Analele Universităţii din Oradea, Seria Geografie **XXVIII**, no. 2/**2018**, pp. **156-163**
ISSN **1221-1273**, E-ISSN **2065-3409** Article no. **282102-771**

GEOMATICS APPROACH FOR URBAN EXTENSION MANAGEMENT CAUGHT BETWEEN PLANNING TOOLS AND REALITY ON THE GROUND, CASE OF THE DISTRICT OF BISKRA (ALGERIA)

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Abstract: Biskra city, the administrative center of the Biskra region (wilaya), has poor potential in terms of urban space development; and this is strongly linked to the unfavorable characteristics of the soil with specific geographical features (soil collapse) which prohibits the vertical extension and imposes an urban development horizontal. The incoherence between the urban planning of Saharan cities with a proactive urbanism and the spatial dynamics that obeys other socio-economic factors and financial stakes, due in part to the absence of a prospective vision that It is based on the real needs of an urbanizable space over time, and on the other hand with a reliable spatial analysis allowing an objective diagnosis of the urban space. In view of the large number of variables and their spatiotemporal combination, it is necessary to use geomatics techniques for accurate spatial analysis and sustainable planning. This research work integrates with the results obtained by the geomatic approach compared to conventional land use planning and development master plans (P.D.A.U) which are always outdated even before their approval.

Key words: Biskra, spatio-temporal plan, Geomatics approach, P.D.A.U, soil collapse,

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INTRODUCTION

The growth of Saharan cities is a recent and rapid phenomenon, both from a demographic and a spatial point of view; this does not go without creating enormous difficulties and planning constraints for managers of urban agglomerations as part of a strong social demand in terms of housing, public facilities, infrastructure and diversified jobs. The objective of this study is based on a proposal for geomatics planning by the P.D.A.U to illustrate the deficiencies of traditional development plans to better detect non-compliance with strategic orientations, particularly in studies of management tools.

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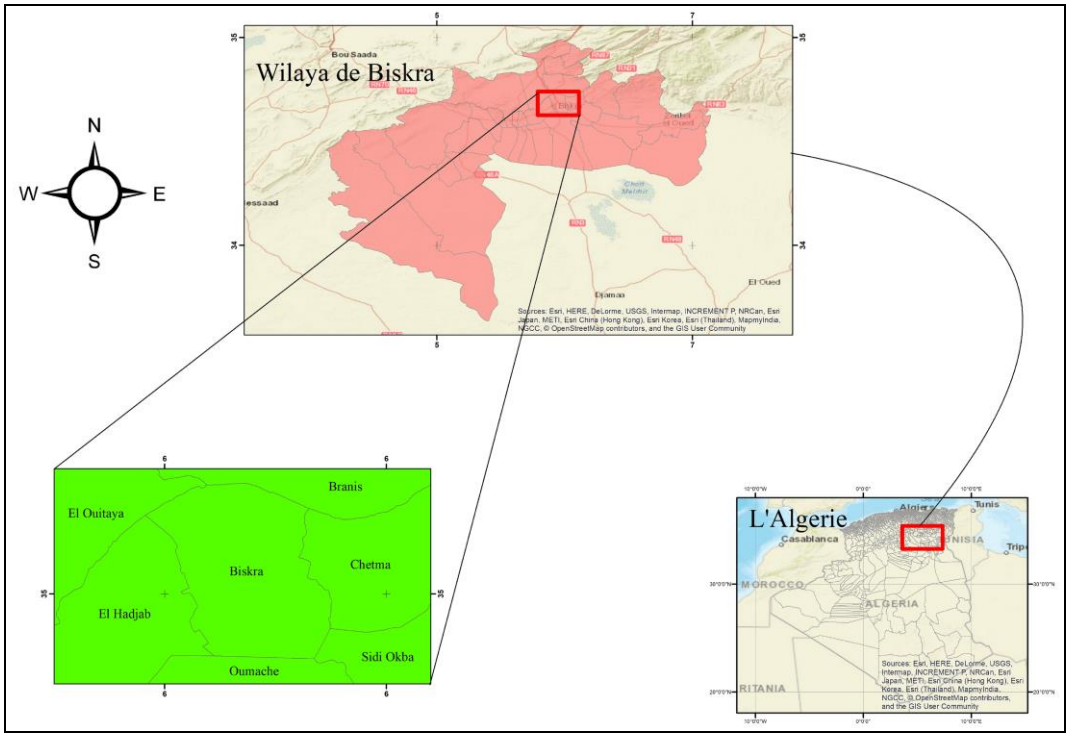

Figure 1. Study area
(Source: Saker Adel)

The study area corresponds to the territorial space of the municipality of Biskra which constitutes a boundary between the Tell zone to the north and the Sahara to the south. It is also a real obligatory passage towards the big Saharan spaces with specified geographical ones such as the geotehnic constraints (soil collapse). The commune of Biskra extends over an area of 127.70 km², 400 km south-east of the capital, Algiers, is administratively limited by the commune of Branis and Djemorah to the north, to the East by the commune of Chetma and Sidi-okba, to the West by the municipality of Elhadjeb, to the south by the commune of Oumache (figure 1).

STRATEGIC PLANNING TOOL

The P.D.A.U. is an instrument of spatial planning and urban management setting the basic orientations of the spatial planning of the municipality (s) concerned.

This essential instrument for the development of the local community plays an important role in the rationalization of the land use (urbanized and non-urbanized) and their prediction for the satisfaction of present and future needs in terms of sustainable development (Loi nº, 1990).

"The imprecisions in the representation of territorial boundaries affected by urban planning are not acceptable under any circumstances, and can only lead to unwanted conflicts that slow down the implementation of plans" (Gomis and Turon, 2017, p. 75).

The strategic directions of the Biskra PDAU are based on the following premises:

- transferring the railway line from the city center to outside the city;
- creation of modern public transport means (tramway);
- extension of the green city on the west side;
- protection of oases on the South side;
- tracking of public facilities and housing in all its forms;
- rehabilitating the old urban fabric.

The complexity of the data and its distribution across different sectors makes coordination difficult between them and constitutes an obstacle to urban development operations because of the bureaucratic burden of information exchange. This situation of lack of fluidity of spatial information amplifies the problems of territorial control, knowing that the revision of the (PDAU) which is carried out every decade (1998-2008) is not sufficient for the follow-up and the evaluation of the proposed strategy (Akakba et al., 2014) (figure 2).

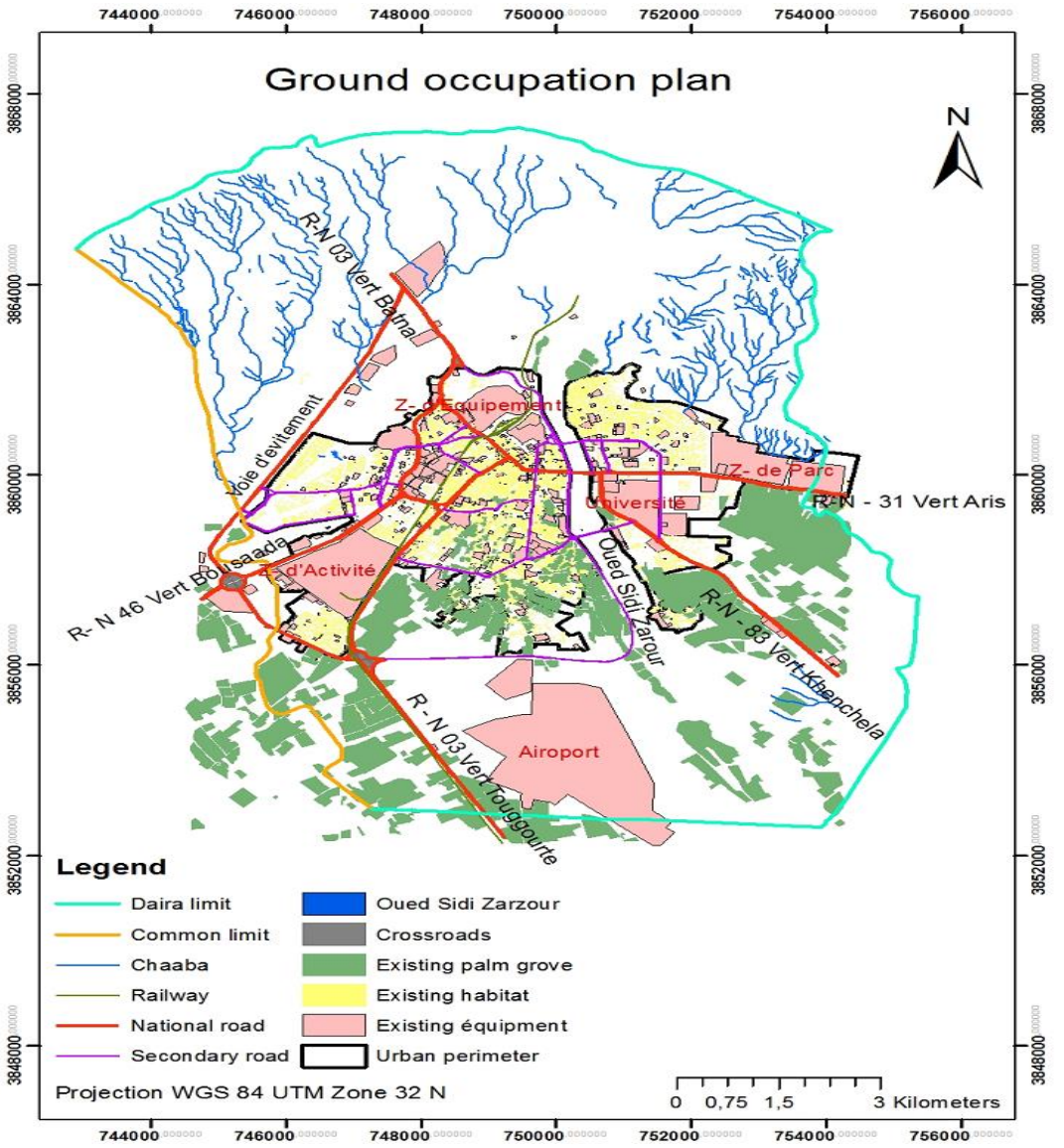

Figure 2. Land cover Municipality of Biskra
(Source: Master Plan of Planning and Urban Planning 2008)

The alteration of the terrain, the population needs and the evolution of the industry will inevitably lead to the formation of an urban conurbation because all these changes mean an unavoidable extension (Chetma, Elhadjeb). ”Suburban areas are exposed to a particularly strong

investment pressure due to the growth of cities and their expansion beyond urban limits. Such municipalities face the challenge of imposing spatial order on areas experiencing intensive development. On the other hand, lying in the proximity of a city is an important growth stimulant for suburban communes" (Wolny et al., 2017, p. 113; Wolny et al., 2014; Herman, 2009).

MATERIALS AND METHODS

We used for "this study three Landsat satellite images of 30 x 30 m resolution; the first dating 6 May 1987; the second dated 15 April 2001 and the third dated 24 May 2016. We opted for a color composite channel 432 for images TM 1987 and 2001, instead of 543 for the image LDCM", 2016, "which allows us to cleanly identify the different units of Land Use compared to other colored compositions. Based on the visual interpretations and especially the knowledge of the reality of the field, we defined three classes of land cover (Buildings, Palmary and bare soils). This choice is made in a way to allow better identification of the city, and its extension in reference space-time" (Bouhata et al., 2016, p. 161). The overlaying of the results of the SVM with the P.D.A.U plans allows us to determine in real time the difference between the proposed strategy and the reality on the ground (figure 3).

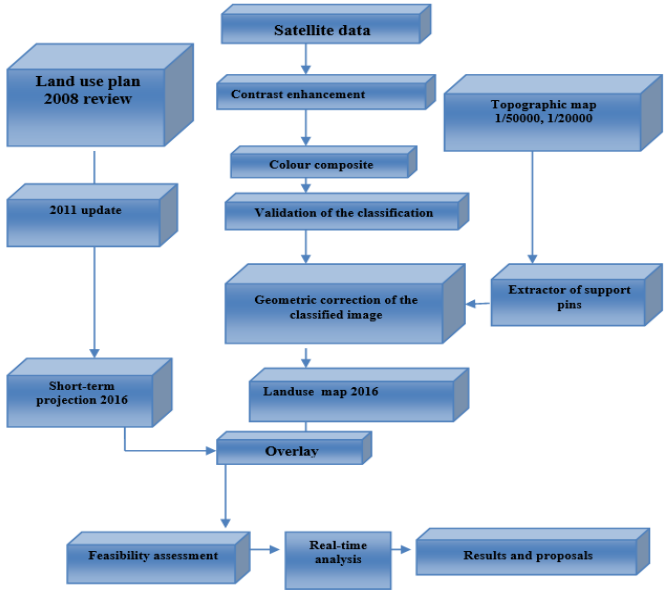

Figure 3. Organization chart of the different stages of management plans evaluation

(Source: Saker Adel)

Pan-Sharpening

"Pansharpening is a process of merging high-resolution panchromatic and lower resolution multispectral imagery to create a single high-resolution color image. Google Maps and nearly every map creating company use this technique to increase image quality. Pansharpening produces a high-resolution color image from three, four or more low-resolution multispectral satellite bands plus a corresponding high-resolution panchromatic band" [1]: Low-res color bands + High-res grayscale band = Hi-res color image, for example Landsat 7, which includes six 30 m resolution multispectral bands, a 60 m thermal infrared band plus a 15 m resolution panchromatic band. [2]

[1] *http://www.geocarto.com.hk/edu/PJ-PANSHARP/main_PNSP.html*
[2] *https://en.wikipedia.org/wiki/Pansharpened_image*

”Generally, the Pan-sharpening is defined as a combination of two or more different images to form using an algorithm a new image” (Bouhata et al., 2016, p. 161; Ehlers et al., 2010).

”The aim of image fusionis to integrate complementary data in order to obtain more and better information about an object or a study area than can be derived from single sensor data alone (Sarup and Singhai, 2011). In our work the pan- sharpening is to merge a panchromatic image (band 8) at high spatial resolution (15 m) obtained by the LDCM sensor with a multispectral image of medium spatial resolution (30 m) also obtained by the same sensor and the result produced a multi- spectral image with the same resolution as the panchromatic image. A supervised classification based on the method of maximum likelihood, was used on the previous two colored composition images using the image processing software (ENVI 4.5). This method is considered as a powerful technique for classification. The rule of the decision of this method is based on the probability of a pixel belonging to a given category” (Bouhata et al., 2016, p. 161; Fojstng, 1999; Murtaza and Romshoo, 2014). The average performance of classifications is 98.23% for the classification of TM 1987, 98.69% for the classification of TM 2001 and 98.79% for the classification of 2016 LDCM.

According to (Rupali and Karbhari, 2015), when 0, 81 < Kc < 0,99, it means that our results are statistically perfect (table 1).

Table 1. Validation the results of classification by good values of GP and KC

Matrix of Confusion	Global Precision (GP)	Kappa Coefficient (KC)
Confusion Matrix 1987	98.23	0.9713
Confusion Matrix 2001	98.69	0.9609
Confusion Matrix 2016	98.79	0.9753

RESULTS AND DISCUSSIONS

Comparing the classification of the images makes it possible to locate and identify changes in land use. The visual examination of the satellite images acquired in 1987, 2001 and 2016 shows that the changes in land use have been largely identified in the city of Biskra, the images help to understand at a glance the landscape changes of different parts of the study area. This landscape represents the increase of the urbanization perimeter and the reduction of the bare grounds and the surfaces of the palm groves.

The visual comparison of the changes limits their real appreciation and encourages errors of judgment. This is why, in addition to the visual method, we checked the relevance of the changes using another statistical approach in 1987, 2001 and 2016. This approach was carried out under ENVI 4.5 using the instrument (statistical classes) which makes it possible to measure and calculate the surface area of the different classes (figures 4, 5 and 6).

The following table summarizes the distribution of the area of the units of land occupation.

Table 2. Areas of unit of land occupation

Land use unit	Area in 1987 (km^2)	Area in 1987 (%)	Area in 2001 (km^2)	Area in 2001 (%)	Area in 2016 (km^2)	Area in 2016 (%)
Palm grove	17.97	12.51	12.20	8.46	7.47	5.18
Bare ground and rocky terrain	101.207	53.658	91.857	48.701	84.572	44.839
Urban fabric	14.751	7.821	17.311	9.178	24.066	12.760

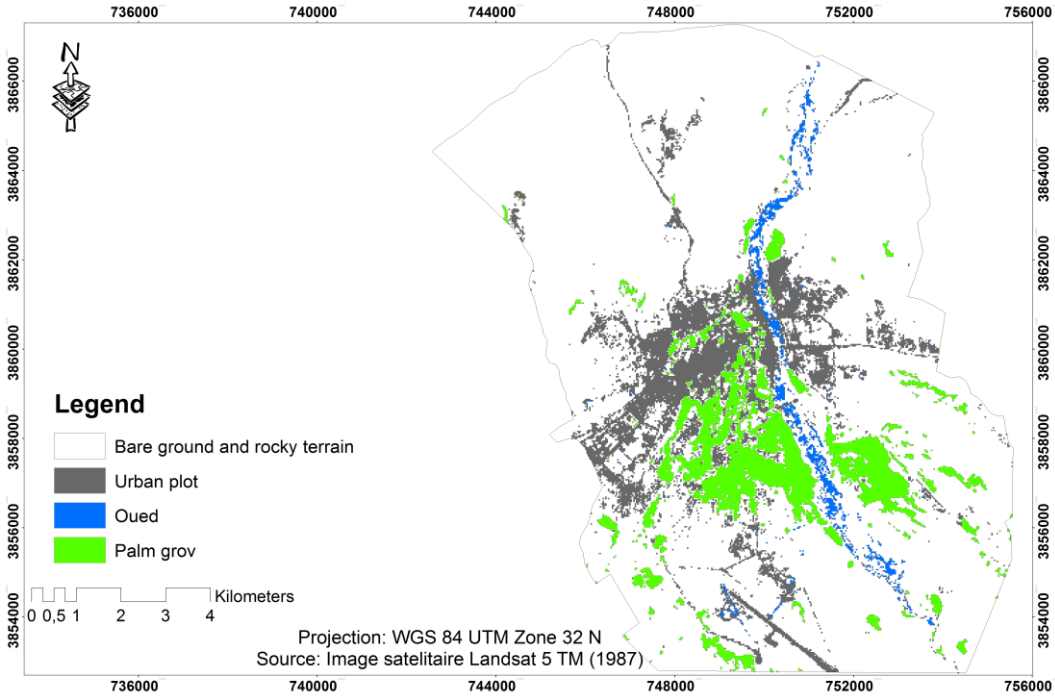

Figure 4. Thematic map of land occupancy in Biskra city in 1987
(Source: Saker Adel)

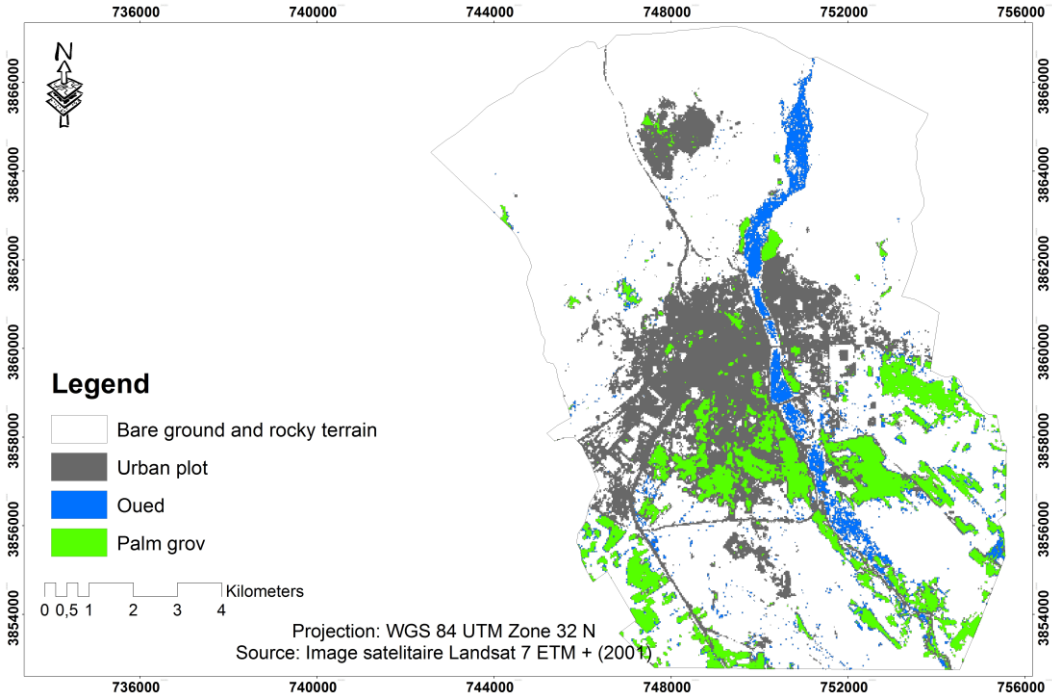

Figure 5. Thematic map of land occupancy in Biskra city in 2001
(Source: Saker Adel)

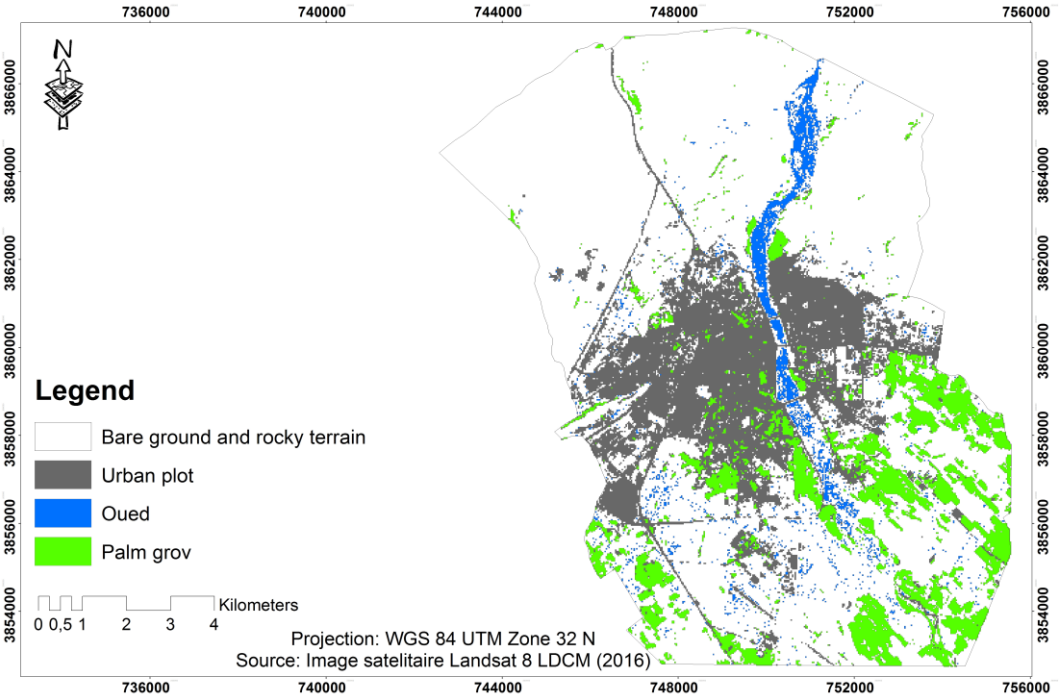

Figure 6. Thematic map of land occupancy in Biskra city in 2016
(Source: Saker Adel)

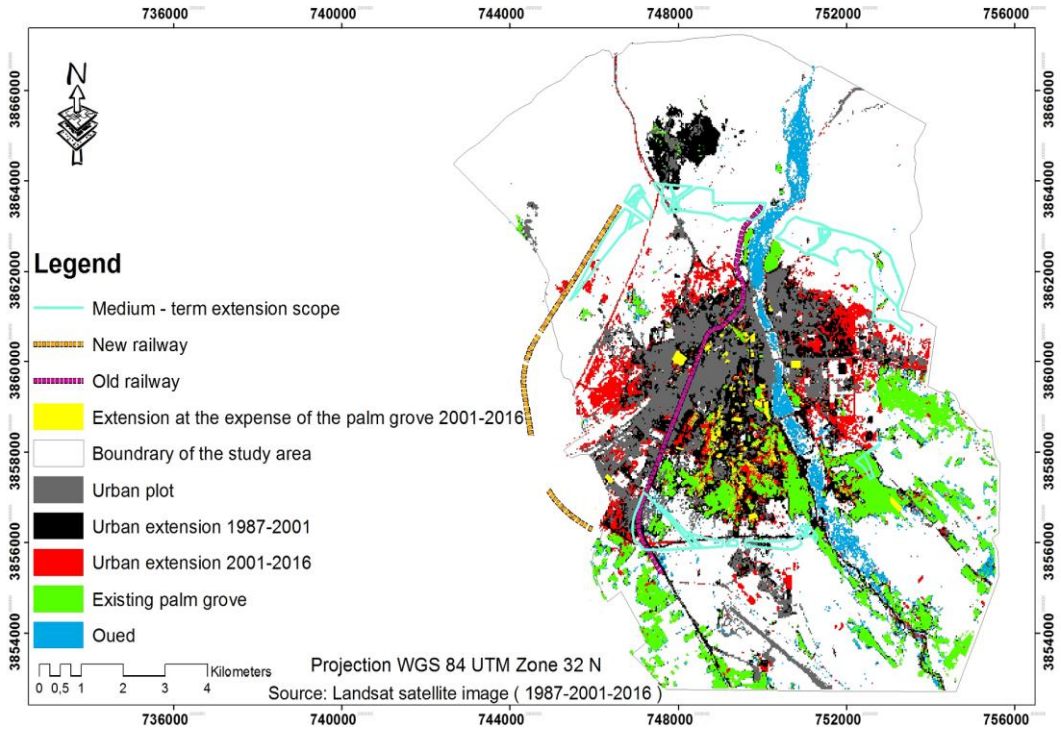

Figure 7. Diachronic evolution of the municipality of Biskra (1987-2001-2016)
(Source: Saker Adel)

Based on a comparison between 2016 and mid-term 2021 short-term extension areas of the P.D.A.U with the 2016 SVM results, it was found that:

- in view of the deficits recorded on the P.D.A.U, it is more than necessary to adopt a geomatics approach as a complementary mechanism for digitizing the urban plan;
- the actual five-year extension areas (2011-2016) exceeded the medium term. Therefore the extension areas proposed by the P.D.A.U are insufficient by contribution to high investment rates;
- projected railway (in progress). The problem has not been solved between the period of study and realization;
- extension at the expense of the palm groves (figure 7).

CONCLUSION

The use of remote sensing techniques has allowed us to evaluate many abuses that prove the futility of the rehabilitation approach in the region, which can be summarized as follows:

- to manage the territory, the P.D.A.U must be updated each year through geomatics approaches;
- it is necessary to direct the expansion towards the inside of the city through renovation actions in order to reduce the expansion outside the city;
- shifting housing projects towards neighboring municipalities.

In order to implement an urban planning strategy, new digital tools are necessary for evaluation and monitoring.

Urban planning is mainly determined by the division of land into zones which, with different degrees of concretion, are assigned to a certain purpose. As a result of this planning, each point of the territory belongs to a particular category, to a particular use of the land.

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Submitted:	Revised:	Accepted and published online
April 13, 2018	June 06, 2018	July 20, 2018