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USE OF REMOTE SENSING FOR MONITORING OF THE DEFORESTATION IN SEMI-ARID REGION CASE OF THE DJELFA FORESTS (ALGERIA)

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Abstract
The current study is interested in the pilot region of Djelfa steppe located in northern Algeria, where a sizable pastoral activity serves as the foundation of the social organisation and the primary source of income. Today's courses experience a severe degradation that menaces the future of pastoral activity due to the disorganisation of social fabric, the phenomenon of turning into a desert, and eolian erosion.
It is in this concern that we worked out a methodological approach aiming at characterising the current ecological situation, by using efficient tools namely: remote sensing and GIS.
Thus a card of occupation of the ground containing a characterisation of the various courses of the area was carried out by the use of the Landsat imagery.
The results so obtained and other inherent data in the middle of study and with our problems were integrated in a Database with the purpose of placing at the disposal of the decision makers and the specialist's rational management tools in the fodder resources.

Keywords: Algeria, Degradation, Djelfa, ETM+, NDVI, TM.

1. INTRODUCTION

In steppe Algeria the area, forms a ribbon of more than Twenty million hectares extend, western south in north east, a natural ecological barrier between the Sahara in mobility and such in loss of fertility (Khader et al, 2020).
Many mailmen, generally acting as synergy, work with the attenuation of the steppe (Bensaid, 2006); Hirche et al., 2010; Benguerai, 2011). A hard climate and irregular and rare precipitations have ridged, for already a few decades, against an increase in population extremely testing and an unsuited exploitation (Djellouli, 1990; Hadjiat, 1997; Cornet, 2002); Benslimane et al, 2008; Mouissa & Fournie, 2013).
This situation is in fact extremely alarming. Nevertheless if it is confirmed now that the risks of turning into a desert are accentuated and multiplied when the human ones act on the ecosystems beyond their limit of resistance (Khader et al., 2009a). The management of this pastoral space largely

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obeys still traditional practices which proved their limits. The obligation to adapt efficient tools investigations prospection is strongly recommended in any reflection on suitable models of management.
The geomantic one is an important information source for the management of vegetable covers (Mederbel, 1983; Chuviec, 1993; Ababou et al., 2009). The Normalised Difference Vegetation Index derived from the radiometric data of remote sensing, are largely used in the monitoring plans of the dynamics of the vegetation and the cartography of the changes which have occurred in the various ecosystems (Rondeaux, et al, 1996) ; (Bannari, 1999 ; Chirici et al., 2001).
Remote sensing techniques have been mainly applied to overcome the shortcomings of classical inventory methods, and they resulted in a large variety of inventory data and derivative products (Ababou et al, 2010; McRoberts & Tomppo, 2007). Since the launching of the first Landsat dealing with a Multispectral Scanner System (MSS) dated to 1972, remote sensing and different modeling methods have been used in forest inventory studies: regression analysis (Ardö, 1992; West, 1995 ; Lu, 2005; Salvador & Pons, 1998;); k-nearest neighbor method (Franco-Lopez et al., 2001; McRoberts & Tomppo, 2007 ; Tomppo et al., 2008; Gasparri et al., 2010; Dandan Xu, Xilun Guo 2014; Khader et al., 1014) ; neural networks (Foody et al., 2003); and fuzzy logic (Triepke et al., 2008). Remote sensing data, geographic information systems, and modeling are now often used in ecological studies (Cohen & Goward, 2004). According to (McRoberts & Tomppo 2007; Khader et al., 2009b). Actually, remote sensing data contributes in the enhancement of forest inventories in several factors:

- Deliverance of simple acquired geospatial data at lower cost than aerial photography;
- Possibility of wide areas Inventories with better accuracies and stratified and weighted estimates;
- Estimation of restricted areas where field data is unavailable;
- Productions of forests thematic maps which can be useful for further ecological studies.

The present study comes under the aim to map the state of steppe rangelands in the semi-arid region of Djelfa (Algeria) in comparison to the standardised Normalised Difference Vegetation Index (NDVI) derived from satellite images covering the same area in two different dates. In particular, it relates to the northern party of the province of Djelfa.

2. Hardware and method

2.1. Study areaand available data

A geographical area of 116 650 ha has been delimited, it is between latitude 34° 32’ and 35° 03’ N and longitude 2° 27’ and 3° 05’E (Fig. 1). This area is located in the middle of the steppe, commonly known as the South Algiers steppe. It is characterized schematically by the existence of a relatively large thermal and pluviometry gradient, by the presence of limestone substrate and by the existence of a landscape ranging from steppes to forests (Pouget, 1998).
The forest occupies a surface of approximately 50 000 ha (Haddouche, 2002). It is a natural forest except for some afforestations primarily made up of clear formations of *Pinus halpensis*. The total surface area of the wooded areas was reduced much by the attacks of the processionary caterpillar this last decade.

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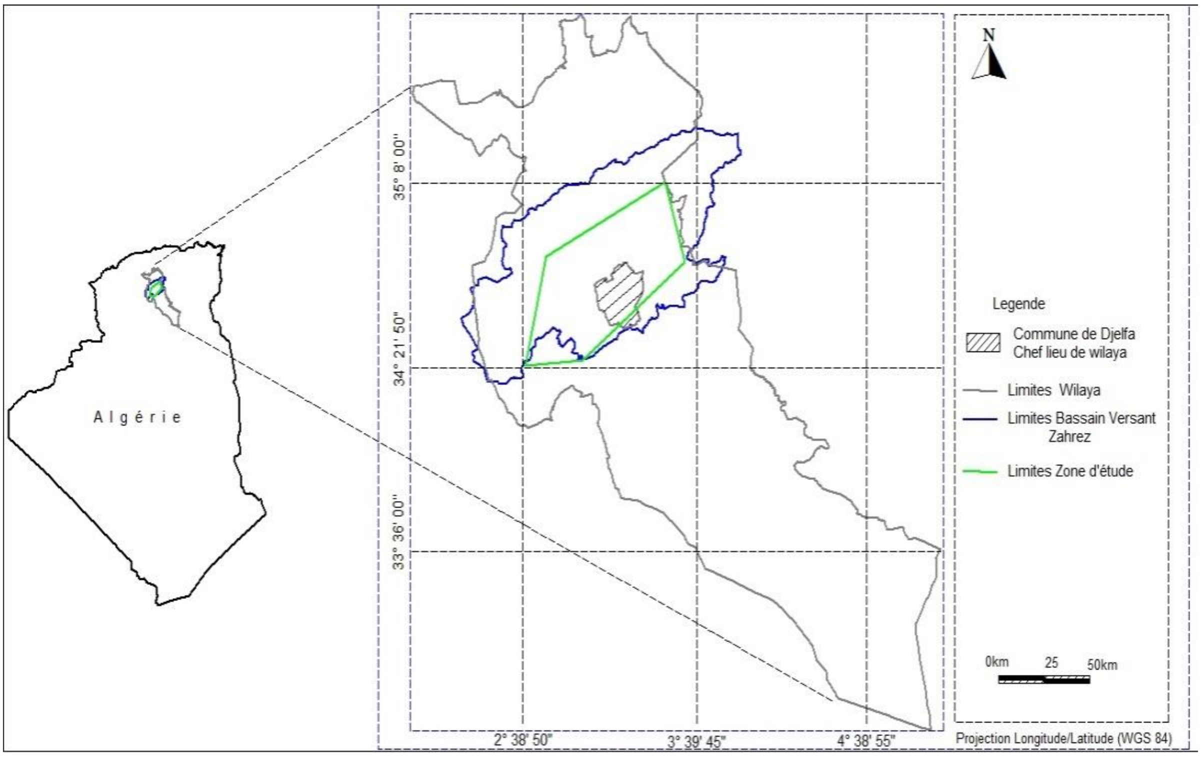

Figure 1. Localization of the study area.

2.2. Analyze of changes

The cartography of the changes in the studied area requires the use of the satellite images taken on separate dates. For this purpose, two scenes Landsat-TM and ETM+ covering the area of study on Mai14th, 2001 and on April 18th, 2013 were used. It is about scene 195/36 of the Landsat squaring of Algeria. The geometrical conditions of captures of sight of the two scenes are given on the following board:

Table 1: Characteristics of the data captured images for the study

Image	*I-2001*	*I-2013*
Date d'acquisition	*14/05/2001*	*18/04/2013*
Temps d'acquisition	*10^h 08'45''*	*10^h 21'53''*
Capteur	*TM*	*OLI/ TIRS*
Charge nuageuse et ombre	*0*	*0*
Azimut	*139°002*	*136°418*
Angle solaire	*49°401*	*59°938*

The atmospheric conditions marked by the light presence of clouds on the image of 1987 do not have a great influence on the use of this image. The adopted methodological approach rests on the comparison pixel with pixel of the index of vegetation standardized derived from the radiometric securities of the image for each date. This comparative method requires the elimination of the

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distortions related to the conditions of capture of sight of the images (negotiable instrument of the geometry and the influence of the atmospheric conditions).
The geometrical preprocessings thus contained a D-sampling of the dot pitch of image 2001 of 28,5 therefore to 30 meters to correspond ETM+ of 2013. To return the two images used geometrically superposable, a geometrical correction using of the check-points was carried out.
The other stage of the preprocessings relates to the atmospheric calibration of the images, in fact that the atmospheric mailmen are not identical for the two dates of capture of sight. However, the relative method of atmospheric correction used by (Durriu, 1994) based on the selection on the image of the purposes a priori invariants was adopted. A simple linear model aiming at describing the relation betweennumerical accountsof the two images at the two dates was established (Fig. 2).

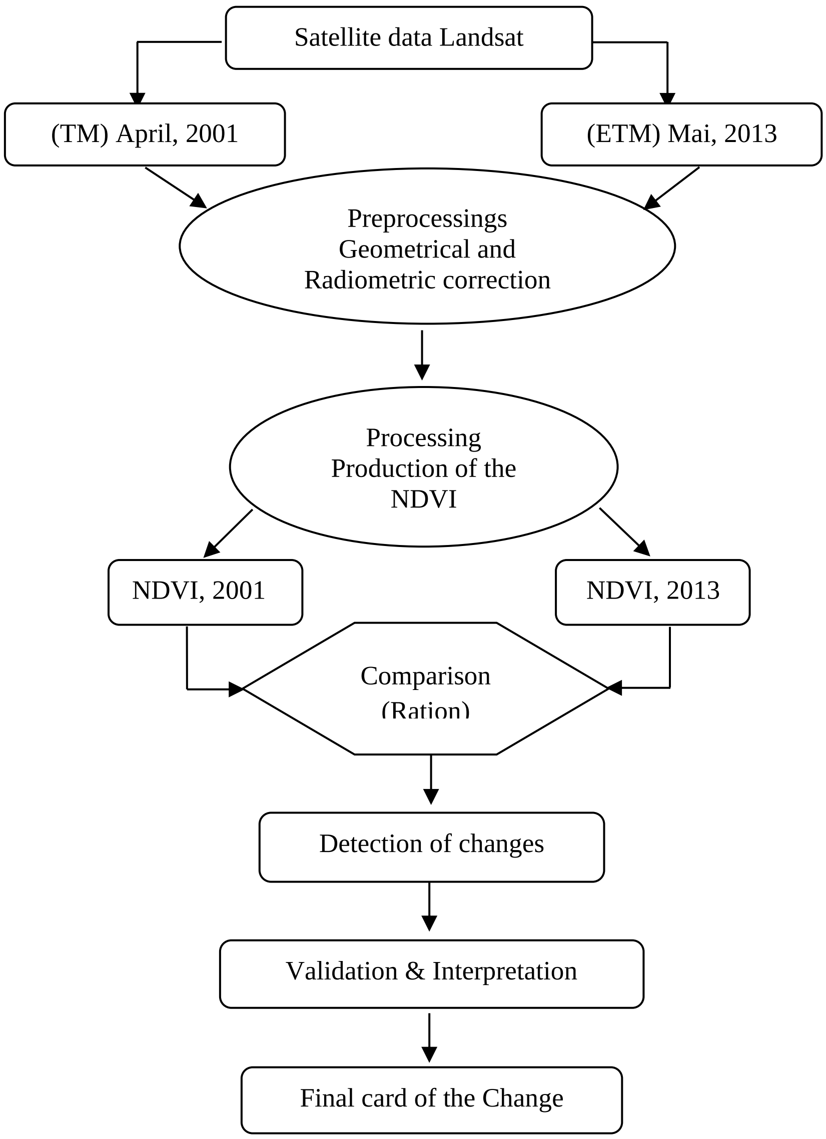

Figure 2. Flow chart of various stage of the study.

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The calculation of the coefficients (a) and (b) of the model permits to makes the radiometric condition for the two images identical.
The estimate of the two parameters of the linear equation a and b has been done samples (unities of sol occupation considered unchangeable in the time, case of the structures, salted rocks, road and retained). The data used for the relative radiometric correction and the parameters of the linear relation are presented on the on the following table:

Table 2. Radiometric averages of the samples selected for the estimate coefficients of atmospheric standardization.

1) **Channel**	**Image of 2001**					**Image of 2013**					**Coefficients**	
	Sable	*Built*	*Rock of salt*	*Road*	*retained*	*Sable*	*Built*	*Rock of salt*	*Road*	*retained*	*A*	*B*
2) ***TM 1***	*0.216*	*0.085*	*0.073*	*0.116*	*0.169*	*0.539*	*0.256*	*0.191*	*0.299*	*0.482*	*2.46*	*0.029*
TM 3	*0.533*	*0.223*	*0.116*	*0.293*	*0.110*	*0.436*	*0.227*	*0.102*	*0.253*	*0.082*	*0.81*	*0.013*
TM 4	*0.378*	*0.272*	*0.176*	*0.294*	*0.189*	*0.222*	*0.175*	*0.108*	*0.186*	*0.106*	*0.607*	*0.00036*

The relation (1) thus becomes for the three channels:

$$\rho 1_{2013} = 2.46183 * \rho 1_{2001} + 0.02893$$
$$\rho 3_{2013} = 0.811754 * \rho 3_{2001} + 0.013$$
$$\rho 4_{2013} = 0.607490 * \rho 4_{2001} + 0.000359$$

This pre-treatment permitted to have as result the relative atmospheric normalization of the image taken in 2001 in relation to the one of 2013.
After the atmospheric normalization we have done the treatment of the images by the production of (NDVI) for each date in order to show the state of vegetation in the zone of investigation, figure 3 and 4).

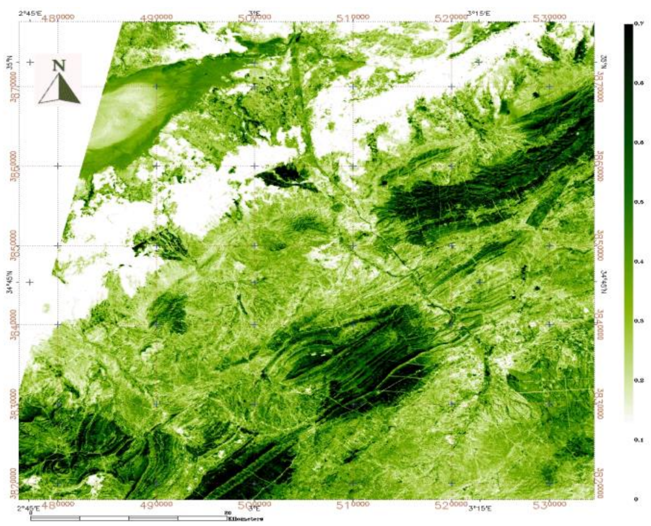

Figure 3. Image of the vegetation index (NDVI) of Mai14th, 2001.

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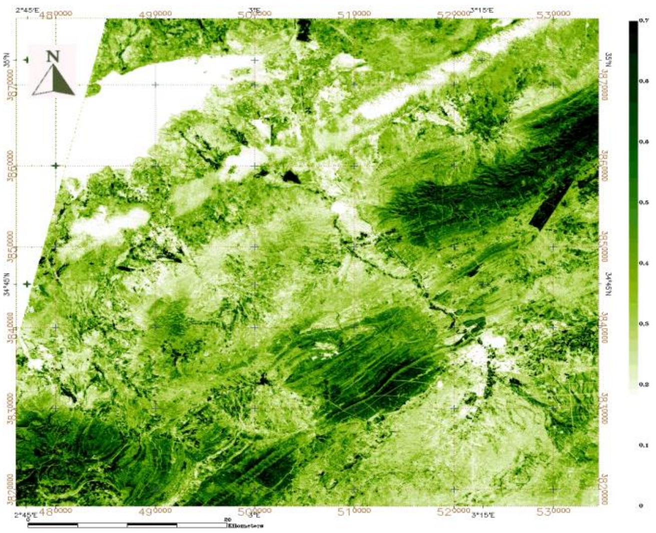

Figure 4. Image of the vegetation index (NDVI) of April 18th, 2013

Result and discussions

The result of report (NDVI2013/NDVI2001) is an image of changes which have occurred in the studied area. The securities of the histogram of this image lie between 0.33 and 0.70 and were gathered in three classes according to the types of change.

- securities lower than 0 ⇒ Regression of radiometry
- securities equal to 0 ⇒ No change
- higher values with 0 ⇒ Progression of radiometry

The analysis of these results made it possible to establish a link between the state of the vegetation and the type of detected change. The regression of radiometry is related to a degradation of the state of the vegetation between 2001 and 2013. The increase in radiometry is a sign of progressive variation of the latter. On the other hand unchanged radiometry corresponds to the relatively stable areas; it acts especially of the naked grounds, cleared up inside the forest, sliced by fire and the clothes. The interpretations made after investigation on the ground, made it possible to establish the card of changes of the vegetation in the area of study (Figure. 5)

On a surface of 47679 ha, the rate of regression recorded over one 12 years period is of 35.50% of the total surface area, which explains an intense degradation due mainly to the climatic share and the anthropozoïque pressure by the overgrazing and the setting in crop of the courses to *Artemisia herba alba* course to *Lygeum spartum* and pastoral *Artemisia campestris* (*Table 3*)

On the other hand and although the rate of increase recorded during the same period is of 13.38 % only, it appears encouraging, owing to the fact that it are especially about a progression on the level of the cord dune under the negotiable instrument of the alteration work pastoral completed within the framework of the fight against the turning into a desert carried out on the one hand by the National forest research Instutt (INRF), consistent with the mechanical and biological fixing of the dunes and on the other hand the pastoral plantations containing *Atriplex canescens* on the level of the dune cord,

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Atriplex halimus and *Atriplex canescens* with the edge of the sebkha, put in defens controlled of the courses by the High commission for the Development of steppe (HCDS) and the biological increase of the South-eastern area recorded at the turn of selected collinaire realized during the Nineties.

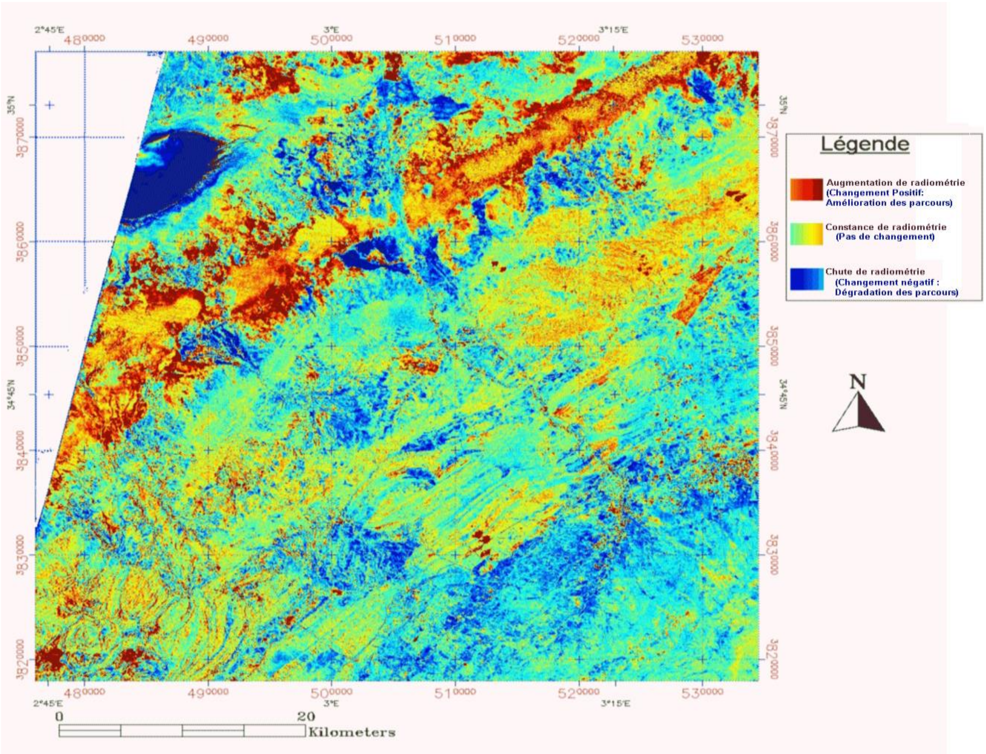

Figure 5. Map of the changes of occupation of the grounds.

While the 51.12% of the total area, of which the Sebkha represents 14%, remained stable due to the unfavorable absence of human action on the one hand and the protection of the territory on the other. The progression only accounts for 13.38%, it appears encouraging, owing to the fact that it are especially about a progression on the level of the cord dune under the negotiable instrument of the alteration work pastoral completed within the framework of the fight against the turning into a desert carried out on the one hand by the INRF, consistent with the mechanical and biological fixing of the dunes and on the other hand the pastoral plantations containing *Atriplex canescens* on the level of the dune cord, *Atriplex halimus* and *Atriplex canescens* with the edge of the sebkha, the settings in defends controlled of the courses by the HCDS and the biological increase of the South-eastern areas recorded with the turn of the deductions collinaires carried out during the Nineties.

In this study, the stress was laid on the information processing of multi-temporal remote sensing for the follow-up and the evaluation of the degradation of the steppe courses in a semi-arid medium in Algeria. The comparison of the NDVI derived from the discussed images made it possible to obtain the card of the changes. The analysis of the results showed the impact of degradation in the studied area. In general, this area knew a radiometric regression result of a change in the state of the vegetation related to multiple mailmen. That did not prevent nevertheless the improvement of some courses

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especially on the level of the sites touched by installation pastoral (dune cord, with the periphery of the sebkha and retained the collinaire).
Finally, the results obtained are acceptable in spite of the limits of adopted methodology. It is about the relative approach of the atmospheric standardization of the images which could be refined if one had data on the atmosphere at the time of image acquisition.

Table 3. the evolution of the biologic state of the survey region.

	Intense regression	*Moderate regression*	*Steady*	*Intense Progression*	*Moderate Progression*	*Superficie totale*
Area (ha)	*4848.95*	*12077.09*	*24373.51*	*2255.22*	*4124.23*	*47679*
Percentage	*10.17*	*25.33*	*51.12*	*4.73*	*8.65*	*100*

4. CONCLUSION

The ecological and socio-economic importance of steppe and pre-Saharan ecosystems on the one hand, the degradation of these environments and the need for sustainable development on the other hand, are all elements that justify our study.
The results obtained show that our study area offers a very important ecological diversity in direct connection with climatic and anthropogenic edaphic factors. The combination of these different factors determines an eco-complex where various natural units are intertwined, characterized by a very particular physiognomy and ongoing dynamics.
The current physiognomy of the environments is more due to degradation linked either to anthropogenic factors (overgrazing, clearing, uprooting, etc.) or to climatic and edaphic factors
From an ecological point of view and according to our results, the study region is seriously exposed to the phenomenon of degradation, all the units that make up our area have experienced degradation, it is evaluated 8.16% and 50.51% for 2001/2013. On the other hand, despite the regression of the plant cover, an encouraging biological recovery has been recorded.
Throughout the study area, there is a strong ecological imbalance over a period of 12 years (2001/2013). Indeed stable environments, with a rate of 51.12%, the rest are shared between regression with 35.50% and the progression 13.38%.
Our study has provided valuable lessons on the use of geomatics in the field of environmental analysis and planning. Thus it appears as an interface between researchers and actors.
They are tools for representing a reality, for understanding phenomena and the conditions in which they occur. They are also tools for dialogue between partners and communication between disciplines through a constant back and forth between observation-interpretation-hypothesis-validation.

5. REFERENCES

Ababou. A, Mohammed Chouieb, M'hammed Khader, Khalladi Mederbal, Djamel Saidi4 and Zineddine Bentayeb. (2009). Multivariante and analysis of vegetation of the salted lower-Cheliff plain, Algeria. Bol.Soc.Bot.Méx. 85: 59-69. http://www.scielo.org.mx › scielo
Ababou A, Chouieb. M, Khader. M, Mederbal. K, and Saidi. D. (2010). Using vegetation units as salinity predectors in the Lower Chelif Algerie. Turkish Journal of BOTANY, V34 n°2 (2010). http:/journals.tubitak.gov.tr botany.
Ardö, J., (1992). Volume quantification of coniferous forest compartments using spectral radiance recorded by Landsat Thematic Mapper. International Journal of Remote Sensing 13, 1779-1786.
Bannari. A. (1999). Analyses des effets atmosphériques sur les indices de végétation en milieu urbain. Revue de

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ISSN-L: 2284-9521

Télédétection, Voll N°11, 19-45.[Analyzes of atmospheric effects on vegetation indices in urban areas. Remote Sensing Review, Voll N°11, 19-45.]

Benguerai, A. (2011). Evolution du phénomène de désertification dans le sud Oranais (Algérie). Thèse de Doctorat. Univ. Tlemcen, Algérie. 138 p [Evolution of the phenomenon of desertification in southern Oranais (Algeria). Phd thesis. Univ. Tlemcen, Algeria. 138 p].

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. Univ. Joseph Fourier-Grenoble 1. 299p. [GIS and remote sensing for the study of silting in an arid zone: the case of the wilaya of Naâma (Algeria). Phd thesis. Univ. Joseph Fourier-Grenoble 1. 299 p].

Benslimane, M., Hamimed, A., El Zerey, W., Khaldi, A. & Mederbal, K. (2008). Analyse et suivi du phénomène de la désertification en Algérie du nord. [VertigO] La revue électronique en sciences de l'environnement, Vol 8n0 3, 1-9.[Analysis and monitoring of the phenomenon of desertification in northern Algeria. [VertigO] The electronic journal in environmental sciences, Vol 8n0 3, 1-9]

Chirici et al. (2001). Testing iknos and Landsat 7etm+ images for stand-level forest type napping: a case study uneder Mediterranean conditions in proceeding « and analysions information for sustainable Forest management and biodiversity minotiring with special reference to Mediterranean ecosystème ». Palermo, Sicily (Italy) 4-7 Decembre 2001.19p.

Chuviec. O. (1993). Mapping and evaluation of burnrd land from mulitenporal analysis of AVHR NDVI images. Proceedings of International Workshop on Satellite Technology and GIS for Mediterranean Forest Mapping and Fire Management, Tassaloniki, Greece 4-6 November 1993, 71-83.

Cohen, W.B., Goward, S.N. (2004). Landsat's role in ecological applications of remote sensing. Bioscience 54, 535-545.

Cornet A. (2002). La désertification à la croisée de l'environnement et du développement: un problème qui nous concerne, 35 p. [Desertification at the crossroads of environment and development: a problem that concerns us, 35 p.] www.csf-desertification.org/catalogue/2001_CSFD_Cornet.pdf.

Djellouli Y. (1990). Flores et climats en Algérie septentrionale : Déterminismes climatiques de la répartition des plantes, Thèse Doct. Sciences, Univ. Sciences et Technologies Houari Boumedienne, Alger, 210 p. [Flora and climates in northern Algeria: Climatic determinisms of the distribution of plants, Thesis Doct. Sciences, Univ. Sciences and Technologies Houari Boumedienne, Algiers, 210 p.]

Dandan Xu, Xulin Guo. (2014). Compare NDVI Extracted from Landsat 8 Imagery with that from Landsat 7 Imagery. American Journal of Remote Sensing. Vol. 2, No. 2, 2014, pp. 10-14. doi: 10.11648/j.ajrs.20140202.11.

Durriu S. (1994). Utilisation de la télédétection satellitaire pour la mise à jour de la carte des types de peuplement de l'inventaire forestier national. Thèse de Doctorat, ENEFREF, 202p.

Foody, G.M., Boyd, D.S., Cutler, M.E.J. (2003). Predictive relations of tropical forest biomass from Landsat TM data and their transferability between regions. Remote Sensing of Environment 85, 463e474. [Use of satellite remote sensing to update the map of stand types in the national forest inventory. Doctoral thesis, ENEFREF, 202p. Foody, G.M., Boyd, D.S., Cutler, M.E.J. (2003). Predictive relations of tropical forest biomass from Landsat TM data and their transferability between regions. Remote Sensing of Environment 85, 463e474.]

Franco-Lopez, H., Ek, A.R., Bauer, M.E. (2001). Estimation and mapping of forest stand density, volume, and cover type using the k-nearest neighbors method. Remote Sensing of Environment 77, 251e274.

Gasparri N. I., Parmuchi M. G., Bono J., Karszenbaum H. & Montenegro C. L. (2010). Assessing multitemporal Landsat 7 ETM+ images for estimating aboveground biomass in subtropical dry forests of Argentina. Journal of Arid Environments, 74. pp. 1262 -1270.

Haddouche. I., 2002. Utilisation de la télédétection pour l'étude de la déforestation en milieu semi aride cas de la région de Djelfa, Rapport, 34p.

Hadjiat K. (1997). Etat de dégradation des sols en Algérie, Rapport d'expertise, Plan National d'Action Environnementale PNAE, Banque Mondiale, Washington DC, 45 p.

Hirche, A., Salamani, M., Boughani, M., Oukil, Y., Hourizi, R. (2010). Is the desertifcation really in reverse? Thecase of South-West Algeria. Conference on "Advanced Scientifc Tools for desertifcation Policy", Roma,28-29 sept. [State of soil degradation in Algeria, Expert report, National Environmental Action Plan PNAE, World Bank, Washington DC, 45 p. Hirche, A., Salamani, M., Boughani, M., Oukil, Y., Hourizi, R. (2010). Is the desertification really in reverse? Thecase of South-West Algeria. Conference on "Advanced Scientific Tools for Desertification Policy", Roma, 28-29 Sept.]

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Khader. M., Mederbal. K., Chouieb. M., Ababou. A., Hamimed, A et Mederbal, Z. (2009a). Detection by satelite data of the steppe courses degradation in semi-aride regions case of the forest of Senalba Chergui Djelfa (Algeria). Egyptian Jornal of Applied Sciences. Edited and published by the Egyptian society of applied Science: pp. 362-369.

Khader. M ; K. Mederbel ; Y. Fekir ; R. Gueddidem et B. Mekkous. (2009b). Etude du risqué d'incendie à l'aide de la géomatique: cas de la forêt de Nesmoth (Algerie). MEDITERRANEA, serie de Estudios Biologicos. 2009 Epoque II N°20. Université d'Alicante, Département d'Ecologie, Faculté des Sciences. 205-234. [Study of fire risk using geomatics: case of the Nesmoth forest (Algeria). MEDITERRANEA, series of Estudios Biologicos. 2009 Epoch II N°20. University of Alicante, Department of Ecology, Faculty of Sciences. 205-234.]

Khader M, Mederbal . K Chouieb. M. (2014). Suivi de la degradation de la vegetation steppique à l'aide de la télédétection: cas des parcours steppiques région de Djelfa. Courrier du Savoir Scientifique et Technique Université Mohamed Khider Biskra. https://www.asjp.cerist.dz. [Monitoring the degradation of steppe vegetation using remote sensing: case of steppe rangelands in the Djelfa region. Mail of Scientific and Technical Knowledge University Mohamed Khider Biskra. https://www.asjp.cerist.dz]

Khader, H. Mouissa, D. Bouhadi, B. Mekhloufi And B. Sahel. (2020). Inventory and mapping of the flora of zahrez el gharbi djelfa algeria using geomatics. MITTEILUNGEN KLOSTERNEUBURG. 70 (2020) 10, 32-41. www.mitt-klosterneuburg.com.

Lu, D., 2005. Aboveground biomass estimation using Landsat TM data in the Brazilian Amazon. International Journal of Remote Sensing 26, 2509e2525.

Mallinis, G., Koutsias, N., Tsakiri-Strati, M., Karteris, M. (2008). Object-based classification using Quickbird imagery for delineating forest vegetation polygons in a Mediterranean test site. ISPRS Journal of Photogrammetry and Remote Sensing 63, 237-250.

McRoberts, R.E., Tomppo, E.O., 2007. Remote sensing support for national forest inventories. Remote Sens. Environ. 110, 412-419.

Mederbel. K. (1983). La télédétection aérospacial et la phyto-écologie. Application à deux regions naturelles d'Algérie : Le littoral (Mostaganem) et l'Atlas saharien (Djelfa). These 3ème cycle, Université d'Aix Marseille III, 178p. [Aerospace remote sensing and phyto-ecology. Application to two natural regions of Algeria: The coast (Mostaganem) and the Saharan Atlas (Djelfa). Thesis 3rd cycle, University of Aix Marseille III, 178p.]

Mouissa. H., R.A. Fournie. (2013). Mapping stand volumes of Pinus halepensis Mill in a semi-arid region using satellite imagery of the Sénalba Chergui forest in north-central Algeria. Journal of Arid Environments Volume 92, May 2013, 63-75.

Pouget. M. (1980). Les relations sols végétation dans les steppes sud algéroises. Travaux et document. OST ROM. n°116. Paris .555 p. [Soil-vegetation relations in the southern Algiers steppes. Works and documents. OST ROM. #116. Paris .555 p.]

Rondeaux, G., Steven, M., Baret, F. (1996). Optimization of soil-adjusted vegetation indices. Remote Sensing of Environment. 55, 95-107.

Salvador, R., Pons, X. (1998). On the applicability of Landsat TM images to Mediterranean forest inventories. Forest Ecology and Management 104, 193-208.

Tomppo, E., Olsson, H., Ståhl, G., Nilsson, M., Hagner, O., Katila, M. (2008). Combining national forest inventory field plots and remote sensing data for forest databases. Remote Sensing of Environment. 112, 1982-1999.

Triepke, F.J., Brewer, C.K., Leavell, D.M., Novak, S.J. (2008). Mapping forest alliances and associations using fuzzy systems and nearest neighbor classifiers. Remote Sensing of Environment. 112, 1037-1050.

West, P.W. (1995). Application of regression analysis to inventory data with measurements on successive occasions. Forest Ecology and Management 71, 227-234. [Application of regression analysis to inventory data with measurements on successive occasions. Forest Ecology and Management 71, 227-234.].

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