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Reflection on Development Prospects Spatio-temporal Forest and Agricultural Land in the Region of Beni Saf (Algeria)

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ABSTRACT

This study highlights and develops a management plan spatio-temporal of forests and agricultural land in the region of Beni Saf. The pressure of the human activities has caused an imbalance in the land use. The methodology applied to superpose the map of potential land and the land use map, using the Geographical Information System (GIS), in partnership with the observations of the ground and the consultation of the forestry and agricultural history of the zone of study. The results obtained revealed a progression in forest space with a surface of 3.332 ha (54%) instead of 2.843 ha (46%), a regression of the space occupied by cereals with a surface of 690 ha or a rate of 11% and an extension of vines up to 600 ha (10%) instead of 5 ha (0,1%), the citrus 275 ha (4,5%) instead of 46 ha (1%) and rustic plantations with a surface of 336 ha (5%) instead of 104 ha (2%). With this planning which rests primarily on the aptitude of the grounds, we can achieve a harmonious balance of the use of the space.

Key words: Cartography, TM land sat, potentiality, management, Beni Saf (Oran-Algeria)

INTRODUCTION

The degradation phenomenon of natural environment presents a major concern for scientists and politicians in Algeria. The natural and agricultural heritage remains the only means to stop desertification and soil erosion. In general, the spaces have undergone a major scourge of increasing degradation, caused by several phenomena: climatic, edaphic and anthropogenic character also xerophytic vegetation and pyrophytic that change their aspects and space (Delabraze and Valette, 1974; Le Houerou, 1980; Tatoni and Barbero, 1995). So, a study to map database is required with a detailed diagnosis, conducted in the field of forest and agricultural areas. We will try through this document to find out expand knowledge about the development and conservation of these environment disturbed and damaged.

The intensification of scientific research on these areas is still the first step to back consistent forestry and agricultural strategies where we can use management programs for sustainable development of these useful areas taking into account the man and his activities.

In this context, our study was conducted on a spot that seems to be mismanaged and underexploited in the region of Beni Saf which has witnessed much damage and disruptions caused by several natural factors and anthropozoic and have left a strong imprint on structures.

Gaining a better understanding of these environments requires an inventory of the occupied land as well as their potential to carry out simulations and crossing information plans in a Geographic Information System (GIS). This landscape analysis is particularly important in the field of restoration in order to know in details the factors structuring the resilience of vegetation. Thus, a preliminary reflection on the reintegration of degraded ecosystems in the landscape is an important step in the development of a restoration strategy, in addition to the choice of the technical objectives of the intervention (Aronson *et al.*, 1993).

The objective of this study is an elaboration of a regional planning map of the zone of study. This will allow us to suggest the appropriate management practices to these natural and agricultural areas often poorly developed.

MATERIALS AND METHODS

Materials

Location: The zone of the study covers an area of 6162 ha. It is located in the region of Beni Saf on the Western coast of Algeria (Fig. 1). It is characterized by two types of relief: the massif of Beni Saf which culminates in its central part at 409 m in Djebel Skhouna and Valley Tafna, on the right bank with a relatively flat topography which extends to the western end of the area of the study.

Geology: The bedrock geology consists of shale and primary Jurassic limestone at the Skhouna chain which lies south of the town of Beni Saf. In addition, the valley Tafna is the most fertile agricultural area of the region due to the presence of volcanic rocks (basalts) that allow the formation of a porous and fertile ground (ANAT, 1994). The soil is generally very heterogeneous, often brown calcareous soils and slightly developed soils of colluvial contribution which occupy the region (Merioua, 2007).

Climate: The climate is Mediterranean, with an average semi-arid bioclimatic level and a warm winter. The average annual rainfall is 360 mm and the average monthly temperatures range from 10°C for the coldest month to 31°C for the hottest month.

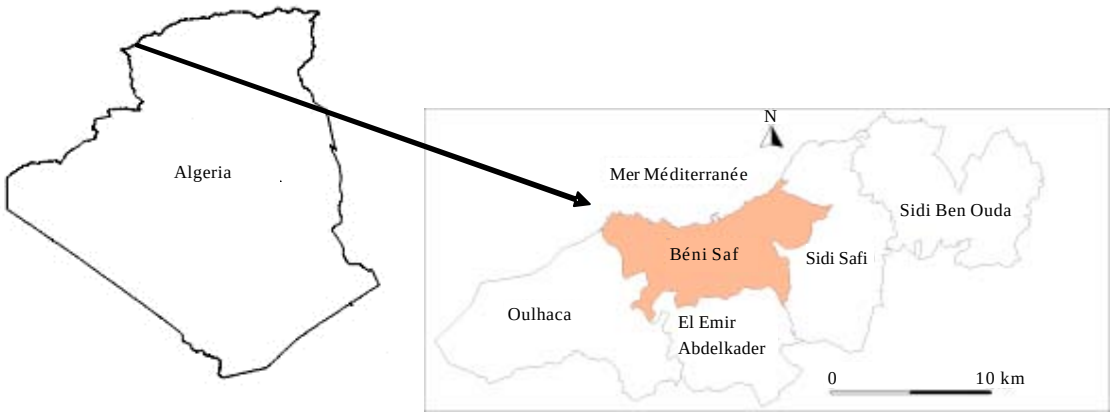

Fig. 1: Location map of the study area

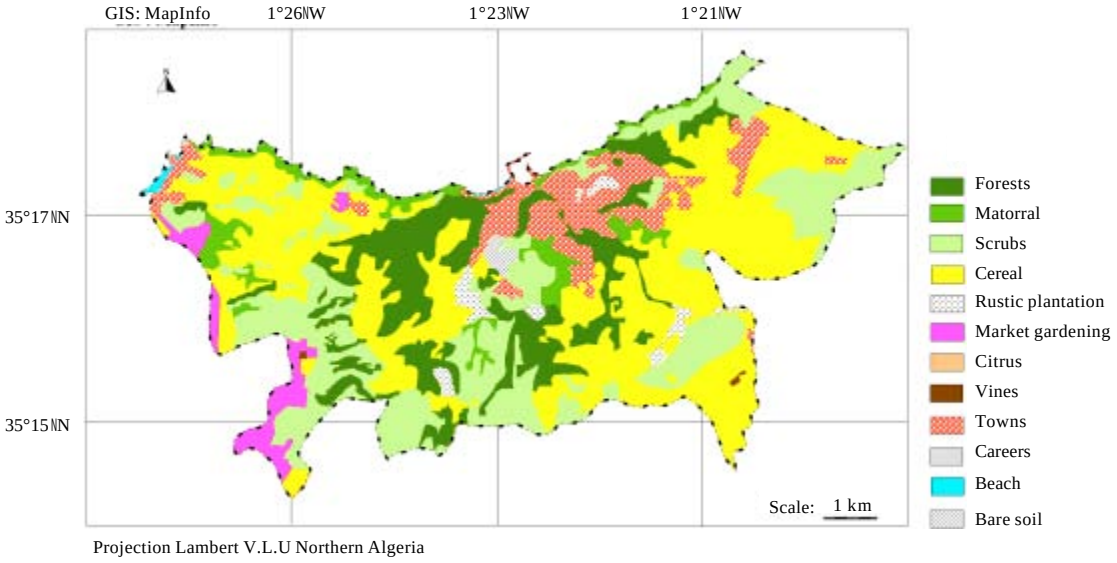

Fig. 2: Map of land use in the area of Beni Saf (year 2004)

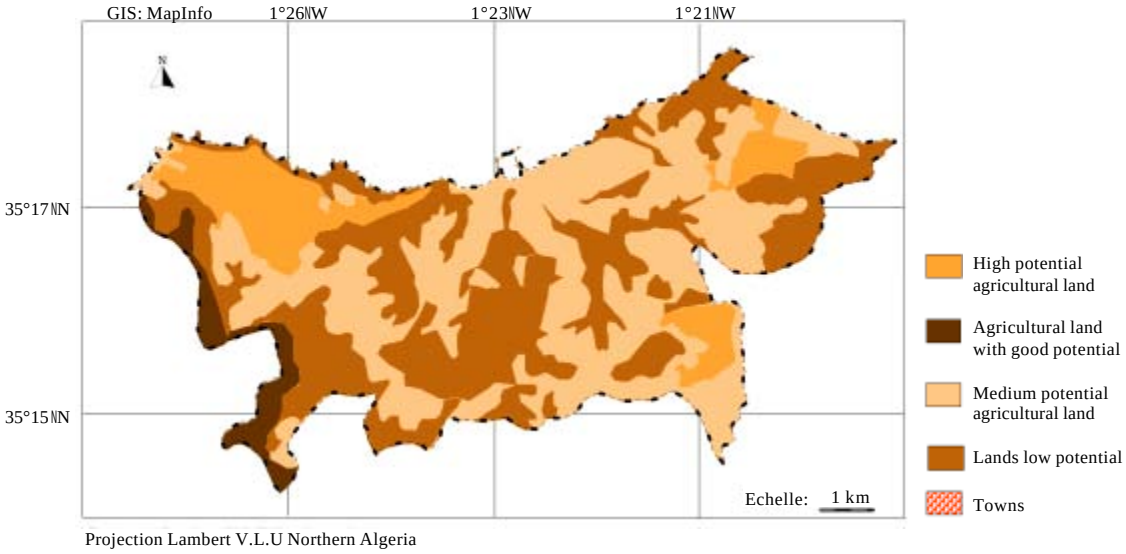

Fig. 3: Map of potential land of Beni Saf area (source: Agence nationale de l'aménagement de territoire) (ANAT, 1994)

Methods: Through this study, we will discuss the specific application of the Landsat TM satellite imagery on 27 July 2004 (part 198-36) in the realization of the land use map (Fig. 2) and its use of potential land area (Fig. 3) of study by ANAT (1994) (Agence Nationale d'Aménagement de territoire), to obtain quality of data for the management and development of land (Fig. 4).

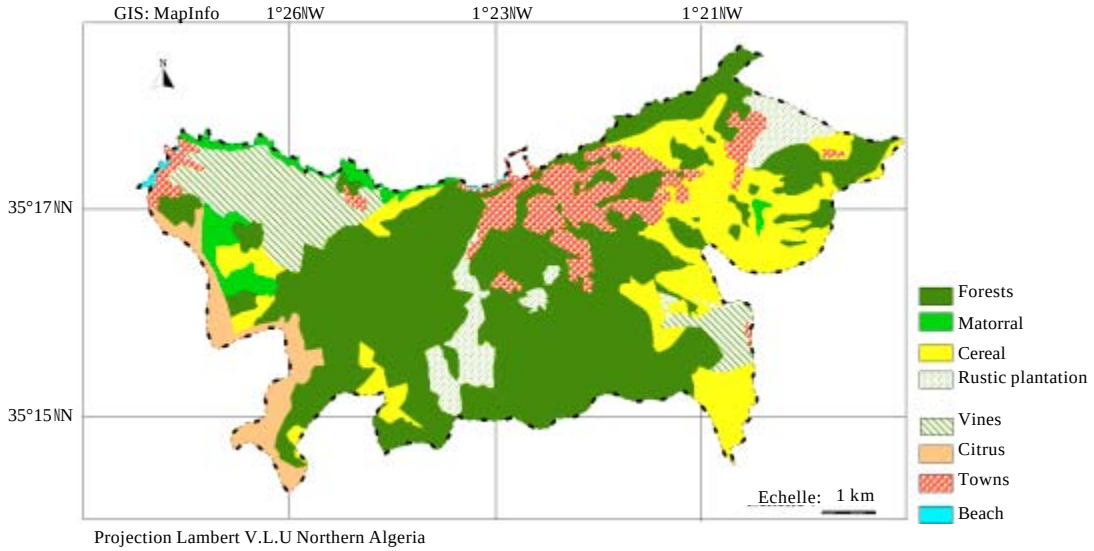

Fig. 4: Map spatio-temporal development of agricultural and forest land of Beni Saf area

Thus, our choice focused on the following channels: TM4, TM3 and TM1. This choice was based on the correlation between significant spectral channels allowing a visualization of colored image compositions (red, green and blue "RGB") that promote the best information for the interpretation of the thematic content of the Landsat TM image.

Corrections involved in the classification phase of the image that was used to attach values to radiometric characteristics of thematic classes of land use. It was the supervised approach which was used, based on the sites properly identified. The forests formation, agricultural lands and other places of human activities were digitized in form of geo-referenced layers "tables" on Landsat TM satellite image, after being treated and wedged under the software ENVI 3.5 and MapInfo 6.5 without any loss of data. The georeferencing used to establish the position of the phenomena on the territory (Prelaz-Droux, 1995). The GIS were designed to study synthetic human activities and natural environments distributed throughout the territory. The target objectives aimed to a better understanding of natural and anthropogenic processes that alter the structure and land use (Theriault, 1996).

Many audits of primary products have been made in the field of study to verify the themes recognized on the map already designed by the office and to assess the quality of the results.

Superimposing maps of the land use and the land potential were established using the GIS, in addition to the history of forestry and agriculture in the study area, allowed us to obtain the map's layout of the region of Beni Saf.

RESULTS AND DISCUSSION

General occupancy land: The total area of the study covers 61.62 km², according to different criteria: land use and occupation of land. The information derived from our research through the use of the GIS (Table 1).

Table 1: Land use of Beni saf area for year 2004

Designations	Area (ha)
Area "ha"	
Forests	990.50
Matorral	315.30
Scrubs	1538.00
Cereal	2310.50
Market gardening	165.30
Citrus	46.10
Rustic plantations	104.20
Vine	5.20
Towns	544.20
Beach	15.10
Careers	95.70
Bare soil	31.83
Total	6161.93

Agricultural area: This space is dominated by the Useful Agricultural Area (UAA) which occupies 2631 ha, or 43% of the total area. Indeed, the potential irrigated UAA represents an area of 211 ha or 8% of the total UAA. The majority of these lands are located in the valley of Tafna where intensive agricultural activity is carried out, based on the cultivation of citrus fruits, market gardening and cereal.

The field crops, especially cereals, occupy a surface of 2311 ha, or 88% of the total UAA, practised on the interior plains of western and eastern zone of study. These crops are often associated with ovine and bovine breedings.

The irrigated land are used primarily for citrus and vegetable crops and are distributed on the Eastern shore of Tafna and El Abradj fields in the North West region of Beni Saf, where the climate is favorable (no jelly).

In the valley of Tafna, citrus occupy an area of 46 ha. Other hardy species are grown in the region following the development programs of the agriculture of the mountains; it is the olive groves and fig trees on an area of 104 ha. These orchards are in a very advanced state of degradation due to lack of maintenance work.

The irrigated and dry vegetable crops cover an area of 165 ha, or 6% of the UAA. They lie on volcanic soils and clay marl in the West of Beni Saf.

The growing potential is very low. It occupies only 0.2% of the UAA or 5 ha. The old orchards as evidenced by existing infrastructure (cellars), gave way to the cereal.

Forest area: The zone of Beni Saf, like the other Mediterranean regions, is characterized by a very high biodiversity in terms of flora which largely consists of particular therophytes, represent 41% of all vegetation (Merioua, 2007). Therophytisation is a form of resistance to drought and degradation of vegetation (Quezel, 2000; Daget, 1980; Benabadji and Bouazza, 2000).

The wealth of therophytes, short-cycle species in the Mediterranean region in particular, are more adapted to the aridity of the climate especially to the summer hydrous stress (Stebbins Jr, 1952; Stebbins and Major, 1965).

The forest area covers 2844 ha. It consists of degraded forests which extend on a surface of 991 ha. They are mostly artificial plantations generally resulting from reforestation installed

from a network of benches carried out during the years 1945, 1965, 1976, 1984 and 1985, to fight flooding and land subsidence. These stands are made of *Pinus halepensis* representing 98% of forests in the mountains of Beni Saf (north side of Jebel Skhouna), the area of Ghar El Baroud and the edge of the town of Beni Saf. Stands of *Eucalyptus camaldulensis* represent 2% and occupy the lowlands and wadis, including El Saf Saf and El Middah. These two species are mainly used in reforestation and taking the place of degraded vegetation, consisting of matorrals trees (pine forests) more or less dense, based on thermophilic species. The matorral generally occupies the whole of the coastline with a surface of 315 ha. It consists of a few scattered trees of *Pinus halepensis, Ceratonia siliqua, Olea europea, Pistacia lentiscus* with a degraded physiognomic state which does not exceed the height of 3 m. This layer is accompanied by the shrub which consists of *Calycotome spinosa, Calycotome vilosa, Chamaerops humilis, Ampelodesma mauritanicum, Asparagus acutifolius*, etc. (Merioua, 2007).

The scrub represents 1538 ha much of these formations are degraded and are distributed throughout the region of Beni Saf. It is based of *Calycotome spinosa, Calycotome vilosa* of *Chamaerops humilis, Ampelodesma mauritanicum, Asparagus acutifolius, Rosmarinus officinalis, Cistus albidus, Cistus monspeliensis, Lavandula multifida, Lavandula stoechas, Withania frutescens*, etc. (Merioua, 2007).

The presence of the following species: *Ampelodesma mauritanicum* (Poir) Dur, *Chamaerops humilis subsp argntea, Urginea maritima* L. *Asphodelus microcarpus* Salz, *Ferula communis* L. highlights the degradation level and an imbalance of vegetation (Quezel, 2000; Quezel *et al.*, 1992).

Urban space: The satellite images play an important role in urbanization. They help planners to have an overview of the current situation and to consider future developments (Awad, 2003).

Urban landscapes of Beni Saf and the secondary towns, experienced significant growth. During the early 1970, the chief town of Beni Saf occupied an area of 137 ha. Now, after thirty-two (32) years, the town takes a larger space (544 ha), almost 75% (Merioua, 2007). This immense development and occupation of the area are related to several factors:

- **Demographic factor:** The population of the town of Beni Saf is becoming increasingly important, 42,846 inhabitants, with a growth rate of 1.76%. The majority of the population, about 80% lives in the town of Beni Saf, attracted by the scourge of rural exodus
- Encouragement of self-construction of habitats
- The extension of the industrial zone (the Cement factory and other industrial sites)
- Creation and construction of social amenities such as: educational centers and cultural, health centers etc. which have also participated in the extension of the town

CLASSIFICATION OF LAND ACCORDING TO THE POTENTIAL

High potential agricultural land: In the region of Beni Saf, it is the soil of the lower valley of Tafna (Fig. 3). It consists of slightly developed soils of alluvial contribution, good depth more than 80 cm, with a fine to medium texture and the topography is flat (ANAT, 1994). These lands represent an area of 266 ha, or 4% of the total area of the municipality, usually occupied by citrus and vegetable crops.

Agricultural land with good potential: These soils are located in the western part of the town of Beni Saf (El Bradj). They are from Marno-sandstone and volcanic formation with a good depth to moderate (60-80 cm) and topography less than 3% (ANAT, 1994). This type of land represents 766 ha, or 12% of the total area. It is occupied by cereals and orchards.

Medium potential agricultural land: These soils are set out everywhere through the region. They are rich in iron (iron dioxide), not deep (30-50 cm) with a shallow calcareous crust (30 cm) and a topography marked by slight undulations (slope varies the 3-12%) (ANAT, 1994). These lands represent 35% or 2155 ha and are occupied by cereals.

Lands low potential: These lands are occupied by vegetation (forest, scrub, shrub formation). They represent 40% of land i.e., 2431 ha, located on the massif of Beni Saf (mount Skhouna), with a steep slope (25%). These skeletal soils are heavily eroded (ANAT, 1994).

PLANNING AND PERSPECTIVES

Owing to our research in the region of Beni Saf, we made a reflection on the developments and future prospects to restore the ecological balance, environmental and economic development of these areas.

A management and perspective map of the region of Beni Saf (Fig. 4) was established by the superposition of two maps namely: the map of potential land and land use map (2004) and the consultation of archives and history of forestry and agriculture in the zone of study.

In fact, we offer the following recommendations (Table 2):

- Forest-space must be protected and maintained by silviculture
- The area occupied by the shrub formations must be reforested manually without destroying the vegetation work benches network
- A forest area can reach 3156 ha
- The matorral should be protected by a strict implementation defends
- The expansion and development of the vineyards in the area Labradj, Gaadette El Gozlène, Bled Lahmaida over an surface of 600 ha, instead of cereal
- The citrus extension on all the banks of the Tafna River, whose water help for permanent irrigation, occupies a surface of 275 ha
- Development of rustic orchards as Olive, almond and fig trees, on lands with average slope over a total area of 336 ha
- The market gardening will be carried out in the fields of citrus fruits (between the trees) what is called the integrated cultures or intensive cultures

Table 2: Occupation proposed land of Beni saf area

Designations	Current surface (ha)	Rate (%)	Surface proposed (ha)	Rate (%)
Forests	990.50	16.0	3156.00	51.21
Scrubs	1538.00	25.0	-	-
Matorral	315.30	5.0	176.00	2.86
Vine	5.20	0.1	600.00	9.74
Rustic plantations	104.20	2.0	336.10	5.45
Citrus	46.10	1.0	274.70	4.46
Cereal	2310.50	37.0	1619.20	26.28

CONCLUSION

The phenomenon of degradation has left a strong imprint on the natural environment in the region of Beni Saf. Indeed, natural vegetation and agricultural areas have undergone a major scourge of increasing degradation caused by several natural agents such as climate aggression (irregular rainfall), drought, fungal diseases, in addition to anthropogenic factors which play a major role in the current organization of vegetation structure. Indeed, a rapid increase in population, especially in rural areas, determined a radical transformation of the use of the environment by man and his livestock. Deforestation, dématorralisation, uncontrolled development cultures and excessive overgrazing deeply disturbed the ecological balance (Barbero *et al.*, 1990). The protection of natural ecosystems requires integrated multidisciplinary approach taking into account both human practices and dynamic vegetal formation.

For further analysis, the implementation of Geographic Information System GIS in Land Sat satellite image interpretation of 2004 in the region of Beni Saf, led us to know our space by theme (forest, agriculture, urban ....) and eventually the establishment of a map of the occupied land. The superposition of the latter with the map of potential land in the same zone of study enabled us to achieve the regional planning board which will be used for the management and arrangement of such different backgrounds, in order to maintain a balance between agricultural production and other forest land. The results obtained concerning the changes which will occur in these areas in the future, have revealed an increase in the forest formation with a rate of around 54% and a decline in space occupied by cereal around 11% and an extension of vines up to 10% instead of 0.1%, the citrus 4.5% instead of 1% and rustic plantations with a surface of 5% instead of 2%. With this planning, we can achieve a harmonious balance that is mainly based on soil suitability linked directly to ecological conditions.

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