

EVALUATING THE DYNAMICS OF THE ACHACH FOREST, CENTRAL PLATEAU - MOROCCO

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Abstract : *The Moroccan forest ecosystems are changing rapidly due to the ecological, social and economic constraints that result in different forms of degradation. Annually, WWF has estimated that more than 31000 hectares are subtracted from the forest estate because of clearing, harvesting fuel wood, cutting green wood, overgrazing, prolonged drought, urbanization, forest fires and woodland decline. The primary objective of this study is to high light the degradation and forest dynamics in the Achach forest which is located in the Moroccan central plateau. This forest area occupies 15995. 97 ha and is composed mainly of Tétracelinis, holm oak, cork oak and other secondary species. Bioclimatic analysis has allowed locating the area of study in bioclimatic semi-arid area with temperate variant. Remote sensing and GIS helped to establish land maps. The evolution map of Achach forest obtained from a diachronic analysis of Landsat 5 satellite images captured in July 1987 and August 2011 revealed a regression of 64.58% of pure holm oak area and 27.14% of pure Tétracelinis area compared to their initial areas of 1987. Permanent vegetation is under significant anthropozoogenic pressure.*

Keywords - *degradation, dynamics, télédétection, SIG, Achach Forest, Morocco*

I. INTRODUCTION

On the Mediterranean circumference, the "gap analysis" study conducted by the WWF (2001) [1] considers that the original forest cover was approximately 82% of the total area of the Mediterranean countries. Currently, there is only 17% of this forest heritage often considered deeply degraded in the southern countries. The current situation is described as being dramatic in various countries in North Africa [2]. The degradation of forest ecosystems and forest Moroccan perished manifested through deforestation (31,000 ha / year), dams siltation (annual loss of storage capacity of 50 million m³ equivalent to irrigate 5000 to 10,000 ha, decreased forage potential (loss of 4.8 million UF / year), the loss of agricultural production (22,000 ha of arable land) and ecosystems simplification (biodiversity loss). Indeed, the annual cost of this degradation is estimated to 710 million dirham [3]. Thus, the Rif area alone lost between 1966 and 1986 half of its vegetation cover [4] and Maâmora forest lost almost two thirds of its area in less than a century [5].

Similarly, the argan forest covering an area of 830 000 hectares, located mainly in South West Morocco, witnessed a massive degradation in recent decades. In less than a century, more than a third of the forest has disappeared [6] and its average density dropped from 100 to 30 trees / ha. For example, an ecosystem of the argan trees in the Admine forest (Agadir region) initially occupying 22,000 hectares in 1950 decreased to 9,900 hectares between 1969 and 1986 [7] which amplified the phenomena of wind erosion and silting in the region.

The Achach forest exudes a fundamental specific problem to the region where several constraints, endogenous and exogenous, continuously induce a very strong pressure. Remote sensing is defined as the scientific discipline that brings together all the knowledge and techniques for observation, analysis, interpretation and management of the environment from measurements obtained using flat airborne platforms, space, land or sea [8]. The objective of this research study is to quantify and develop the kinetics of evolution stands of the Achach forest by diachronic study over 24 years (between 1987 and 2011), using GIS techniques and remote sensing.

II. MATERIALS AND METHODS

II.1. Presentation of the study area

The Achach forest is bounded on the north by the M'dakra forest, on the south-west by the Oued Zemrine, in the east by the Gnadiz forest, in the north and northeast by the forest of Oued Tifssasine.

The area is located on the bioclimatic semi arid temperature. The average annual rainfall ranging from 350 to 450mm (Sidi Sbaa station and El Kkhatout station).

Indeed, 70% of the relief is formed by mountains. The remain area consists of plateau and valleys. The soil is dominated by Lahrache (33%) and Dendoune (77%). Tétracelinis, holm oak and cork oak are the basic plants formation of this forest stands.

Publication History

Manuscript Received : 26 June 2014
Manuscript Accepted : 1 July 2014
Revision Received : 5 July 2014
Manuscript Published : 6 July 2014

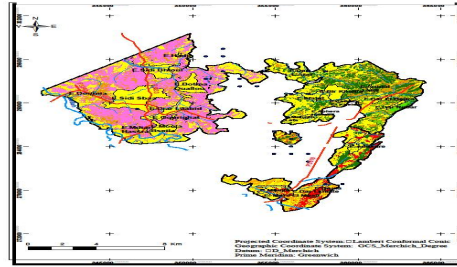
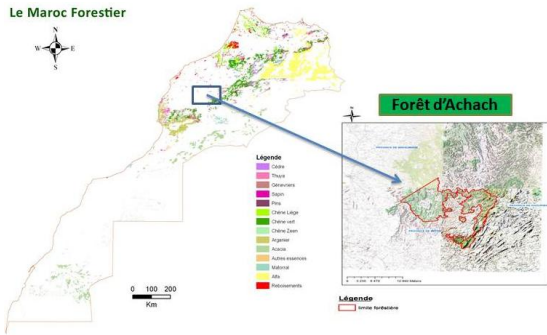


Fig. 1: Map of forest Achach in 1987

II.2. Available Data

- Forest stand map of the Achach 1/200000, 1997;
- Forest Map, Azhiliga NI-29-XI-4, 1/100000, IFN; 2008
- GPS data on the boundary of the study area; 2009/2011
- Landsat satellite images used were obtained from the website <http://earthexplorer.usgs.gov>.
- Satellite imagery (Landsat 5) TM 13 July 1987 covering the study area;
- Satellite imagery (Landsat 7) TM of 4 August 2011 covering the study area.
- Notebooks Consignment forest offenses 1987-2011
- Management plan of the Achach forest (period 1999 to 2027)
- Management Study of Oued Mellah watershed (2005)

II.3. Methods of treatment and analysis

We adopted a methodological approach, whose various steps were detailed to produce a forest map of Achach, following a classification supervised by the 'likelihood' method. The study area is divided into five districts, processed independently. The nomenclature, necessary for the design of the thematic map, is presented in 7 classes.

II.4. Diachronic analysis

The method of detecting changes in forest stand was used based on the comparison of two Landsat TM scenes between 1987 and 2011.

I. RESULTS AND DISCUSSION

III. 1. Cartographic presentation of the results obtained

The merging of partial results from different stages of classification allowed us to retain the relevant themes of land occupation (cover) (Figures 1 and 2). The 6 classes of land occupation are finally mapped to present holm oak, cork oak, tetraclinis, mixed stand, reforestation and the State-owned empty (not woodland) or enclaves (land cultivated by users). The classification process generates statistics on areas of different types of land cover for each of the two dates. The comparison of the two maps and the two corresponding statistical series can highlight the vegetal land cover changes that have occurred between 1987 and 2011 (Figure 3). Misclassified pixels are marginal.

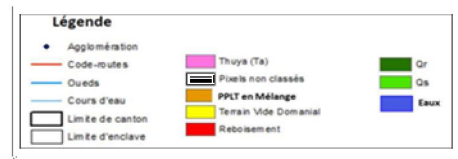
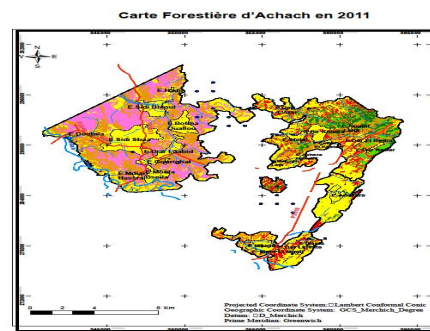
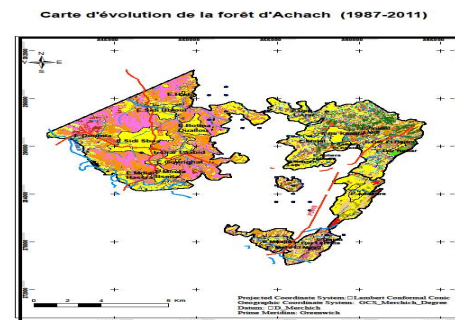


Fig. 2: Map of forest Achach in 2011



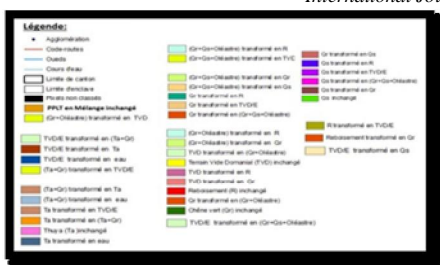


Fig. 3: Map of forest change Achach (1987-2011)

Table I: Results of the changes during the period (1987 - 2011).

Px: pixel, R: reforestation, EDTV: empty land or federal enclave, Qr: holm oak, Qs: cork oak, Ol: oléastre, Ta: tetraclinis,

The EDTV also undergoes regression 548.64 ha (7.62%). The average annual rhythm and the average annual rate of reduction are respectively 0.33% and 22.86 ha. The subtracted superficies have undergone some regeneration work of Tetraclinis and in water (Ttamesna dam built in 2005).

On the contrary, the area of settlement in the mixture of tetraclinis and Green Oak (Ta + Qr) increased from 1738.44 hectares or 172.81% compared to the original area. The annual rhythm and the average annual rate increases are respectively 72.44 ha / year and 7.20%. This mixture took place mainly EDTV especially following the campaigns of Tetraclinis regeneration. The cork oak (Qs) also increased at the expense of (EDTV) and (Q) over an area of 374.85.ha, or 115.2%, which corresponds to an average annual rate of 14.49 ha and an average annual rate 4.8 %.

Land	1987		2011		difference		Annual average rate	
	Sup (ha)	%	Sup (ha)	%	Sup (ha)	%	Sup (ha)	%
Px	85.5	1%	121.41	1%	35.91	42%	1.50	1.75
R	579.69	4%	1305.09	8%	725.4	125.13%	30.23	5.21
TVDE	6920.1	43%	6371.46	40%	-548.64	-7.92%	-22.86	-0.33
Qr	1671.3	10%	591.93	4%	-1079.37	-64.58%	-44.97	-2.69
Qr+Qs+Ol	987.84	6%	1024.56	6%	36.72	3.71%	1.53	0.15
Qr+Ol	414.9	3%	231.93	1%	-182.97	-44.1%	-7.62	1.83
Ta+Qr	1005.93	6%	2744.37	17%	1738.44	172.81%	72.44	7.20
Qs	301.95	2%	649.8	4%	347.85	115.2%	14.49	4.8
Ta	4028.76	25%	2934.99	18%	-1093.77	-27.14%	-45.57	-1.13
Eau(barrage)	0	0%	20.43	0%	20.43	-	0.85	-
Total	15995.97	100%	15995.97	100%	-	-	-	-

III.2. The forest evolution during the period (1987 - 2011)

During the period 1987-2011, the pure holm oak (Q) and pure tetraclinis (Ta) have decreased significantly. Regression of the area of pure green oak is valued at 1079.37 ha or 64.58% of its area in 1987 (Table I). This decline corresponds to an average rate of 44.97 ha / year, or an average annual rate of decline of 2.69%. Similarly, the decline in the area of pure Tetraclinis is valued at 1093.77 ha, or 27.14% of its area in 1987. This decrease corresponds to an average rate of 45.57 ha / year, or an average annual rate of decline of 1.13%. The majority of areas of pure green oak and pure Tetraclinis were transformed into State-owned vacant lots or enclaves (EDTV) or have undergone processing by reforestation (R) produced by the Water and Forest administration .

Settlement in a mixture of green oak and oléastre, has also declined to 182.97 ha, or 44.10% of its area of origin, which corresponds to an average rate of decline of 7.62 ha/year giving an average annual rate of decline of 1.83 %. Loss of area of this mixture was replaced by holm oak (Q) and reforestation (R).

Similarly, reforestation (R) has evolved 724.5 ha or 125.13% compared to the original area. The annual rate and the average rate of their growth are respectively 30.23 ha and 5.21%.

Settlement in mixture of green oak, cork oak and olea Oleaster (Qr + Qs + Ol) has also experienced a slight increase of 36.72 ha (3.71%), therefore the annual rate of 1.53 ha with a rate annual average of 0.15%.

According to the map the evolution of the Achach forest (Figure 3), the extension of golf cultures and EDTV are seen most often around the enclaves, and gradually spread to the surrounding forests. However, it is not impossible to find some land crops in full forest and sometimes in very difficult fields (steep slopes, ridges ...).

During this period, the decline of the Achach forest has particularly affected the holm oak and pure tetraclinis stands and settlement in the mixture of green oak and oléastre state.

III.3. Explanatory factors of identified changes

Based on the prospection we made in the field and on the analysis of existing documents at the local Waters and

Forests of the Province of Settat, we have found a strong human activities pressure on forest resources or by the criminal cuts of wood for charring or by overgrazing. We have not identified any phenomenon of death or decay of any species in the forest. Therefore, the climatic factor is not a direct factor in the degradation of this forest. The grazing in the region is highly dependent on woodlands. The local population exploits the natural resources in an excessive and irresponsible way not caring about its sustainability. Analysis minutes (PV) offenses timber prepared by forest wardens between 1987 and 2011 (24 years) show that they have amounted to 3324 PV cutting 34,714 trees and path having damaged 161531arbres.

III. 4. Effort of the Moroccan government to remedy this situation

To overcome this situation in Achach, the High Commissariat for Water, Forests and Combating Desertification (HCEFLCD) has adopted a strategy for the recovery of degraded ecosystems by using participatory and integrated approaches. Thus, intervention programs usually revolve around three axes: the first concerns the implementation of reforestation, regeneration and silvopastoral improvement; the second addresses the upgrading of equipment and infrastructure; while the last axis focuses on accompaniment actions directly to local people based on actions generating revenues. The HCEFLCD also organizes training workshops and sensitization to profits of all stakeholders and users, namely: population, elected officials, rural municipalities, NGOs, to sensitize them to the consequences of forest degradation and to try to organize associations and cooperatives to sustainably manage resources in a legal and regulatory framework.

VI. CONCLUSION

The diachronic study is based on the use of multitemporal image (TM 1987 and TM 2011). This study has allowed mapping the evolution of forest stands using remote sensing and GIS. The results show that green oak and Tetraclinis are the more species that have declined respectively to 64.58% and 27.14% compared to the initial area in 1987. The Achach forest is subjected to multiple farms in socio-economic constraints, leading to degradation of this ecosystem. This is due to the high anthropic pressure as criminal logging and overgrazing. The alarming situation and the issues and challenges in this studied area led the forest managers to develop solutions which could be ensure the development and the sustainability of Achach forest.

ACKNOWLEDGMENT

We like to express sincere appreciation and deep gratitude to all participants in this work.

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