 33.4 %. The S3 class occupy a relatively small surface (12.5%). The main limitation for the soils of this class is the coarse texture of their upper horizon. The S4 class includes the soils in the foot slope, gradient of which fluctuates from 12-25%. The soils of N class are situated in the most inclined corners of the hills. The gradients in these soils go over 25% which is also the limit for arable agriculture. The majority of agricultural land has been classified in S1 and S2 classes, respectively 37.9 % and 33.4 %, while the land of S3, S4 and N classes occupies a small area, respectively 12.5 %, 6.2 % and 10.1 %.

One of the applications has been developed for the zoning of the best agricultural land of Xhafzotaj Commune. The best agriculture land is ranked into four categories, A to D (table 1).

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		

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. Figure 2 shows the zoning of best agricultural land. In this commune C and D class predominates. The lack of A and B classes in this commune is related to the non-functioning of irrigation system. As a result, the most of soils have a low actual productivity.

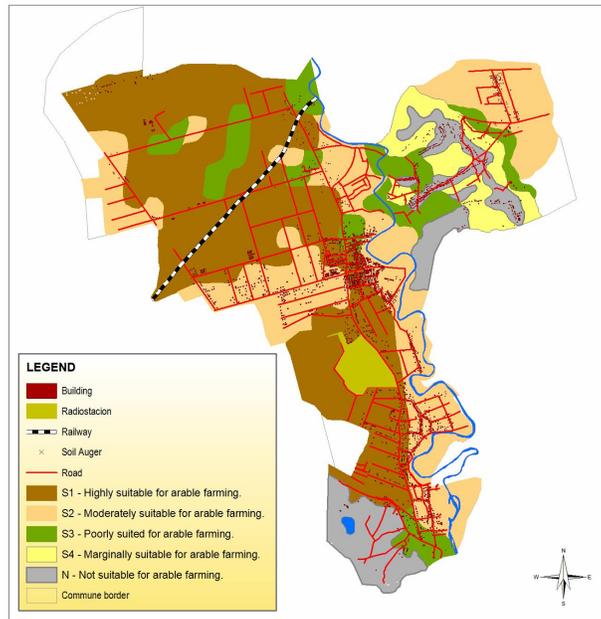


Figure1. Land Suitability Map of Xhafzotaj Commune

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

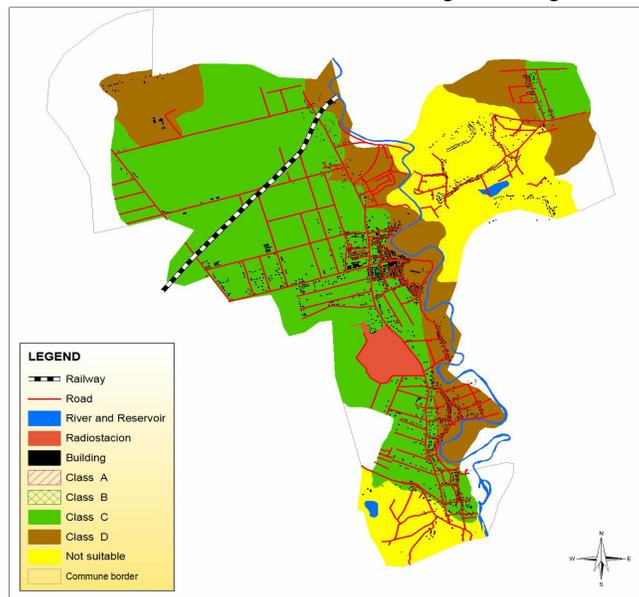


Figure 2 The best agricultural land, Xhafzotaj Commune

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 2005 respectively, as well as the land use changes of Xhafzotaj commune in figure 5.

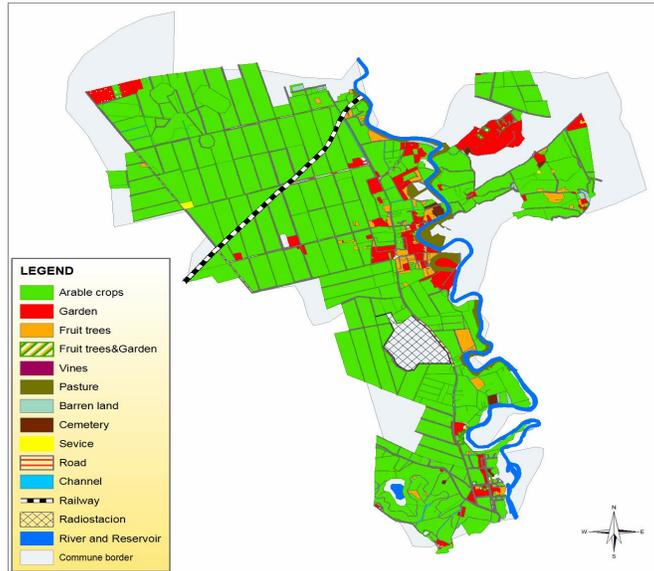


Figure 3. Land use of Xhafzotaj commune 1991

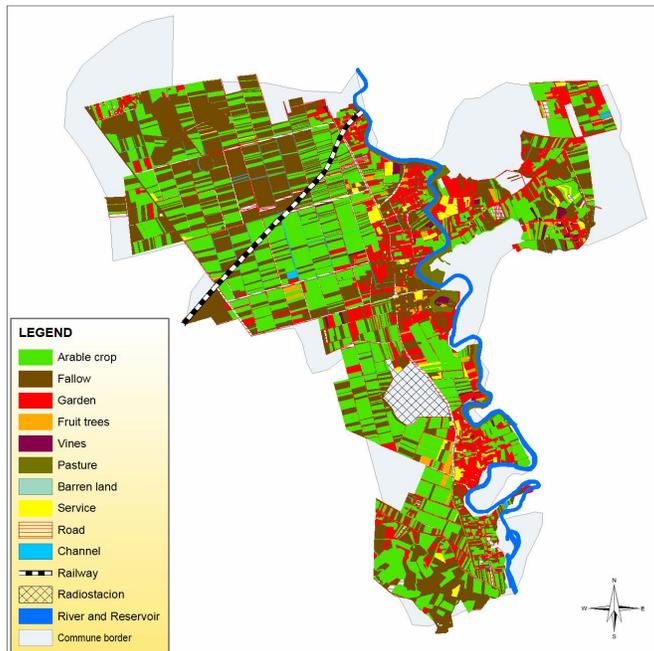


Figure 4. Land use of Xhafzotaj commune 2005

The intensity of changes in the period mid 1990s-2005 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.

Table 2.

Main land use change in Xhafzotaj commune

Type of changes	Total 1991	Change	%
Arable land → fallow	1674.3	730.0	43.6
Fruit trees → fallow	55.4	27.0	48.7
Arable land → non-agricultural	1674.3	200	11.9

The trends found in this commune are:

- Land-use changes in sloping areas where Arable land are lost to Fallow or Pasture Land-uses, and
- A tremendous increase in urbanised areas at the cost of Agriculture Land-uses mainly in flat plain.

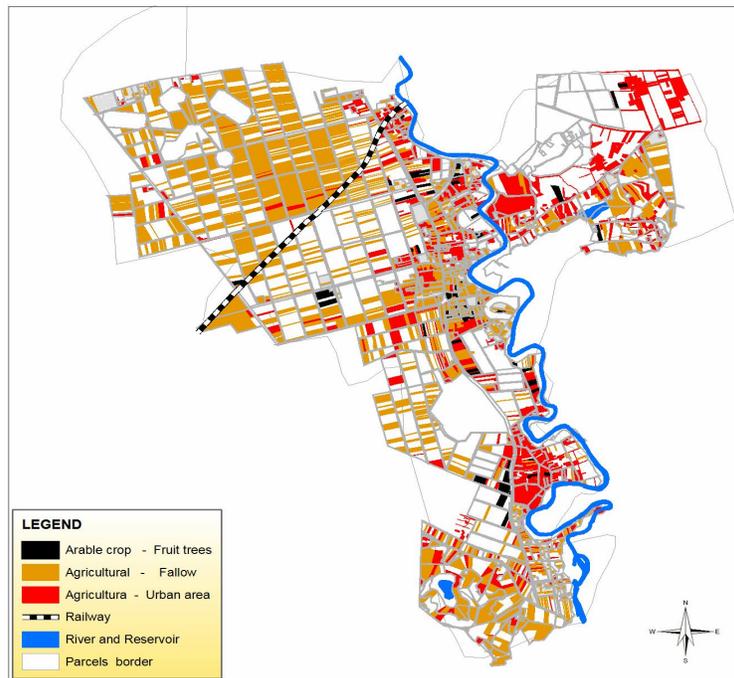


Figure 5. Land Use Changes 1991-2005

A GIS application has been developed based in the zoning of land suitability classes and the extension of buildings in agricultural land (Figure 6.), which demonstrates that the most part of new buildings is built in the most suitable agricultural land of commune. The data showed that 21.6% of class S1 and 21.2% of class S2 are urbanised, while in the land of class N the urbanization is too little (only 1.2%).

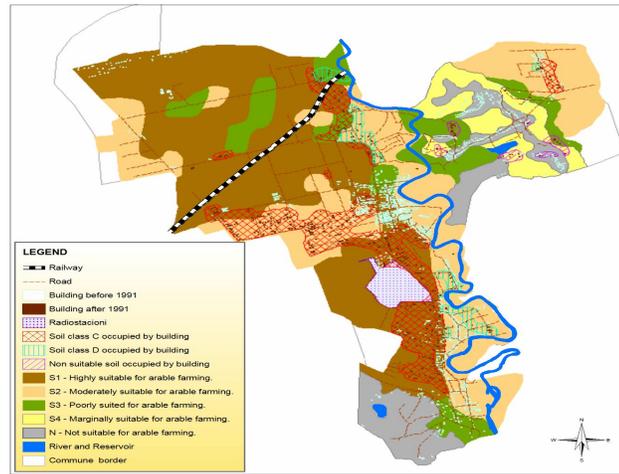


Figure 6. The zoning of urbanised agricultural land

A preliminary medium-term land-use plan in communal level has been developed and is presented in Figure 7. This plan will cover a time period of 5 – 10 years.

The three main units of the legend of land use planning are: urban, agriculture and conservation.

The urban development shows the extension of residences in the north and west of the commune. The biggest part of the new building will continue to rise along the main roads. The developments will be a mixture of business activities and residences with gardens. The most suitable land will be used for arable crop. The irrigation system should be rehabilitated making possible the shift from livestock production to promoting of cultures of high effectiveness like vegetables, vineyards, fruit trees and greenhouses.

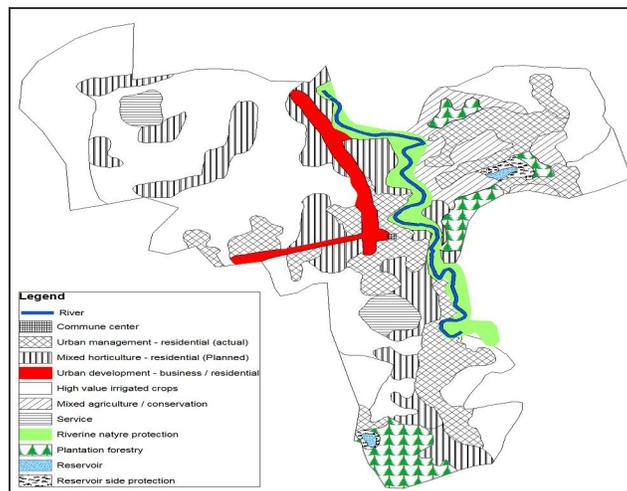


Figure 7. Medium-Term Land Use Plan, Xhafzotaj Commune

For the hills it will be necessary to improve the road infrastructure in order to make these zones attractive for the construction of residencies and for agriculture purposes. Suitable land uses should be adapted in order to protect it from erosion and degradation. Because of the high variability of land declination, land depth and other factors, land use will have a mixed nature. The forest plantations will be located in the most gradient corners of the hills. The foot slopes will be used for graze, vineyards cultivation and for building residences.

CONCLUSIONS

1. Geographic Information system (GIS) is a new technology widely used to survey the land use problem.
2. The collection of the data is a large and difficult task, and expensive as well, but the benefits from its use through GIS are too high. These new technologies can reduce the time and cost to the planners in organizing the data in arriving at precise conclusion and decisions.
3. The analyses of land use before 1991 and past shows some undesired changes in land use and needs for possible intervention and development in the future.
4. 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.
5. Soil and land suitability assessment show a great potential productivity of soils of this commune.
6. The present contribution is an example of the system to be applied at communal, scale in consideration of the systematic catalogue of Albania's agricultural land quality, land potential and land use, very effective in different applications in the land use policy and land use planning.
7. 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.

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