Cartographic approach to regression of forest ecosystems in the area of Guerbes (Algeria)

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ABSTRACT
This work is a diachronic study of the changing landscape occupying the land of the plain of Guerbes, which is localized in Skikda (north-east-Algerian) and covers an area of 26 260 ha. This landscape is characterized by a biodiversity that suffers from several ecological factors; the most important are the anthropogenic. The Geographic Information System (GIS) technology such as MapInfo represents the best method to solve the main problems in the vulnerability survey by using the different information on aerial photographs of the years 1972 and 2003. The results provide more information on the evolution and dynamic landscape on the plain of Guerbes. It becomes more artificial than natural, given the increase in area of crops which is estimated at 50% between 1972 and 2003. The impact of this increase on the loss of natural landscape area is currently very remarkable at different sites. The objective of this work is to develop scientifically and technically a project management in the study area which is part of an integrated development plan and sustainable development through land use maps of the region that are essential tools for this project.

Key words: *Vegetation, conversion, degradation, aerial photos, GIS*

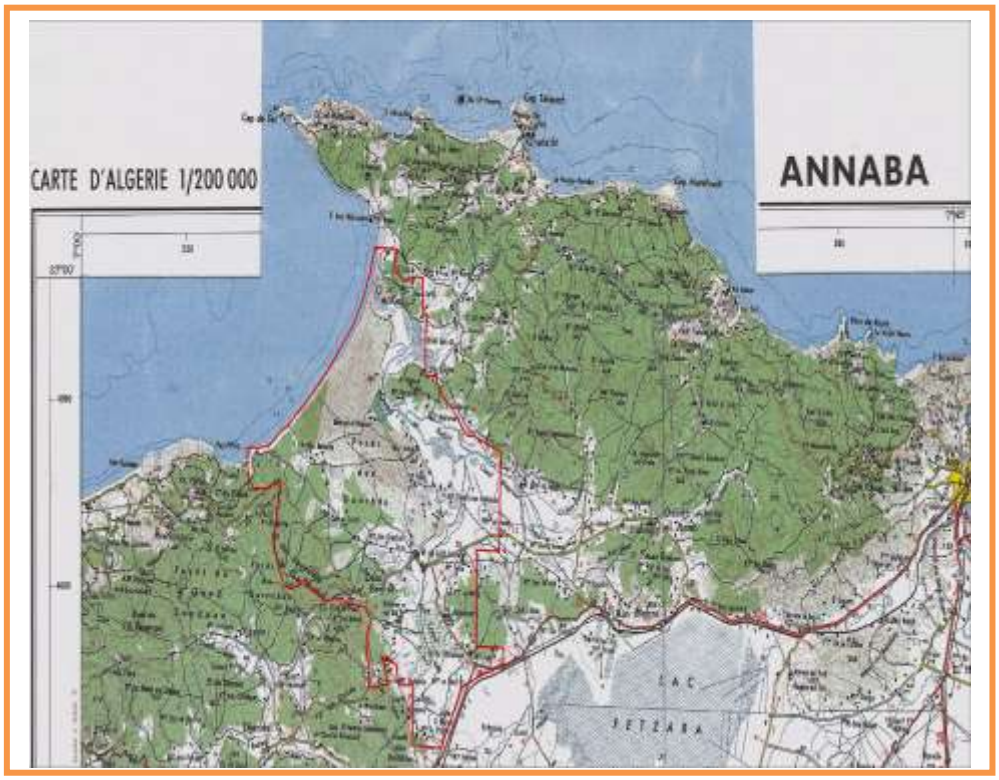
INTRODUCTION

The area of Guerbes aims ecotourism and was classified as a wetland of international importance under Ramsar Convention in 2002. This area localized in north-eastern Algeria is characterized by a very important flora and fauna wealth. Its landscape consists of various ecosystems (terrestrial, aquatic and urban ecosystem). This fragile biodiversity is also threatened by ecological and anthropogenic factors (intensive agriculture) (Aouadi, 1989).
The preservation and protection of existing assets, the valuation of forest products and supporting the development of the area requires sustainable management of the sector by applying the concept sustainable development of forests. Sustainable management reflects an awareness face persistent attacks made forest resources (degradation, exhaustion, excessive resource use, social conflicts ...) that requires mobilizing all its energies to the protection of the forest heritage which represents 26.260 hectares. This therefore needs to intensify the acquisition not only of technical and scientific knowledge effort, but also the observation and understanding of the organization, spatiotemporal functioning and dynamic evolution of these ecosystems and their interaction with the socio-economic environment. In this context, the present study focuses on thematic mapping of the land, which is a fundamental tool to assess the past and current status of the territory in order to define future policies for integrated management using computer tools which are specialists in the field (GIS ...). The development of land use maps will enrich the cartographic base of the region and can thus serve as managers provide an integrated management plan.

MATERIALS AND METHODS

The Study Area

The study area (Guerbes) administratively belongs to Skikda (East-Algerian) and bounded in Annaba topographic sheet at 1/200.000 (Figure 1), which is located geographically in North Africa between longitude 7°15' and 7°37'E and latitude 36°77' and 37°03'N. The slopes vary between 0 and 16%. The elevation is 0 to 200 m on the plain and can reach the 472 m.



The Mediterranean climate of this area is characterized by a cold humid winter and hot and dry summer. Its bioclimatic is sub-humid. The average annual rainfall is estimated between 800 and 1000 mm and the mean annual temperature of the region is 17.8°C, with an average of the warmest month above 28°C and the coldest month varies between 3 and 7°C. The relative humidity of the air hardly falls below 70% (Bazri, 1999). Real evapotranspiration is around 870 and 890 mm (Hadj-Said, 2007), an appreciable quantity favored by the presence of large areas of water bodies (swamps that fall along the Oued El Kebir). The dominant wind direction is North-West and North-East (Photo 1), its action is remarkable on the dunes and trees located at the sea shore.

Photo 1: Wind action on trees (a port flag) Mouhli, N., (2012).

The geological formation is quite complex. The metamorphic series and sedimentary characterize ancient geological ages, from secondary to tertiary. They mainly dominate the reliefs overlooking the valleys of Oued El Kebir East and West. The marine quaternary contains mostly dune formations. However, continental Quaternary formations dominate the plains and valleys compiled by Oued El Kebir East and West. The plain of Guerbes is the water reservoir about 40 million m^3, which generate a multitude of depressions and valleys forming lakes and marshes. The drainage system consists essentially of El Oued Kebir and Oued Magroun (DGF, 2002). The vegetation of this area is characterized by a dominance of cork oak (*Quercus suber*) (Photo 2), whereas the Kermes oak (*Quercus coccifera*) is especially well developed on coastal dunes (Photo 3). By its richness in rivers and lagoons, the study area is home to flora and riparian marsh and along the valleys and the stagnant waters. We also note the presence of hydrophilic species such as common alder (*Alnus glutinosa*).

Photo 2: Maquis of cork oak in Guerbes **Photo 3:** Maquis of Kermes oak in Guerbes

Data processing

The method used in this study was inspired by the project CORINE Land Cover Europe (CGDD, 2011). The CORINE Land Cover program is based on a hierarchical standard nomenclature to 3 levels and 44 stations distributed in 5 main types of land use (artificial Territories, agricultural areas, forests and semi-natural areas, wetlands and water surface). The use of information such as hue, color and texture helped to define the land use classes.

A geographic information system (GIS) is a system for the acquisition, storage analysis, and display of geographic data (Heshmati *and al*., 2013; Madad *and al*., 2013; Polidoro *and al*., 2010). These practices cover the geomantic processing activities and dissemination of geographical information. Representation is generally in two-dimensional (2D), but a 3D rendering or animations showing temporal variations in a territory are possible. For the establishment of our maps, we have integrated in the GIS topographic map data, aerial photos and field data (Madad *and al*., 2013).

The study area fits on a single sheet of topographic Annaba 1/200.000; it is covered by 39 aerial photographs across 1/20.000. These photos have been assembled to provide a single representation of the study area. The integration of different maps and aerial photos in the GIS takes Raster form after scanning. The use of geographic information provided by these documents requires their calibration (georeferencing) in a projection system chosen. The projection used in Algeria (Skikda region) is UTM WGS 84 zone 32 north and technical timing of topographic maps and aerial photos is made by MapInfo (Polidoro *and al*., (2010). The extraction of information figured on topographic maps (Raster mode) is done by digitizing (vector mode). The result of this operation is the achievement of several layers of data on forest, home network... etc.

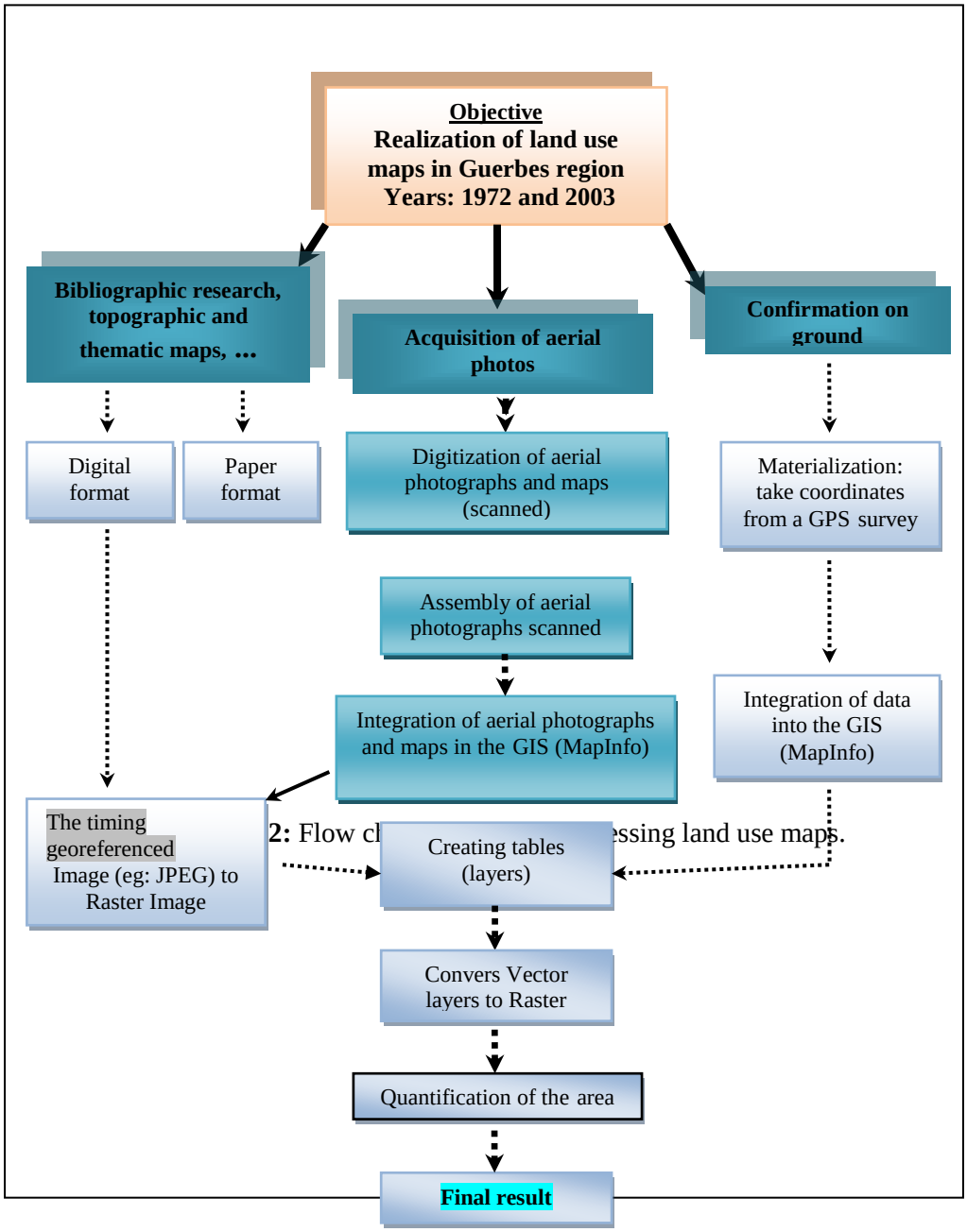
A physiognomic approach, using the overall appearance of vegetation and dominant aspects (e.g.: oaks, alders, lawns ...). This approach thus refers to the concept of plant community and was opted in our case, because it requires less time to recognize the physiognomic units. Multiple outputs on field are to validate the results in the region to identify different plant formations and all other thematic units; characterize vegetation types according to their physiognomy, floristic composition and evolution; check the results of the visual interpretation of aerial photos and to clarify difficult to interpret and record the damage to human action areas.

The field observations are made based on the maps already available and preliminary interpretations of aerial photographs. The method involves determining the parcels on aerial photographs and spot on the ground to validate their thematic significance.

The geometrical position system (GPS) has been used to facilitate the location of the field located on the image sampling points. Indeed, the geographical coordinates were entered automatically into an internal file of GPS, the latter connected with satellites, can guide the cartographer to the point considered (Geoserver, 2013).

Topographic maps were available at scales 1/200. 000, 1/50. 000. This accuracy was sufficient to perform an audit on land in good conditions. Thus, checkpoints have been identified and accurately located on different cards used. Data entry field obtained is made by MapInfo (GIS) software by the function, creation of tables. The data are integrated, either manually or automatically [7]. This operation is done by linking the connection between the GPS functions, the treatment tool and the data storage.

All the steps followed for carrying out two cards of this work are shown in Figure 2.



2: Flow cl…ssing land use maps.

RESULTS AND DISCUSSION

The maps show the major developed land of Guerbes units. The presence of all physiognomic units in 1972 is confirmed, and a bare soil surface representing a fire that hit the scrub cork oak (735.37 ha) is determined (Figure 3). The map of 2003 shows fewer classes following the disappearance of the low plant formation. Degradation of the majority of physiognomic units for agriculture is very meaningful (Figure 4).

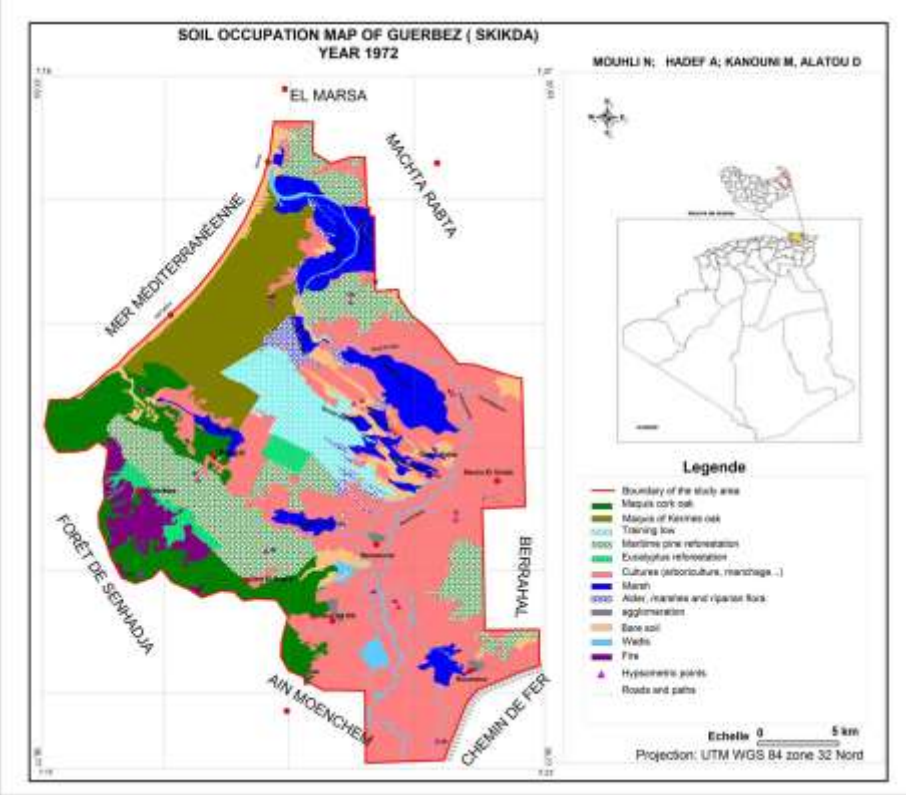


Figure 3: Map of land use in the study area in 1972.

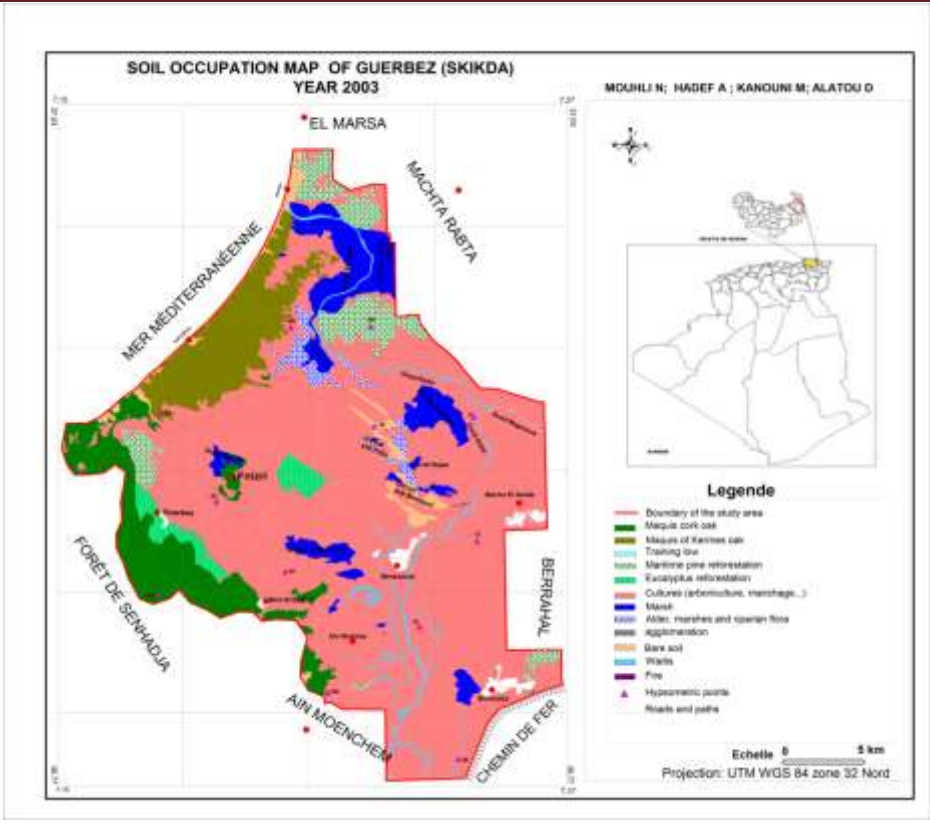


Figure 4: Map of land use in the study area in 2003.

The table 1 summarizes the overall large land units in the plain of Guerbes. The unit's crops have increased significantly between 1972 and 2003, while other units reported an actual decline. For each class, we defined 10 subclasses with their occupied areas to illustrate the regression of the natural vegetation. The land use map of 2003 shows that pressure from human activities are most important contribution by those of 1972. This is probably due to the mechanical means used to carry out the work (clearing, plowing, irrigation ... etc) and the change of the socialist policy towards privatization and self-management of land under concession.

Table 1: Changes in land of Guerbes between 1972 and 2003 areas.

Classes	Sub-classes	Area (ha) (1972)	Area (ha) (2003)
Forest formations	Reforestation	4048.97	1157.26
	Maquis of Cork Oak	2683.61	2832.43
	Maquis of Kermes oak	2735.20	1965.40
	Training low	1403.00	0.00
	Alder	387.61	388.46
Marsh	Marsh	2321.74	1819.45
Culture	Culture	9887.59	16851.77
Valleys	Valleys	597.27	468.95
Bare soil	Bare soil	2113.02	512.53
Agglomeration	Agglomeration	82.00	263.75
Total		**26260.00**	**26260.00**

The period 1972-2003 was marked by a significant change in cultures, where the area increased by 6964.18 ha, with a percentage of 26.52%, an annual average of 232.14 ha in 30 years. The regression of areas physiognomic units due to higher crop due to fierce conversion (Figure 5 and 6):

- Reforestation of eucalyptus and maritime pine is 11.01% with an average of 96.39 ha;
- Maquis of Kermes oak is 2.93% with an average of 25.66 ha;
- Training low is 5.34% with an average of 46.77 ha;
- Marsh with 1.91%, an annual average of 16.74 ha;

- Valleys 0.49% with an average of 4.28 ha;
- Bare soil with 6.09%, or an annual average of 53.35 ha.

By cons, and despite the area destroyed by fire in 1972 735.37ha (2.80%), there was an increase in the area of cork oak scrub with 148.82 ha (0.57%) is an average of 4.96 ha during the period 1972-2003. This gradual change in area of scrub cork oak is not just about the kind of cork oak itself, but also its floristic. As for urban areas (houses), we note an increase in the area of 82 ha (0.31%) in 1972 to 273.75 ha (1%) in 2003. This area is about 181.75 ha (0.69%), and an annual average of 6.06ha.

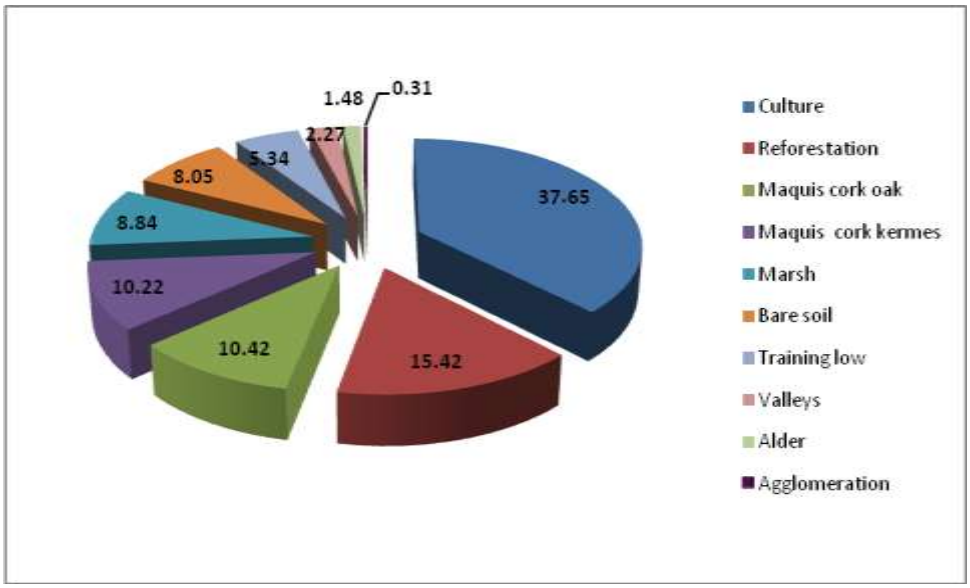


Figure 5: Distribution of the areas Guerbes on different units in 1972.

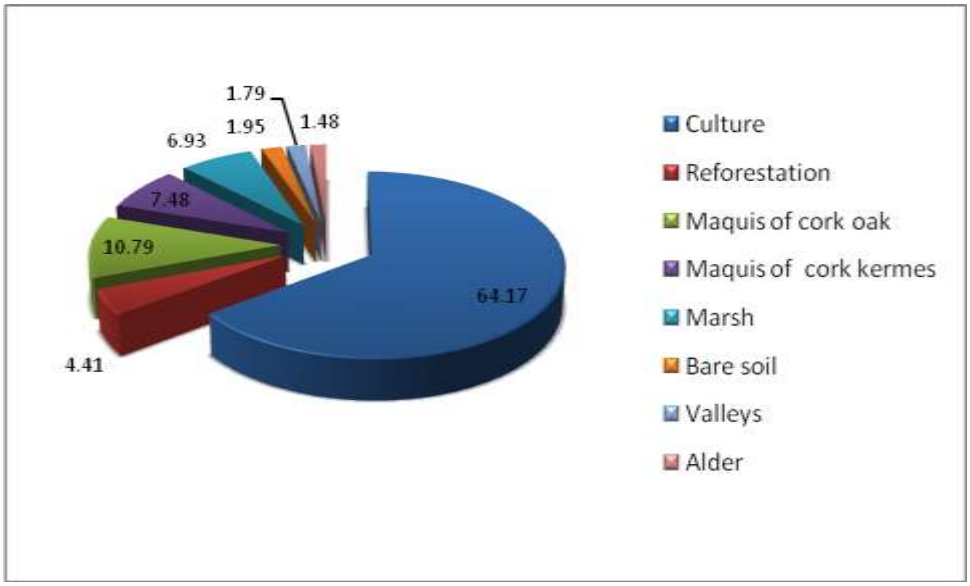


Figure 6: Distribution of the areas Guerbes on different units in 2003.

CONCLUSION

The results obtained in this work show significant variations in the units of the land in the plain of Guerbes and their spatiotemporal dynamic evolution. To this end, we concluded:

• The general statistical analysis of land to two reference dates (1972 and 2003) was used to estimate the intensity of degradation of vegetation cover in terms of conversion the areas of occupation class soil to another ;

• Degradation of natural forests is very important;
• Clearing a threat to plant formations;
• Degradation appears to be irreversible in the case where the continuous phenomenon, despite the special status and international importance given to biodiversity. Moreover, the plain Guerbes with biodiversity needs a real interest of policymakers and environmentalists (integrated management). They must worry about bringing ecosystems under conditions allowing them to provide the goods and services expected. Suggested actions are:
- Rehabilitation of degraded habits;
- Improving socio -economic conditions of local populations;
- Accountability of the population in forest management;
- Monitoring and maintaining the health of the local biodiversity by remote sensing and updating data;
- Avoid assisted regeneration of some introduced species to native place;
- The control of water points, and will be better to stop any water pumping swamp "without water, illicit crops disappear", it is desirable to levy taxes on all exhausting water cultures.

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