International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 10, Issue 8 (August 2014), PP.08-17

Monitoring the proliferation of slums through GIS and satellite image processing in the Rural Common of Sidi Taibi

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Abstract:- Slums throughout the country of Morocco have a great influence in both socio-economic and the side of safety and environmental context. Managing the various aspects involved in this process also requires the conventional method of technical methodology based on satellite image processing, a key element to be introduced into a GIS environment, will surely contribute to making good decisions and identify by following the real problems, leading to a total elimination of inadequate housing and especially slums.

Keywords:- Geographic Information System (GIS), Land use, photogrammetric, Slums, supervised classification.

I. STUDY AREA

In recent decades, urbanization in Morocco has experienced a remarkable expansion, and this is mainly due to the high population growth rate. The huge disconnect between supply and demand for housing regulatory constitutes one of the major implications of the urbanization occurring in Morocco. Faced with a demand that continues to grow, supply is still marked by an insufficient quantity, and disadvantaged urban population cannot meet their needs in terms of housing in the prescribed market are obliged to cross the illegal market, which is very dynamic and is responding to a request that neither regulated private sector nor the public sector cannot meet. During its evolution, this market has produced very different forms of housing, leading to a strong proliferation of slums [2].

This forced and improvised urbanization is encouraged primarily by land structure (collective land), and especially by speculation. Actually this situation poses a serious problem in terms of spatial organization.
This article comes from this perspective and aims to establish a geographic information system for monitoring the evolution of slums in the rural common of "Sidi Taibi" based on alphanumeric data from different studies (socio-economic, census, environment, geophysics..), introducing into a database linked to a conceptual data model (C.D.M) and graphics data mainly from remote sensing data extracted from processing of satellite images in different dates and resolutions, photogrammetric data from different dates of aerial photography and ortho image planes on different dates (1992, 1999,2000,2002 and 2012) and cadastral maps defining the land structures and their evolution [5], also topographic maps at different scales and other maps (forest map, planning documents, etc...) ;

Through pattern recognition methods, introducing the unsupervised classification (**Algorithm: K-means entropique**) supervised classification (**S.V.M : Support Vector Machine**) [6]. This process will generate the Land Use Plans, and Digital Terrain Model **(DTM)** on different dates, it will allow us to extract the data to be entered in a GIS environment and facilitate decision-making to stop the proliferation of slums.

II. STUDY AREA

The study area (Fig.1) concerns the rural common of Sidi Taibi, Morroco; it is located about 15 km south west of the City of Kenitra, crossed by the national road n°1 linking the cities Rabat, Tangier. It bounded by the region of Rabat Sale Zemour Zair south, and north by the cities of Mehdya and Kenitra, west by the Atlantic Ocean and in the east by the rural common of Haddada. The study area covers about 145 km², which 2/3 are covered by forest Maâmora, and includes the following Douars : Oulad Taleb, Laarafja Ouled NCER, Ouled Mbarek, Ouled Moussa ,Hancha and M'ghaita.

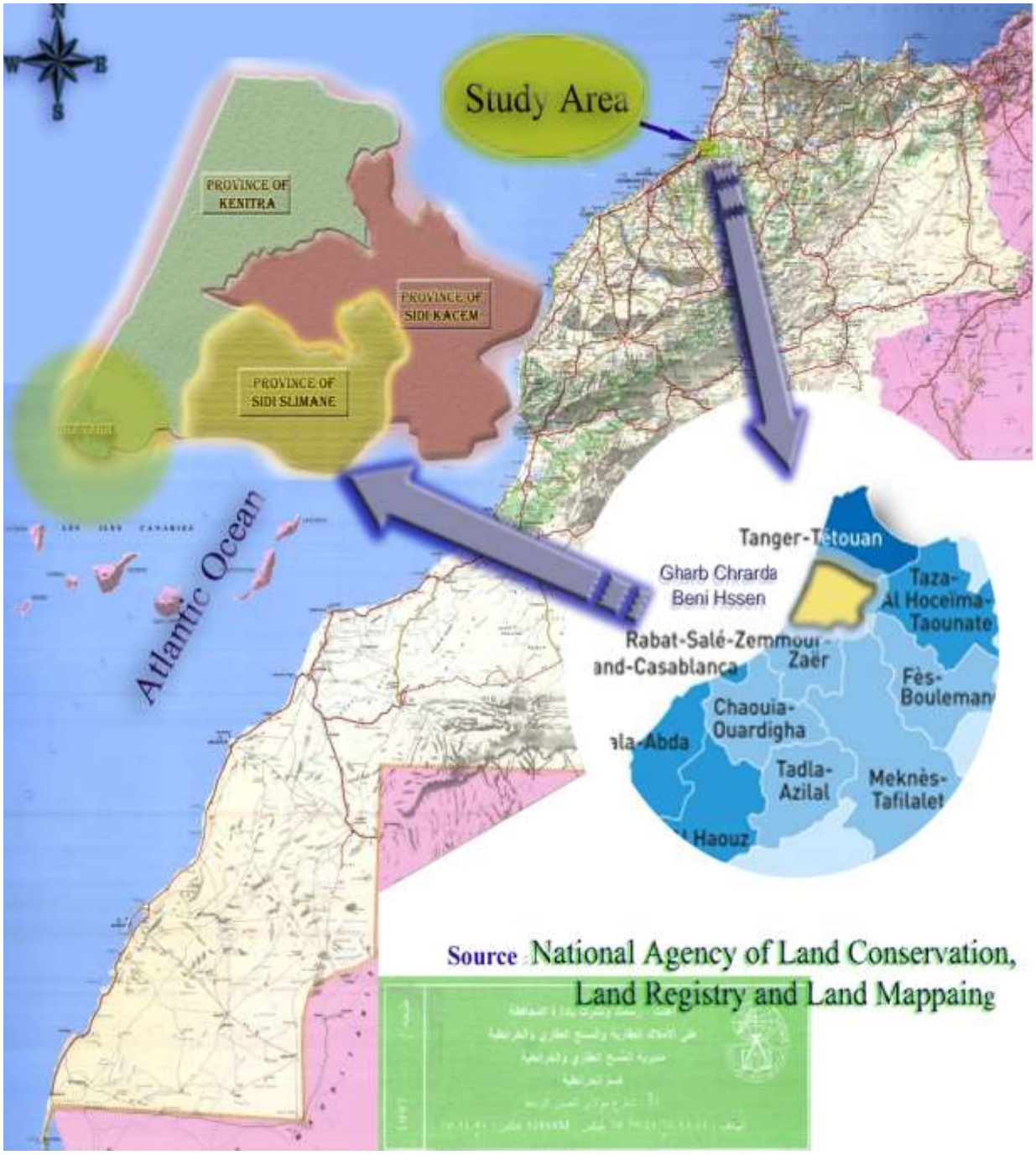

Fig. 1: Map of the study area.

III. MATERIALS AND METHODS

A. Methodology :

The main techniques used in the preparation of this paper are remote sensing processing, geometric rectification, registration of satellite images and the implementation of the digital terrain model (DTM), Digital Elevation Model (DEM) and Digital Surface Model (DSM) from the orthophotoplan (Air shooting in 2012) and the implementation of Land Use (or Land Cover) Plans at different times to monitor the development of slums;

These data stemming from this process to be introduced into the GIS environment, which is going to allow us to define the principles of intervention to face the proliferation of slums.

The flowchart of methodology followed is illustrated in Figure 2.

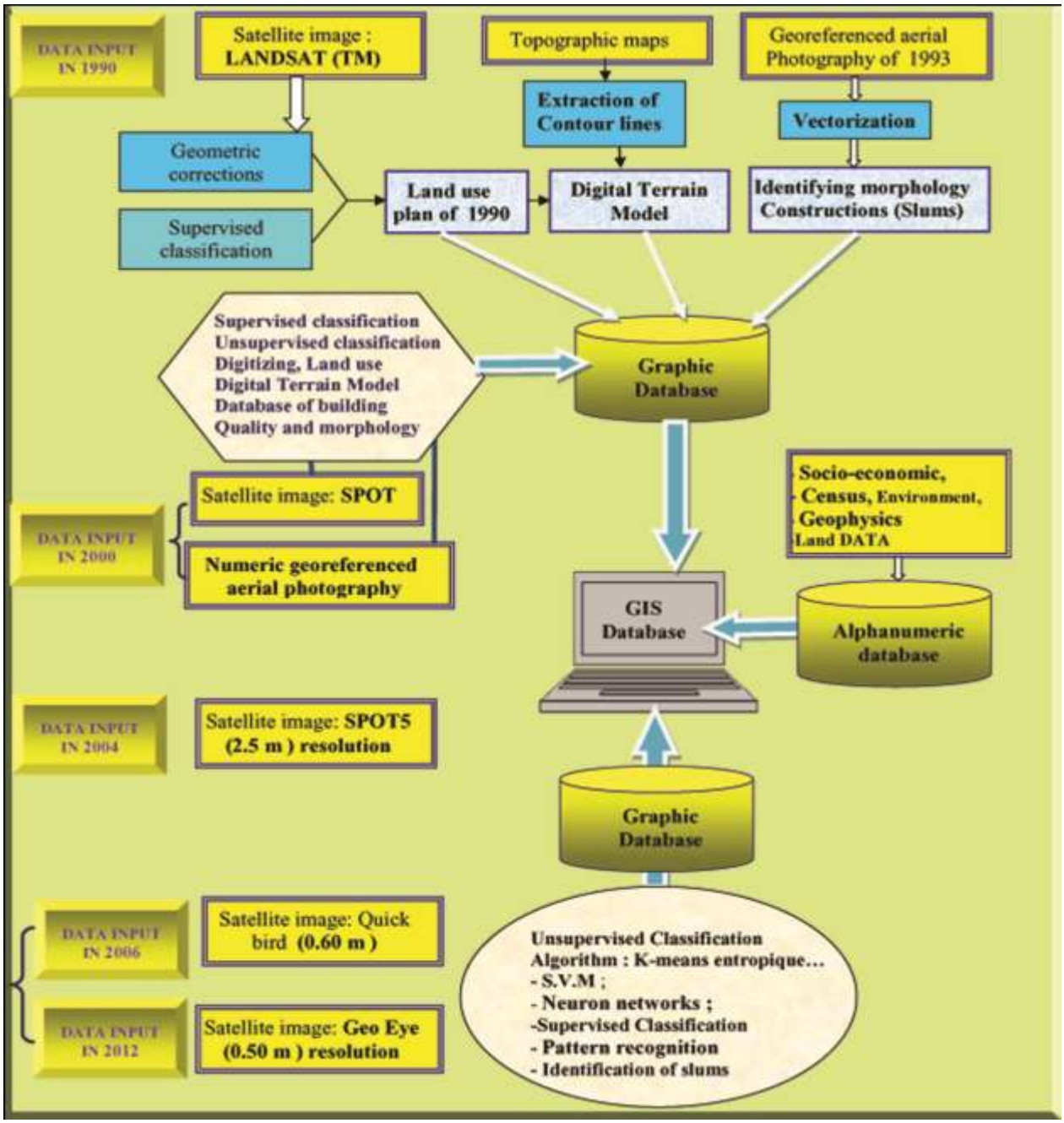

Fig.2: Flowchart of the methodology followed in the study

Principle of classification: Classification produces a natural grouping of pixels in the image that we call "spectral clustering" or "class." it is assumed that the regions of the image having the same spectral signature have a similar type of use of ground. The analyst must determine the identity of the spectral clusters.

The unsupervised classification is primarily used to provide an initial understanding of the reparability of different objects in an image and understanding of the great beaches of radiometric. [Durand, 2000].

In this case, we will use a method of clustering which is the Algorithm of K-means Entropopique.

For the supervised classification, we use descriptors based on primitive stemming from the satellite images.

The role of the descriptor is to characterize the objects of interest, in our case we privilege generic descriptors like **Outline** which shows the contrast of the detected elements and its neighborhood after a contour extraction in the satellite image, what interests us is the calculated average distance between the walls of buildings and contours extracted[6]. And **Shading** (or shadows) quantify the presence of the shadow projected

on the side of the building opposite the sun (which characterizes almost all VHR(Very High Resolution) satellite images).

B. Data used

This document has been made using different types of data. Those alphanumeric based on documents from different studies, graphical data from different sources, such as satellite imagery, topographic and thematic maps, aerial photographs on different dates and spatial resolution, as shown in the following table.

Table 1: Data type and their provenance

Data Type	Date/of aerial shooting	Type Of Data	Scale/ Resolution	Source of Data/ Organization
Road map of Gharb, Chrarda, Bni Hssen	2000	Raster	1/250000	Centre National des Etudes et des Recherches Routières
Topographical map of Kenitra, Sidi Bouknadel, Sidi Yahya of Gharb,Maamoura	1986	Raster	1/50000/ 1/25000	National Agency of Land Conservation, Land Registry and Mapping
Photogrammetric data/Aerial photos/Orthophotoplan .	1993 1999 2002 2012	Raster Vector Vector Vector	1/2000 1/5000 1/10000	Division de l'urbanisme de de la Wilaya du Gharb Chrarda BniH ssen Agence Urbaine de Kenitra-Sidi Kacem
Satellite imagery : SPOT (P+XS) SPOT 5 Quick Bird Geo-Eye	2000 2006 2006 2012	Raster	2.5 m 2.5 m 0.60 m 0.50 m	Convention between A.U.K.S (Agence Urbaine de Kenitra-Sidi Kacem) and the C.R.T.S (Royal Centre for Remote Sensing) for the acquisition of satellite images
documents from different studies	2002 2004	Alpha-numeric	---------	Agence Urbaine de Kenitra-Sidi Kacem HCP (Haut Commissariat au Plan)

IV. RESULTS AND DISCUSSION

A. The result of the classification :

In a first step, we proceed to the unsupervised classification using a spot satellite picture of 2,5 m of spatial resolution, as shown in the following figure :

Fig.3: Spot satellite picture of 2, 5 m of spatial resolution (2004)

A.1 The result of unsupervised classification:

The result of this processing is a colored component represented in the following figure

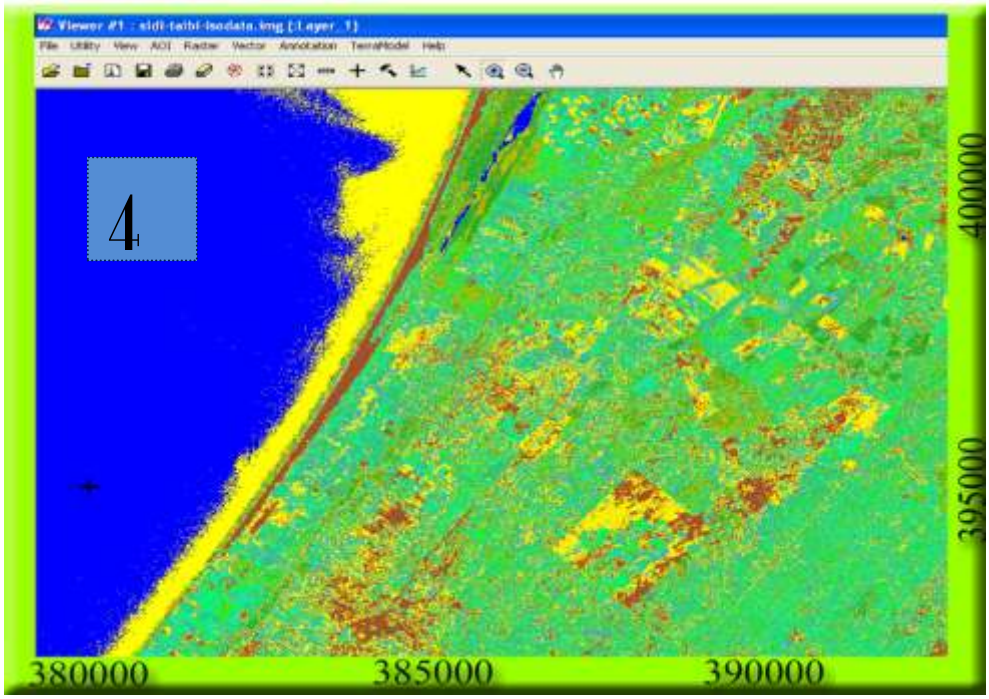

Fig.4: Colored component result of unsupervised classification

V. DISCUSSION

This result shows that there is confusion between several elements, thing that complicates the identification of slums, so we think that this technique is not recommended for such a study.

A.2 The result of supervised classification:

The supervised classification is based on the terrain knowledge. For this, we conducted several terrain visits for recognition, and we define the different classes. The result of this processing is represented in the following figure:

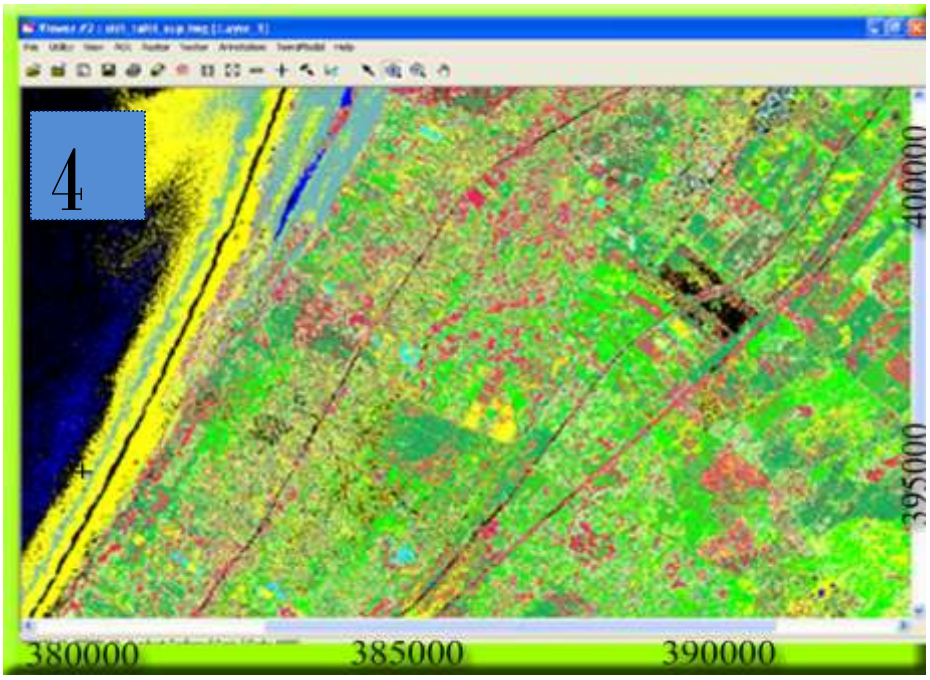

Fig.5: Colored component result of supervised classification

The result of supervised classification has led us to establish the following plan of land use (or land cover) for the rural common of Sidi Taibi:

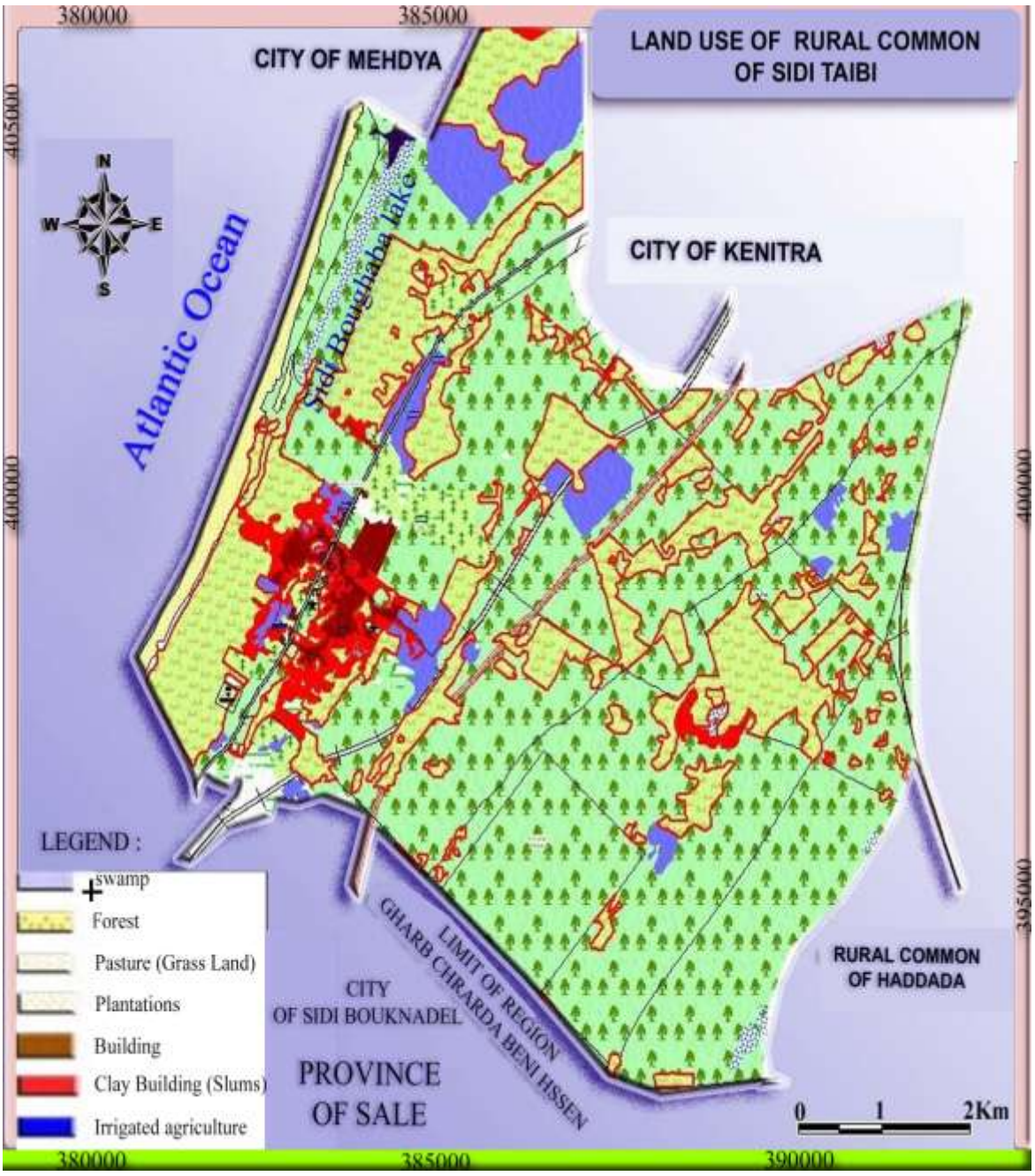

Fig.6: Land use for the rural common of Sidi Taibi based on the result of supervised classification

B. Processing of data from aerial photography :

We have got a series of aerial photographs from 1993 to 2012 that will surely allow us to follow the evolution of slums with some accuracy.

B.1 Digital Terrain Model of the topographic maps processing:

The result of digitizing the contours and introducing into MAPINFO environment, using the Vertical Map solution, is the following Digital Terrain Model dapped with topographic card of Kenitra and Sidi Bouknadel:

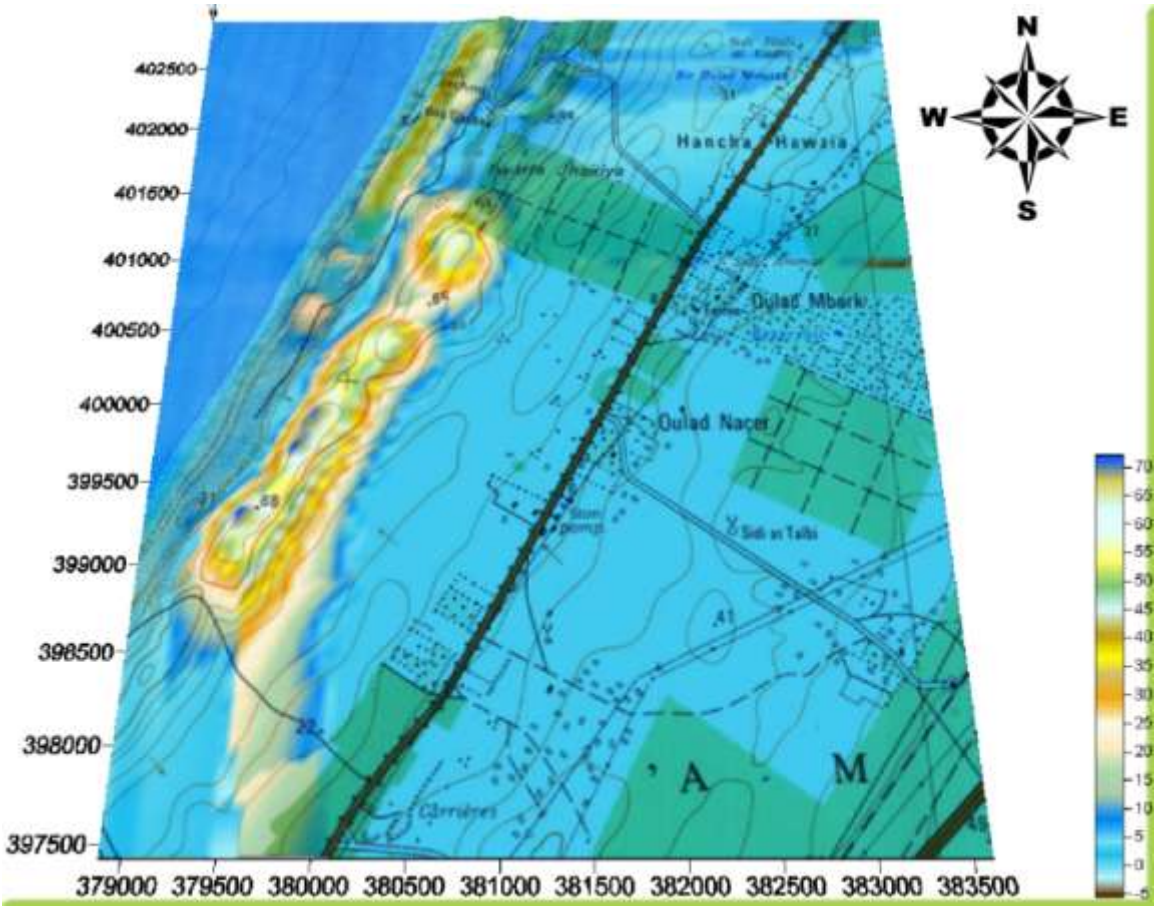

Fig.7: Digital Terrain Model for the rural common of Sidi Taibi based on the Topographic maps processing

B.1 Digital Terrain Model of photogrammetric aerial and the orthophotoplan maps processing:

For this, we use the Global Mapper solution that helps us to convert data from Dwg Drawing to XYZ file to introduce into the Surfer environment.

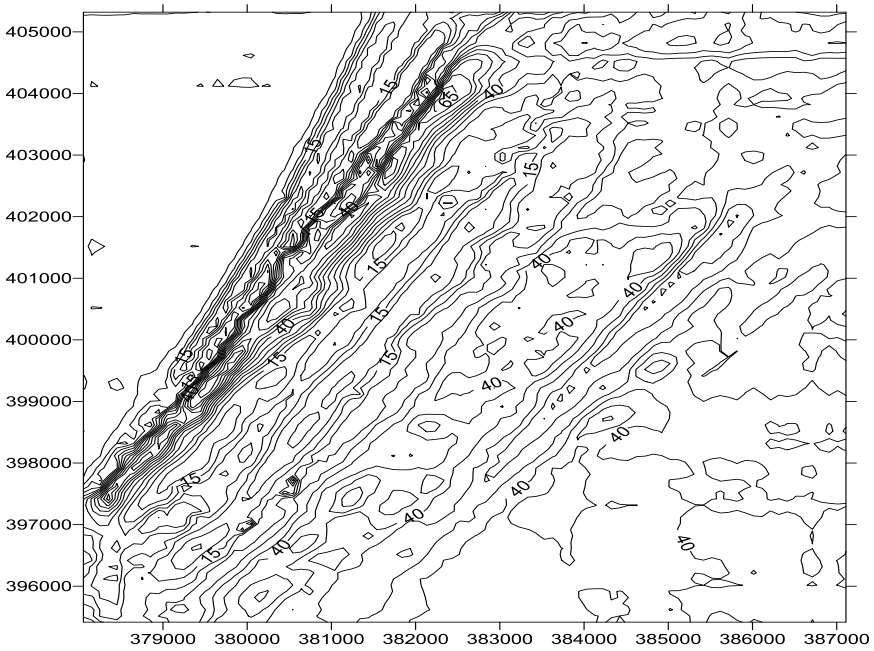

Fig.8: Contour map for the rural common of Sidi Taibi

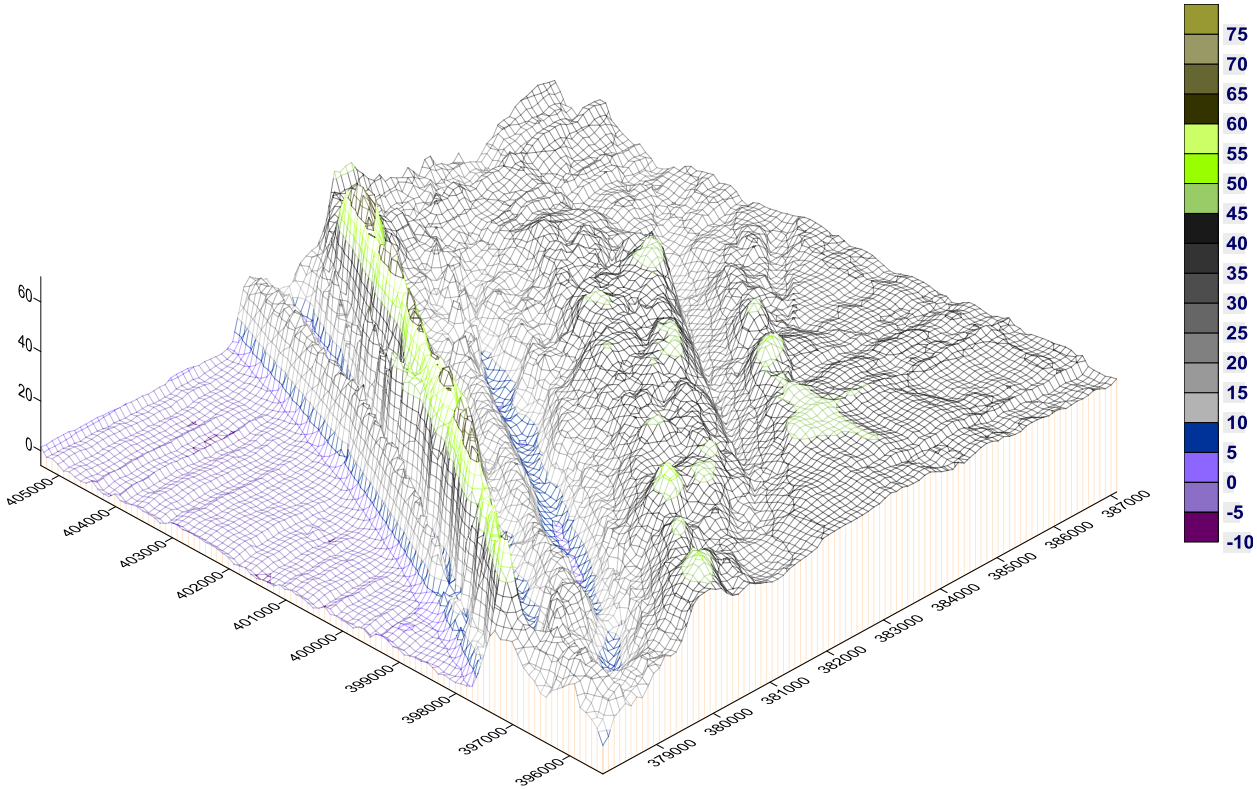

Fig.9: Digital Terrain Model (3D wireframe) for the rural common of Sidi Taibi based on photogrammetric photography and orthophotoplan maps processing

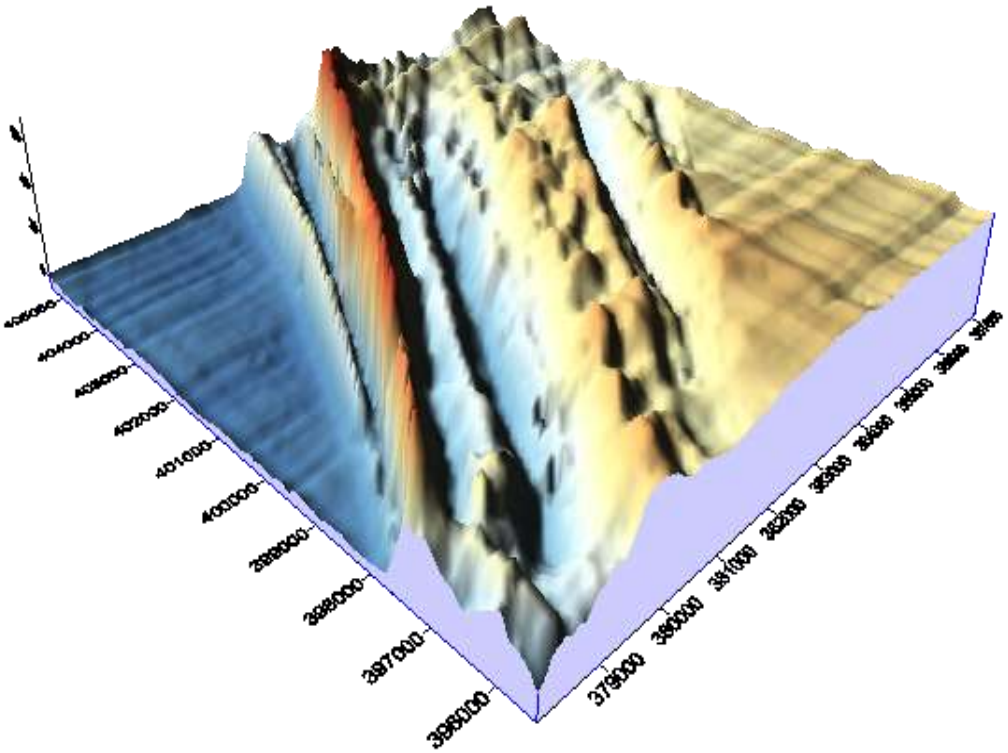

Fig.10: Digital Terrain Model for the rural common of Sidi Taibi (3D Suface map)

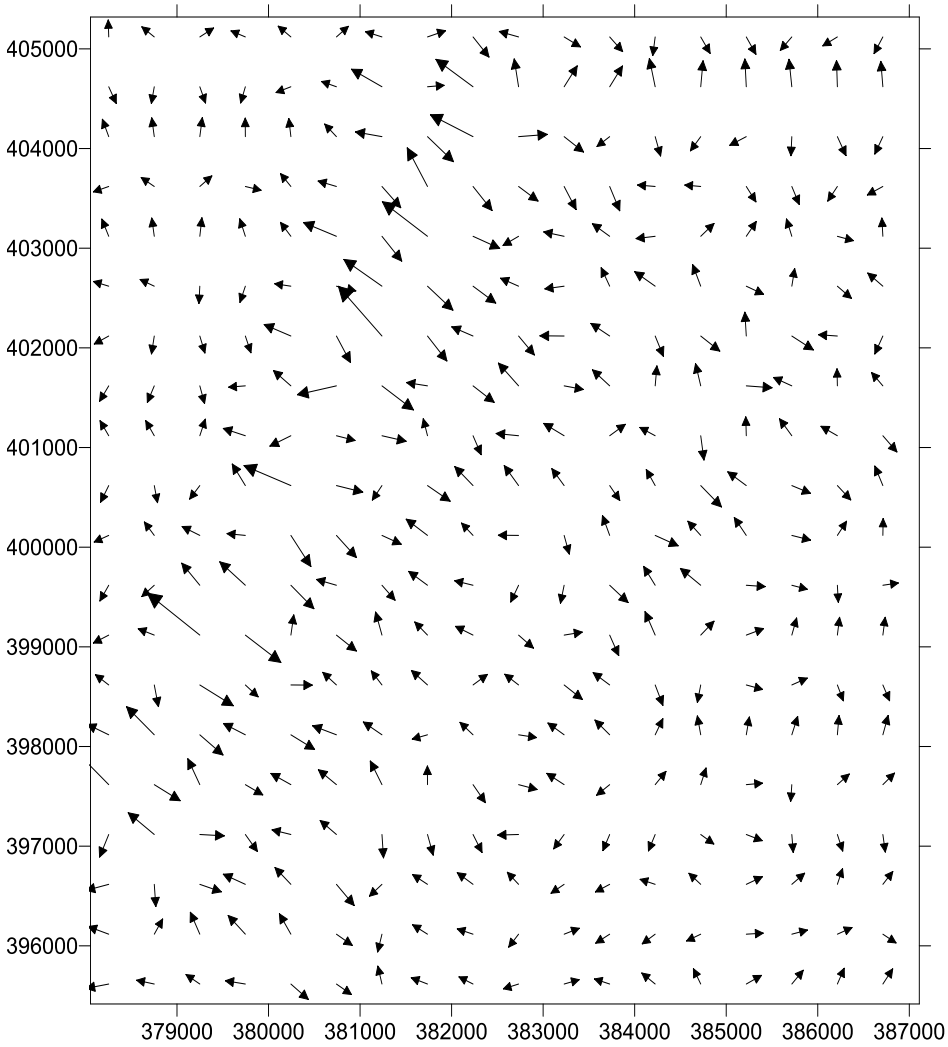

Fig.10: Grid Vector map for the rural common of Sidi Taibi

VI. DISCUSSION

It is very clear that the result of aerial images processing is more accurate than the satellite image, but the cost factor differs, we cannot provide all common of the region by aerial photography. The same process is repeated for all other dates, allowing the extraction of the slums data, to add to all the other alphanumeric data from different studies, surveys, and census and introduce into GIS environment to accurately define the appropriate mode of intervention and facilitate decision-making.

VII. CONCLUSIONS

This paper examines an approach to facilitate intervention in the phenomenon of "slums, unlike older methods based on land surveys and identification of people in slums and land parcels, and gives a contradictory result. The works realized on the basis of satellite pictures allowed to make quickly one first cartographic database up to date containing the data of slums in the rural common of Sidi Taibi.

Monitoring of the evolution of this phenomenon over time, becomes an easy operation using a given satellite images on different dates of the same nature.

Identification of slums accurately therefore requires very high resolution (VHR) satellite images, we just have a satellite image (GEO-Eye, 0.5 m of spatial resolution),that is the subject of our next article entitled “extracting buildings slums from High-Resolution Satellite Images.

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