**Analele Universităţii din Oradea – Seria Geografie** Year **XXI**, no. **1/2011** (June), pp. 16-22
ISSN **1454-2749**, E-ISSN **2065-1619** Article no. **211102-514**

# USE OF IMAGES ALSAT1 FOR THE IMPLEMENTATION OF MAPS LAND IN SEMI-ARID AREA - CASE OF THE AURÉS REGION (ALGERIA)

**Hassen BENMESSAOUD***
Université El Hadj Lakhdar, Laboratoire *"Risques Naturels et Aménagement du Territoire"*
Batna, Algérie, e-mail:ha123m_123 @yahoo.fr

**Abstract:** Algeria is one of many countries which have a natural potential importance with its situation and its territorial sizes. Submit today to impulse of climate tinted by aridity, when the effects conjugate more and more with intense socialization of géosysteme especially in mountainous zones and steppe ones a big part of territory is threaten by desertification. In dowering, of the new generation of satellite of average resolution Alsat1, Algeria today is one of the countries, users of spatial information in different fields especially the mapping of natural resources. This work which consist the realisation of soils occupation map of the Aurès region. This map makes it possible to do a locality state, of vegetal cover and its spatial articulation with the other environment components. We used the Alsat1 picture (13 March 207 scene) which it consist of three spectral bands of 32 m resolution. For this purpose, the methodology approach has been determined when in first time; a colored composition has been obtained for the location of samples and extraction of support points, then a geometry correction has been applied on the picture in order to georeference it in relation to of the topographic map. In a second time, a supervised classification based on maximum likelihood method has been used on the three channels of picture. The occupation map realized by the classification makes appearing of different themes selected (12 themes) when the big wholes stand out clearly, characterizing the different classes of soil occupation of the region. So the picture Alsat1 makes it possible to arrange the new information in the region of study and identify very quickly the big themes in presence and seize their spread.

**Key words:** Images Alsat1, Supervised classification, Map of soil occupation, The semi-arid areas, Aurès.

* * * * * *

## INTRODUCTION

Currently, the arid and semi-arid areas are subject to significant anthropogenic pressures which are highly dependent phenomena, sometimes irreversible, desertification and degradation route (Bensaid, 1997; Haddouche, 2002).

These areas require inventories synchronic and diachronic of their potential biological based on sound knowledge of existing resources and eco-geographical conditions. Effective management of this heritage requires the prior mapping and inventory of available resources. In

* Corresponding Author

addition to these statistics, it is essential to track and monitor the dynamics of the environment due to land cover changes taking place as a result of several factors: soil degradation, overgrazing, introduction of culture Mechanized, industrial, pharmaceutical and household plant resources etc. This strong pressure on resources requires planning and response activities in the territory based on a more precise knowledge of degradation of vegetation cover (Bensaid, 1997; Benmessaoud and al., 2009)

It is therefore vital to develop strategies for monitoring and managing the environment and agriculture. These strategies should be based on technological performance (Garouani and. al. 1993; Haddouche, 2002).

Satellite imagery is now a major source of information for observing the Earth's surface. Algeria's economic potential with these countries is among users of spatial information in various fields particularly in the mapping of natural resources (Bensaid, 1997; Benhanifia, 2003).

The data used in this study include images of the new generation of satellite Algerian Alsat1 of March 13, 2006 with a ground resolution of 32 meters and three spectral bands in the visible (G , B) and near infrared (IR) (table 1).

**Table 1**. Specifications of ALSAT1

| | |
|---|---|
| Platform | Altitude: 686 km<br>Orbital inclination 98.2 °<br>Weight: 90Kg<br>Repeatability: 5 days<br>Time: 1 hr 39 min |
| Payload<br>(Camera) | It consists of two cameras with special tape<br>(2 of 10200 pixel CDD arrays channel)<br>Focal 150 m<br>Spatial resolution: 32 m<br>Fouchée: 600 km<br>Special bands: Green - Red - Red PI<br>Field of view (FOV): 23.62 °<br>Coding: 8 bits per pixel |

The objective of this work is:

- To appreciate the application fields of remote sensed data to medium spatial resolution images;
- Alsat1 for the establishment of inventories of renewable natural resources in arid and semi arid and understanding of the functioning of the ecosystem in place;
- Undertake a land use map and land use across the Aures region;
- The availability of periodic images Alsat1 will track the evolution of the relevant areas.

## PRESENTATION OF THE STUDY AREA

Aurés region located 500 km south East of Algiers. Nememchas is constituted with the eastern end of the Saharian Atlas, which represents the physical boundary between the North and South of Algeria (Ballais, 1981).

It is bounded on the north by the town of Batna (West) and the town of Khenchela (East) and the south by the Wilaya of Biskra. The study area covers a total area of 12,428 sqkm Geographically, the study area is located between the meridians (5° 40' and 7° 10') and parallel (34° 45' and 35° 33').

Our study area is characterized by a climate of Mediterranean type semi-arid in the north and arid in the south with a winter marked by cold, low rainfall, a long dry season and frequent frosts (Abdessemed, 1981; Ballais, 1981).

These conditions are expressed in terms of constraint for the development of crops and vegetation. The landscape that emerges there then comprises different ecosystems, which are traditionally a farming area, an area of transhumance pastoralism, with local points of settlement, oases, forests and crops. These characteristics of the physical environment and in particular those of the land give the region a vocation like agro-forestry-pastoral (Abdessemed, 1984).

The region is characterized by steep slopes over short distances. On the north side elevation varies between 1200 m and 2300 m. On the south it descends to the north to less than 50 m (Ballais, 1981; Ansar, 2002). Seen as a whole, the Aures region appears as a powerful gabled roof, asymmetrical, ride, parallel. This mountain range oriented northeast / southwest (Orientation typical chain Atlas). He wears 2200 - 2300 m its summit ridge (Mehmel, Chélia). North of this ridge fallout quick 10 or 20 km establishes the link with the high plains at 900 m between Batna and Khenchela. In the South, a long slope leads in 50 or 60 km Saharan piedmont, located at 100 m. These steep slopes have distributional consequences of climate and natural resources.

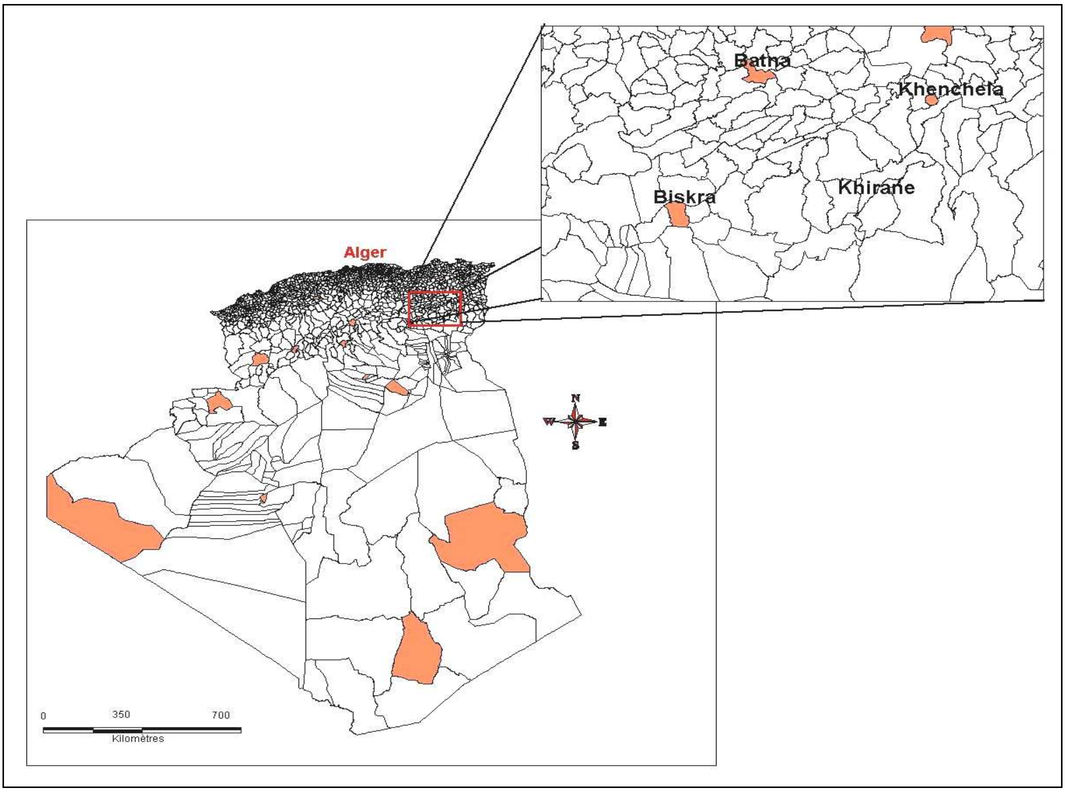


**Figure 1.** Location map of study area

**MATERIAL AND METHODS**

The adopted step consists in using rough satellite images of the Algerian satellite Alsat1, taken on March 13th, 2006 with 9:38' with a solar rise in 56,6°. The pilot zone is covered by the image with dimensions: 5541 X 3875 pixels out of the 03 bands (IR, G and B).

The analysis of the spectral signature of the various objects of the occupation and land use is a big step for the choice of the bands. However, a ground and sampling work for the checking of the real state of the ground, in order to carry out an analysis set of themes of this space, was carried out.

The use of a GPS (Global System Positioning) facilitated the collection of the coordinates of the canters of the pieces and for a precise geographical location of the ground data in the sampling complain as well as for the checking of the state of the ground.

## THE DIFFERENT PHASES OF ANALYSIS

**A). The color composition:** The color composite was obtained from a superposition of three bands (IR, G, and B) of the scene. It was used as a starting image to guide image processing, ground sampling and extraction points for a possible geometric correction.

**B). Geometric Correction:** Geometric corrections can offset all or a portion of these deformations distortion (Ferdinand, 1996). For geometric correction of the image, a polynomial model of degree of deformation (2) was adopted using (11) support points of reference.

**C). Image classification:** This is the mode that was overseen chosen for the classifications of the medium. The method of maximum likelihood was used for image classification (Dubois, 1997; Ferdinand, 1996). This method is considered as a powerful technique of classification. The decision rule of this method is based on the probability of a pixel belonging to a particular class (Fojstng, 1999).

## SAMPLING MISSIONS AND GROUND TRUTH

To produce and design the map of land of the Aurés region, we relied on the contact details of land that were collected during the sampling missions (Spring 2008). These missions were conducted to locate and met a number of plots representing various types of land that we meet on the study area (figure 2) in relation to their spectral signature.

**Figure 2.** Photos of degraded forests in the Aurés region.

The different classes have been selected

1. Dense forest;
2. Clear forest;
3. Forest very clear;
4. Irrigated crops;
5. Course plains;
6. Course of the steppes;
7. Bare soil dominated by sandy texture;
8. Bare soil and rocky terrain;
9. Water Barrage;
10. River; Marly outcrops of bare lands;
11. Shadow

## VALIDATION OF THE CLASSIFICATION

It is possible to evaluate the performance of this classification by assessing the percentage and number of pixels correctly classified. The interior of each polygon test. The confusion matrix illustrates this performance (table. 02).

The analysis of this validation enabled us to emit some remarks, in particular: the very heterogeneous pieces tests are particularly well classified, for example the distinction is very clear between a culture and a forest cover. Whereas the other pieces whose taxonomic contents correspond, in fact, to a badly classified mosaic (covered clearly and very clearly) are much homogeneous, thing which increases the rate of nuance. However, the average performance of classification is around 82 %, a value which seems to be acceptable. Moreover, the use of the matrix of confusion to determine the relevance and the quality of the classified image enabled us to establish a link between the classified image and the field real state. In addition to the confusion matrix, we preformed the statistical calculations to allow a determination of the percentages and areas of occupation and land use of each of the formations present in the foloowing table:

Table 2. Confusion matrix of the estimated classification image Alsat1 for the period of 2006

| | Total pixels | shadow | marly outcrops of bare lands | river | water barrage | bare soil and rocky terrain | bare soil dominated by | course of the steppes | course plains | irrigated cultivation | forest very clear | clear forest | dense forest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dense forest | 8679 | 123 | 0 | 0 | 42 | 1 | 0 | 0 | 0 | 0 | 1295 | 629 | 6589 |
| Clear forest | 4501 | 24 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 0 | 1598 | 2258 | 581 |
| Forest very clear | 7496 | 76 | 0 | 0 | 3 | 108 | 0 | 0 | 46 | 85 | 5939 | 923 | 316 |
| Irrigated cultivation | 2396 | 0 | 0 | 0 | 0 | 40 | 2 | 0 | 0 | 1179 | 1105 | 70 | 0 |
| Course plains | 5360 | 32 | 234 | 0 | 3 | 332 | 0 | 31 | 4724 | 0 | 4 | 0 | 0 |
| Course of the steppes | 5490 | 0 | 25 | 17 | 1 | 148 | 8 | 5253 | 38 | 0 | 0 | 0 | 0 |
| Bare soil dominated by sandy texture | 4495 | 0 | 20 | 1 | 0 | 457 | 3892 | 112 | 0 | 13 | 0 | 0 | 0 |
| Bare soil and rocky terrain | 6466 | 1 | 117 | 2 | 1 | 4530 | 136 | 75 | 113 | 32 | 1391 | 68 | 0 |
| Water Barrage | 792 | 38 | 0 | 0 | 612 | 31 | 0 | 0 | 0 | 0 | 29 | 14 | 68 |
| River | 578 | 0 | 17 | 332 | 0 | 1 | 33 | 195 | 0 | 0 | 0 | 0 | 0 |
| Marly outcrops of bare lands | 2811 | 40 | 2359 | 0 | 18 | 207 | 0 | 43 | 77 | 0 | 67 | 0 | 0 |
| Shadow | 9310 | 4314 | 3 | 0 | 488 | 107 | 0 | 0 | 3 | 0 | 996 | 456 | 2943 |
| Total pixels | 58374 | 4648 | 2775 | 352 | 1168 | 6002 | 4071 | 5709 | 5001 | 1309 | 12424 | 4418 | 10497 |

**Table 3.** Percentages and surface units of occupation and land use

| Unit occupancy and use soil | Acreages (%) | Acreages (ha) |
|---|---|---|
| Dense forest | 04,36 | 54151 |
| Clear forest | 04,85 | 60275 |
| Forest very clear | 11,63 | 144537 |
| Irrigated cultivation | 03,04 | 37781 |
| Course plains | 05,36 | 66614 |
| Course of the steppes | 08,44 | 104892 |
| Bare soil dominated by sandy texture | 14,69 | 182567 |
| Bare soil and rocky terrain | 27,53 | 342142 |
| Water barrage | 00,58 | 6835 |
| River | 06,29 | 78172 |
| Marly outcrops of bare lands | 06,24 | 77550 |
| Shadow | 06,94 | 86250 |
| Total | 100.00 | 1242800 |

**RESULTS**

The results obtained by the maximun likelihood supervised classification were used to map the occupancy and use of georeferenced soil after the geometric correction step (figure 3). The map of occupation and land use of Aurés represents very important information for identification and inventory of space in general forest formations, roads, crops, soils devoid of vegetation, infrastructure and the rivers that are readily apparent.

The final map (figure 3) shows that 20.84 % of the area of the Aurés region (258,963 ha) is covered by forest in the state of degradation such as dense forests (04.36 %) is in General on the peaks. Crop areas and the surfaces of rivers cover 09.33 % of the total surface area of study, although in places the bedrock, bare soil and crop areas are generally contiguous and localized mainly on surficial siliceous and sandy. Areas where crops occupy the argillaceous and sandy soils outweigh porosity. Bare soil dominated by the sandy texture and crop areas is contiguous because of the agricultural practice of crop rotation and the distribution of rainfall. Overexploitation, reflecting the scarcity of arable areas due to the high porosity, exhausts the soil. Bare soil can also be explained by the presence of tilled soil ready for cultivation.

In general, the Aures region has low levels of vegetation cover. This rate is primarily explained by the semi-arid climate characterized by low rainfall. Then, surficial on which plants grow is generally reissued excessively because of their low capacity for water retention.

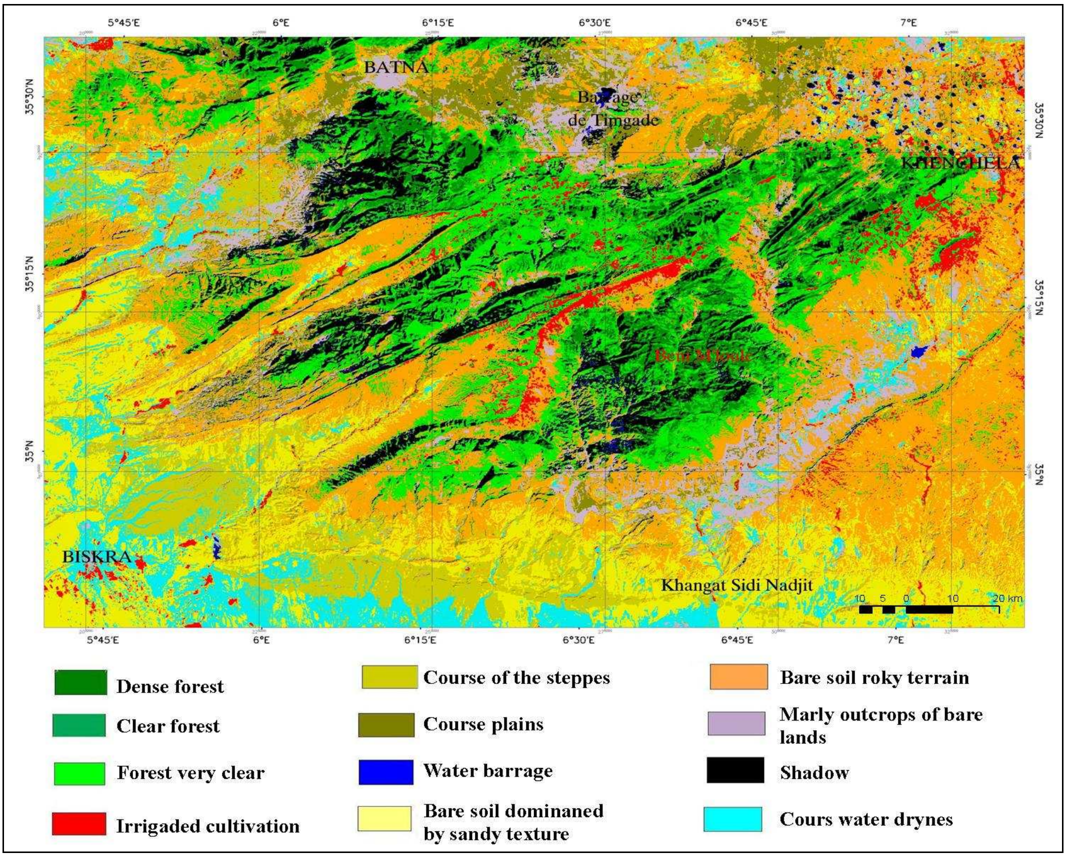


**Figure 3.** Map of occupation and land use of the Aurés region

Finally, human activities (Plowing and cutting firewood) contribute to reduce the density of vegetation. The rare high rates of vegetation occur on the summits because they are generally difficult to reach places.

## CONCLUSION

- The use of the Alsat1 imagery made it possible to obtain the big classes of occupation of the ground in a reduced time;
- The possibility of having the Alsat1 images periodically will allow the follow-up of the evolution of the semi-arid zones large scales;
- The map of the land occupation and use remains a required document and a complement for a better apprehension of the quick change of the total changes and the consequences which result from this, in particular over the two last decades 1990 and 2010. For that, the regular monitoring of this phenomenon over long periods by using the satellite imageries of high-resolution could better evaluate the mechanism of the changes with small scales on the ground.

## REFERENCES


Abdessemed K. (1981), Le *cèdre de l'Atlas (Cedrus atlantica Manetti) dans le massif de l'Aurès et du Belezma* - Etude phytosociologique, problème de conservation et d'aménagement. Thèse Doctorat, Université d'Aix-Marseille;

Abdessemed K. (1984), *Les problèmes de la dégradation des formations végétales dans l'Aurès (Algérie).* Première partie: La dégradation, ses origines et ses conséquences. Forêt méditerranéenne, T VI, N°1, 1984, PP 19-26;

Ansar A. (2002), *L'Aurès Oriental: Un milieu en dégradation* .Journal Algérienne des régions arides. Revue semestrielle N°01, Juin 2002. Ed. C.R.S.T.R.A Biskra (Algérie);

Ballais J. L. (1981), *Recherches géomorphologiques dans les Aurès (Algérie)*. Thèse doctorat - Université de Paris I, p. 572 + annexes + Cartes;

Benhanifia K. (2003), *Etude comparative des données Alsat1 et Landsat ETM pour l'évolution de l'état des Forêts dans la région Ouest-Oran* - Actes des journées techniques Alsat1 / Utilisateurs Asal, 14 et 15 juillet 2003-Algerie;

Benmessaoud H. et al. (2009), *L'évolution d'occupation du sol et désertification dans le Sud des Aurès (Algérie).* Revue Mappemonde (94- 2009 / 2). *http://mappemonde.mgm.fr/*;

Bensaid A. (1997), Traitement *des données multi sources et conception d'une base des données dans un SIG en vue de la caractérisation d'un milieu physique : application à une zone steppique au Nord de Laghouat.* Thèse de Magister, 122 pages, CNTS, Arziew- Algérie;

Dubois J. M. et al. (1997), *La réalité de terrain en télédétection : Pratiques et méthodes*. Actes des journées scientifiques de Sainte - Foy - Agence Universitaire de la Francophonie - AUPELF - UREF, p. 356;

Ferdinand B. (1996), *Précis de télédétection*, Volume 2, Applications thématiques Ed. Presse de l'Université Du Québec, p. 617;

Fojstng E. (1999), *Contribution de la Morphologie mathématique à la cartographie de l'occupation du sol a partir d'image SPOT (Région de l'extrême Nord-Cameroum).* Rapport de doctoral en télédétection, Réseau télédétection, AUPELF - UREF, p. 91;

Garouani A. et. al. (1993), *Cartographie de l'occupation du sol et des zones humides par télédétection dans la basse vallée de la Medjerda (Tunisie).* Cinquième journées scientifiques du réseau de la télédétection d'AUPELF - UREF, Tunisie, 21-24 Septembre 1993, p.163-170;

*Haddouche I. (2002), Utilisation de la télédétection pour l'étude de la déforestation en milieu semi - aride - Cas de la région de Djelfa.* Rapport de stage, 34.



| Submitted: | Revised: | Accepted: | Published online: |
|---|---|---|---|
| December 26, 2010 | February 20, 2011 | April 21, 2011 | May 12, 2011 |