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Spatial entities and cover mapping by thresholding of a vegetation index: Case of the region of Naama (Algeria)

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ABSTRACT

A large variety of methods and techniques for analyzing multidate satellite images have been developed to detect changes in the Earth's surface. Based on the assumption that changes in land use are reflected in changes in radiance, the preclassificatory method was used in this study, conducted on an arid steppe region belonging to the wilaya of Nama, West Algeria. This method consists in highlighting the radiometric changes between two images of Landsat (TM, 1987) and SpotView (XS, 2007) acquired on different dates but within the same annual period.
The interpretation of the two maps derived by thresholding P.V.I. (Perpendicular Vegetation Index) clearly shows the degradation of the environment. The "bare soil" and "low cover" spatial entities increased considerably in 2007 (479 and 1774 km2 respectively) compared to 1987 (258 and 1205 km2 respectively), while the other two entities "medium cover" and "dense cover" have experienced an opposite scenario at the expense of the first two. Thus, the evolution of spatial features of the vegetation cover of the study area can be perfectly monitored and the associated mapping informs very precisely about spatial changes that have occurred over time.

RESUME

Entités spatiales et cartographie de recouvrement par seuillage d'un indice de végétation : Cas de la région de Naama (Algérie). Une grande variété de méthodes et de techniques d'analyse d'images satellitaires multidates ont été développées afin de détecter les changements de la surface terrestre. En se basant sur l'hypothèse que les changements de l'occupation du sol se traduisent en variations de la radiance, la méthode préclassificatoire a été utilisée dans la présente étude, menée sur une région steppique aride appartenant à la wilaya de Nâama, Sud-Ouest Algérien. Cette méthode consiste à mettre en valeur les changements radiométriques entre deux images Landsat (TM, 1987) et SpotView. (XS, 2007) acquises à des dates différentes mais d'une même période annuelle.
L'interprétation des deux cartes issues par seuillage des P.V.I. (*Perpendicular Vegetation Index*) montre clairement la dégradation du milieu. Les entités spatiales « sol nu » et « couvert faible » ont considérablement augmenté en 2007 (479 et 1774 km^2 respectivement) par rapport à 1987 (258 et 1205 km^2 respectivement), tandis que les deux autres entités « couvert moyen » et « couvert fort » ont connu un scénario inverse au détriment des deux premières. Ainsi, l'évolution des entités spatiales du couvert végétal de la région d'étude peut être parfaitement suivie et la cartographie associée renseigne très précisément sur les changements spatiaux parvenus dans le temps.
Mots clés : Entités spatiales, Télédétection, SIG, Seuillage du PVI, Carte de recouvrement, Nâama, Algérie.

1. Introduction

If all of the arid and semi-arid areas in Algeria are actually subject to various forms of degradation, the high steppe plains of South-Oran and specially the wilaya of Naama remain the most affected by the problem of silting, salinisation and consequently the intense degradation of the environment until the creation of deserted areas (Haddouche, 2009). The strategy for preserving and restoring degraded soils and ecosystems in Algeria has been successful over 50 years, with the exception of some mixed successes (Benabdeli et al., 2015). Niox (1890) described in his book the existence of real areas of alfa (sea of alfa) which covered the trays of Mecheria with a good cover rate close to 90%. This witness has helped us to get an idea of the evolution of the steppe landscape from the colonial era until now. Thus, for more than a century, there has been a real change of landscape, from a steppe environment to a desert environment with the installation of dune buildings that are gaining ground at the expense of the steppe rangelands (Le Houérou, 1993). The set values (irrigated crops and cereal crops) are very limited in space and represent a negligible area. This strong tendency towards degradation through the reduction of biological potential and the breakdown of ecological and socio-economic balances is confirmed through numerous studies on the Algerian steppe (Bouazza et al., 2004; Bensaid, 2006; Haddouche, 2009; Hadeid, 2015). According to MATE (2002), in the steppe area 500 000 hectares are in the process of desertification and more

than 7 million hectares are directly menaced by the same process. Consequently, the intense degradation of these fragile environments induces desertification (Haddouche et al., 2007).

The quantification of the dynamics of silted spaces realized by Bensaid (2006) on the whole wilaya of Naâma made it possible to take stock of the current state of the soil surface. However, according to Pouchin (2001), in order to understand the dynamics of landscapes, their identification and characterization go through the delimitation of landscape units. However, according to Haddouche (2017), the environment must be split into spatial entities whose their attributes present homogeneity of appearance on the satellite image, as on the results maps.

Thus, this study focuses on the identification of spatial entities of the vegetation cover and the characterization of the degradation in the wilaya of Nâama (southwest of Algeria) by analyzing the diachronic evolution, which better translates the environmental response to climate change and anthropogenic pressures. The aim is to control the changes by examining the trend of the evolution of bare soils that pose no problem with quantifying the spatio-temporal scale.

2. Material and methods

2.1. Material

2.1.1. Presentation and location of the study area

The study area is located in the western part of the highlands, on the Algerian-Moroccan borders (Fig.1) and is administratively connected to the wilaya of Naâma, which is the result of the last administrative division established by Law 84- 09 of April 4, 1984. It is inserted between the Tellian Atlas in the North and the Saharan Atlas in the South, and extends over an area of 3600 km².From the morphological point of view, the structure of the whole region presents itself as a vast asymmetric syncline oriented OSO-ENE whose axis is very south, at the edge of the first outcrops of the Saharan atlas (Maniere and Chamignon, 1986).

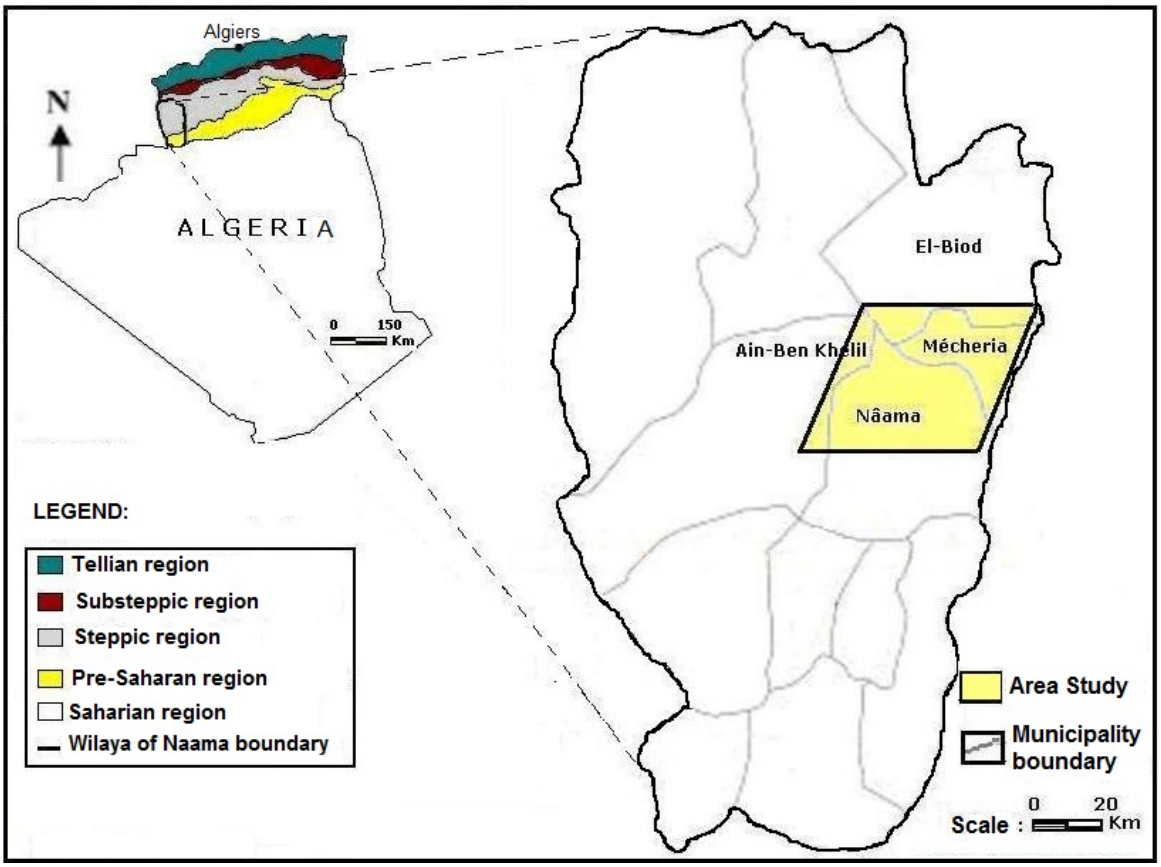

Figure 1- Geographic location of the study area

2.1.2. Digital data and software

In addition to a M.N.E. (Digital Elevation Model) at 20 m resolution), two satellite images were selected for our research. It is a Landsat image (Sensor TM, 1987) at 30 m resolution and another SpotView (Sensor XS, 2007) with 20 m resolution acquired on different dates but from the same annual period (25/04/1987 and 26 March 2007 respectively). The Arc-Gis software "LEICA GEOSYSTEMS" and the ENVI v.4.5 "ENvironment for Visualizing Images" software have been used for the different phases of pre-processing and satellite image processing.

2.2. Methodology

2.2.1. Resampling of the 1987 image

The reference image (Spotview 2007, 20 meters resolution) is corrected with 8 bitter points previously taken on the ground by G.P.S. Having the same spatial reference, the Landsat 1987 image (30 meters resolution) is resampled at 20 meters and corrected geometrically with respect to the reference image in order to make comparisons between the two shooting dates

2.2.2. Covering maps

The vegetation surveys are performed in March 2007 (Figure 2). This month was chosen as the preferred period for this type of measure, because it is the season when green biomass is the most important. Generally, this type of measurement is produce in the spring for perennial and annual steppe plants. Plant surveys were classified allow to their covering rate. Four classes of collection were therefore chosen:

- Class 1 = 0% (code 1);
- Class 2 = <30% (code 2);
- Class 3 = 30 to 50% (code 3);
- Class 4 => 50% (code4).

The method used in this work is that of preclassification. It consists, by accentuation, of creating a new image where the changes are highlighted. This enhancement of images is obtained by the implementation of point (pixel-to-pixel) and / or global operations (taking into account the whole image). Thus, thresholding was applied to P.V.I. of the 2007 image to find the different intervals of the values of this index, corresponding respectively to the four classes retained (Tab.1). By a simple application model, these same intervals were found on P.V.I. of the 1987 image, because they are two P.V.I. are totally comparable in view of the radiometric and atmospheric corrections carried out previously.

Table 1- Values of the two thresholding P.V.I.

Code	**Interval values P.V.I. (µm)** « Image 2007 »	**Interval values P.V.I. (µm)** « Image 1987 »	**Covering rate**
1	- 6 __ + 0.72	- 6 __ + 0.72	Bare soil
2	+ 0.72 __ +2.23	+ 0.72 __ +2.23	Low Cover: < 30%
3	+ 2.23 __ + 4.8	+ 2.23 __ + 4. 8	Average Cover : 30 – 50 %
4	+ 4. 8 __ + 23	+ 4. 8 __ + 23	heavy Cover : > 50 %

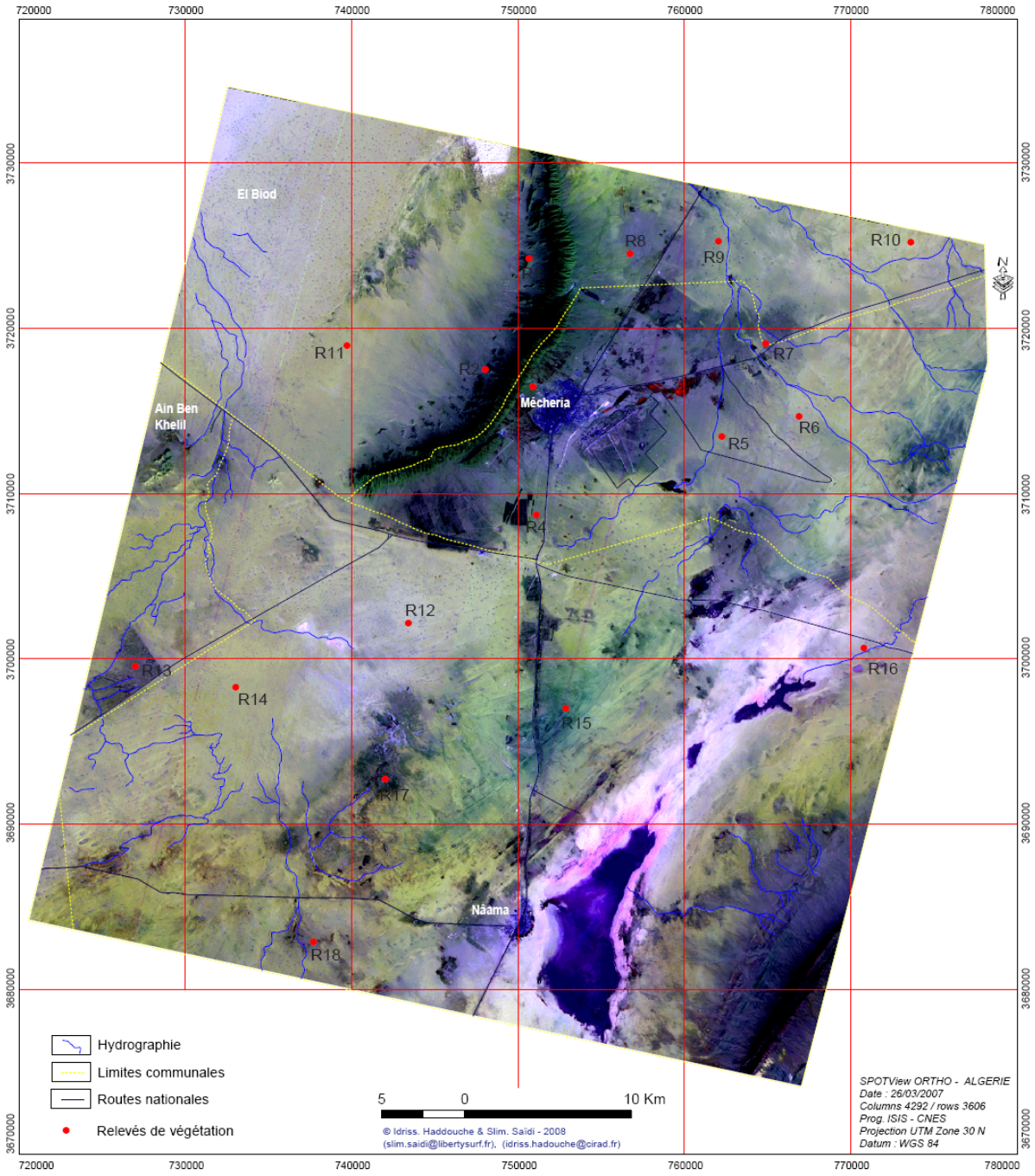

Figure 2- Location of field surveys on the radiometric image Spot View 2007

3. Results and discussion

3.1. Spatial Entities by Numbers

The reading of Table 2, the analysis of the graph (Fig.3) and the interpretation of the two maps derived by thresholding of the P.V.I. (Fig.4) clearly show the degradation of the environment. The "bare soil" and "low cover" classes increased considerably in 2007 (479 and 1774 km2 respectively) compared with 1987 (258 and 1205 km2 respectively), while the other two classes "average cover" and "heavy cover" Have experienced an opposite scenario at the expense of the first two.

Table 2- Rate and percentage of vegetation covering (1987-2007)

According covering of field surveys		**SPOT covering 2007**			**Landsat covering 1987**		
Covering	**Code**	**Surface** (ha)	**Surface** (km²)	**Surface** (%)	**Surface** (ha)	**Surface** (km²)	**Surface** (%)
0	Bare soil	47904	479	20	25709	258	11
<30	Low Cover	177426	1774	73	120495	1205	50
30-50	Average Cover	17423	174	7	91356	913	37
>50	Heavy Cover	230	2	0	5423	54	2
Total		242983	2430	100	242983	2430	100

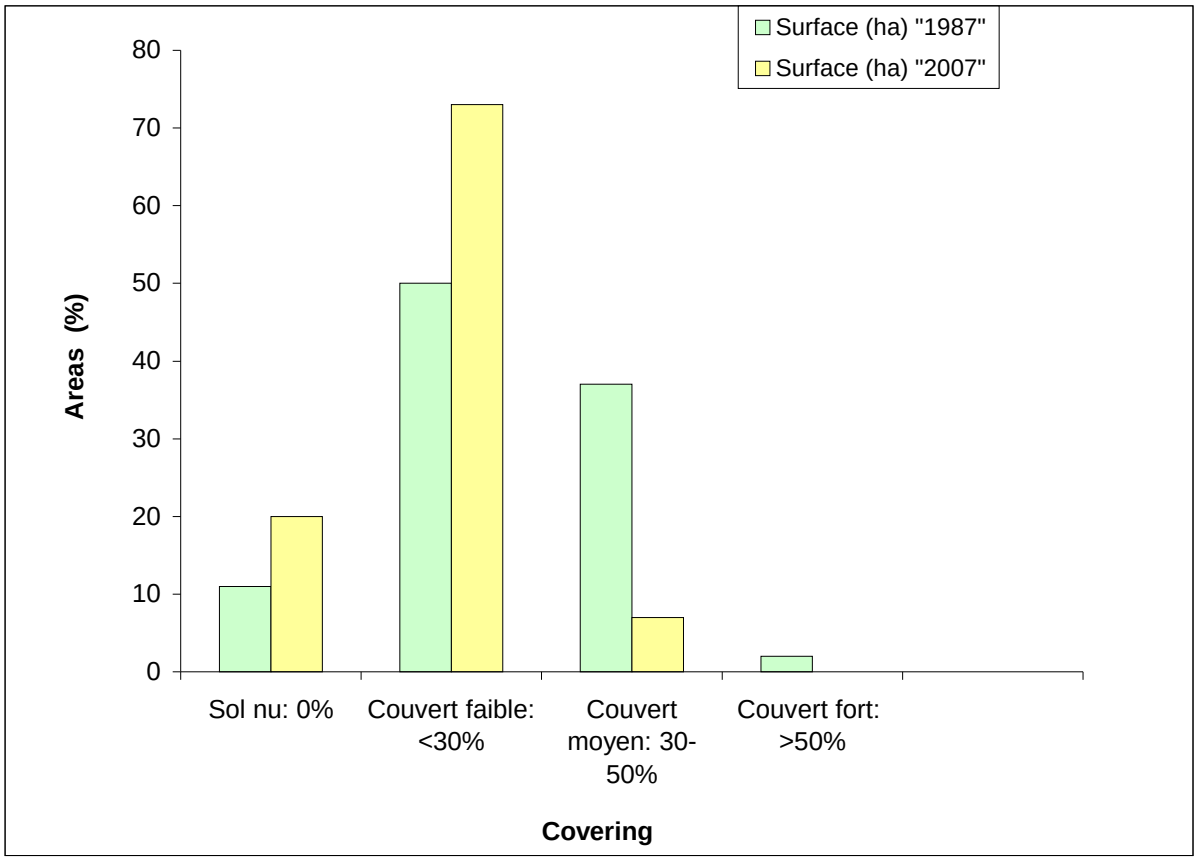

Figure 3- Percentage of vegetation covers (1987 - 2007)

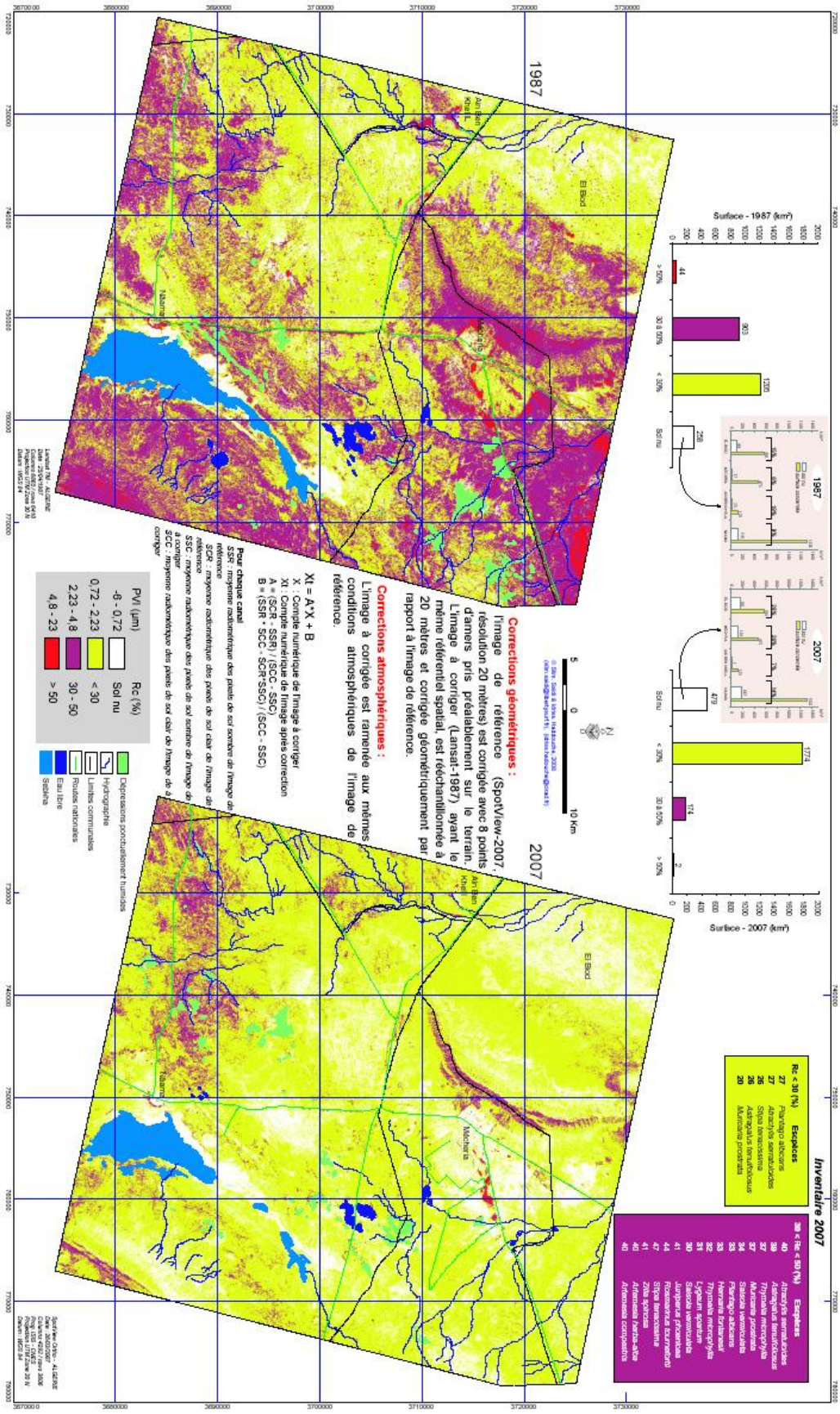

Figure 4- Vegetation covering by thresholding of P.V.I. (1987-2007)

3.2. Tendency of rapid evolution

The thresholding of the two P.V.I. (Image 1987 and image 2007) revealed significant changes in vegetation covering. Once vegetation covered well (1987 map), this vegetation disappeared and was replaced by the extension of bare soil and sand accumulations (2007 map).

The quantitative analysis of the rapid evolution of the landscape, and more particularly the evolution of the bare soils in the territories of the municipalities affected by the study, is interesting insofar as it makes it possible to draw up a provisional assessment of the current state of the study area. Using this analysis, we can sensitize the population, local elected representatives and decision-makers on the extent of the phenomenon of wind and / or water erosion.

The bare soil file obtained by mask was crossed with the file of administrative boundaries in order to establish a quantification of the bare areas within each municipality.

In analyzing table 3 and figure 5, it appears that the communes of El Biodh and Mécheria are the most affected by this purely regressive phenomenon. The image of 2007 shows almost double the area of the bare soils compared to that of 1987 for the municipality of El Biodh. As for the municipality of Mécheria, the area of bare soil has increased in 2007 to nearly five times the area recorded in 1987. This clearly shows the state of degradation reached in this region of the wilaya.

Table 3- Areas of bare soil of two dates (1987 and 2007)

	Image T.M. Landsat 1987		***Image X.S. SpotView 2007***	
Municipality	Bare soil (ha)	Bare soil (km²)	Bare soil (ha)	Bare soil (km²)
El-Biodh	8899.3	89	16064.6	161
Mecheria	2671.0	27	12437.5	124
Ain Ben-khelil	2269.0	23	670.16	7
Naâma	11916.9	119	18732.58	187
Total		258		479

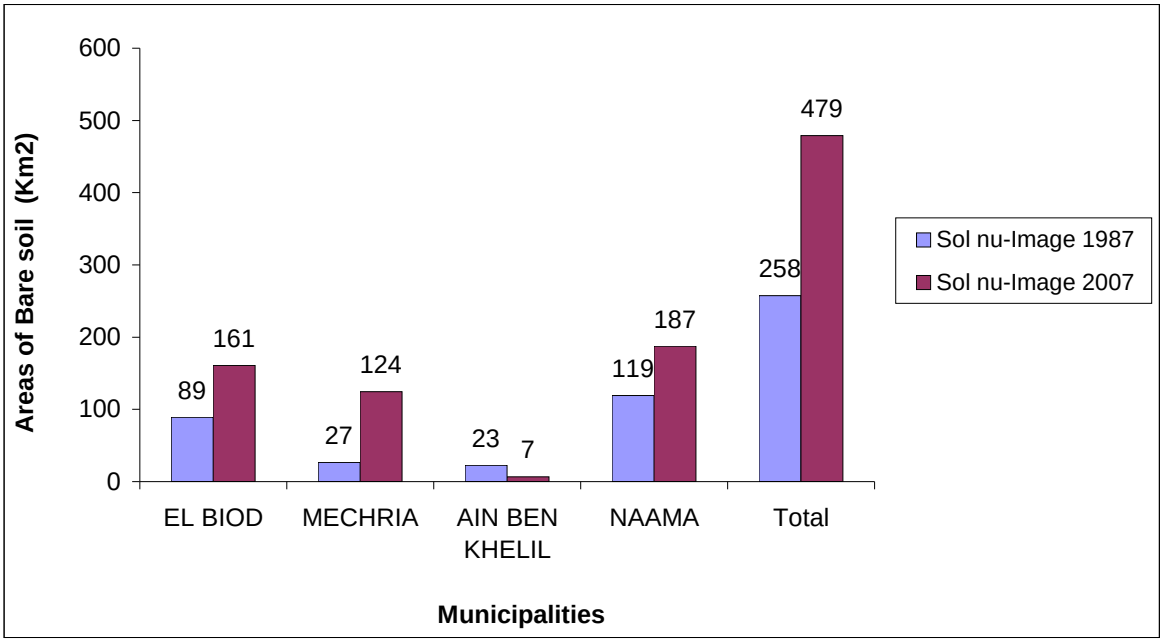

Figure 5- Comparison of the areas of bare soil calculated from the two P.V.I. (1987 and 2007)

3.3. Comparison and Analysis

The vegetation units were defined according to a floristic standard. The results show that the territory is covered by physiognomic groups (steppe species in association, crops, matorral and reforestation) where the vegetation types occupy clearly divided areas in 2007 compared to those of 1987. It emerges that the vegetation of this region is in a very advanced state of degradation and this for the major part of the study area. These areas,

if not protected, will suffer the same fate as the zones around Mecheria and especially the eastern part of this locality (bare soil) have suffered. The vegetation between the Mecheria axis and the Ain Ben-khelil axis, formerly having a good cover rate, has disappeared and has given way to the extension of species of poor quality and sand accumulations.

Thus, after processing the information collected in the field and the results obtained after the analysis of the phytoecological surveys and mapping, We believe that the protection of this ecosystem, which is a determining factor of its sustainability, has not been sufficiently integrated into the approaches of direct users and local managers of the steppe rangelands.

4. Conclusion

The treatments applied to the remotely sensed data on the Naâma region have highlighted the changes that have affected the study area and the characteristics of the ecological environment. The diachronic study by the satellite images allowed us to make measurements of surfaces of the cover of the ground, between two photograph images. The vegetation cover rate between medium and high was increased from 39% to 7% between 1987 and 2007. This regression is explained by the increase in the rate of vegetation cover (<30 %) And bare soils increased from 61% to 93%. The computerized processing of two-dimensional optical satellite images and different sensors (calculation of various indices of change, classifications, filtering) revealed a generalized degradation of the vegetation cover. The latter accelerates the process of desertification, the socio-economic impact of which is reflected in the reduction of agricultural production and the reduction of pastoral areas.

The detailed analysis of the results on the study area shows a high degree of conformity with the evolution of vegetation behaviour that can be observed on the ground. The evolution of the spatial entities can be perfectly monitored and the associated mapping informs very precisely about the spatial changes described above. However, the operations carried out by the Algerian State over the last five decades have been very limited in space and they represent a negligible area compared to that of the whole steppe. These development projects for these areas need to be intensified with more monitoring to ensure a efficacy sustainable of the actions engaged.

References

1. Benabdeli K., Belgherbi B., Benguerai A. et Yerou H., 2015. Apport des matrices de gestion des risques à la restauration écologique des écosystèmes dégradés en Algérie : Cas des monts de Beni-chougrane, Mascara – Algérie. Revue Ecologie-Environnement (11) : 74-79.

2. Bensaid A., 2006. SIG et télédétection pour l'étude de l'ensablement dans une zone aride : le cas de la wilaya de Naâma (Algérie). Thèse de doctorat, Université d'Oran Es-Senia, 299 p.

3. Bouazza M., Benabadji N., Loisel R. et Metge G., 2004. Evolution de la végétation steppique dans le sud-ouest de l'Oranie (Algérie). Ecologia mediterranea, 30 (2) : 219-231.

4. Haddouche D., 2009. La télédétection et la dynamique des paysages en milieu aride et semi-aride en Algérie : cas de la région de Naâma. Thèse de doctorat, Université de Tlemcen, 211 p + annexes.

5. Haddouche D., 2017. Cartographie pédopaysagique de synthèse par télédétection. Editions Universitaires Europeennes, Catégorie: Géosciences, 76 p.

6. Haddouche D., Mederbal K., et Saidi S., 2007. Space analysis and the detection of the changes for the follow-up of the components sand-vegetation in the area of Mecheria, Algeria. Revue Française de Photogrammétrie et de Télédétection (185) : 26-29.

7. Haddouche D. et Saidi S., 2014. Plan et options de gestion de la ressource pastorale : Cas de la région de Mécheria (Algérie). Journal of Remote Sensing and GIS, 2(1): 62-69.

8. Haddouche D., Toutain B., Saidi S. et Mederbal K., 2008. Comment concilier développement des populations steppiques et lutte contre la désertification? Cas de la wilaya de Nâama (Algérie). Revue New Medit VII (3) : 25- 31.

9. Hadeid M., 2006. Les mutations spatiales et sociales d'un espace à caractère steppique, le cas des Hautes Plaines sud-oranaises (Algérie). Thèse de Doctorat d'Etat en Géographie, Université d'Oran, 506 p.

10. Le Houérou H.N., 1993. Changements climatiques et désertisation. Revue Sécheresse, 4(2) : 95 – 111.

11. Maniere et Chamignon, 1986. Cartographie de l'occupation des terres en zones arides méditerranéennes par télédétection spatiale. Exemple d'application sur les hautes plaines Sud Oranaises ; Mécheria au 1/200.000ème. Ecologia méditarranea ; XII, (1-2) : 159 – 185.

12. Mederbal Kh., 1995. Compréhension des mécanismes de transformation du tapis végétal : approche phytoécologique par la télédétection aérospatiale et dendroécologie de *Pinus halepensis Mill*. dans l'Ouest algérien. Doctorat d'État, Université d'Aix-Marseille III. 229 p.

13. MATE, 2002. Rapport annuel du Plan National d'Actions pour L'Environnement et le développement durable. Ministère de l'Aménagement du Territoire et de l'Environnement (MATE), 140 p.

14. Niox (Colonel), 1890. Géographie militaire. VI. Algérie et Tunisie. Éditeur : Paris, Baudoin, 1890, 437 p.

15. Pouchin T., 2001. Elaboration d'un observatoire paysager, Application à l'estuaire de Seine. Centre Interdisciplinaire de Recherche en Transports et Affaires Internationales, Thèse de Doctorat, université du Havre, 316 p.

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