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Assessment of Urban Sprawl on El Minya Archeological Sites, Egypt

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ABSTRACT

In Egypt, thousands of known and unknown archaeological sites are at risk of destruction from urban sprawl and expanding development. Population growth is the main factor driven urban sprawl, Egypt's population has witnessed a remarkable increase over the previous decades. The population rose from 35.3 million in 1970 to around 90 million today, doubling in less than 40 years. Hence, population issues are of the highest priority to the Government of Egypt. El Minya Governorate have a high population growth (i.e., 3.1% per year) and hence the urban sprawl over the archeological sites in the desert fringes of the Nile valley is expected. Remote sensing and GIS are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analysis of earth's system function patterning and change at local, regional and global scales. Overtime such data also provide an important link between intensive localized ecological research and regional, conservation and management of archeological areas. The basic premise in using remote sensing data and GIS for change detection is that the process can identify change between two or more dates that is uncharacteristic of normal variation. This research aims to assess the extent of urban sprawl and its impact on archeological sites in El Minya Governorate, Egypt.

Key words: Archeology, urban areas, population, remote sensing, human activities

INTRODUCTION

Egypt is one of the most populous country in Africa and the Middle East and the 15th most populated country in the world (United Nations, 2004). In Egypt, the great majority of people live near the banks of the Nile River where the arable land is found. The large regions of the Sahara Desert which constitute most of Egypt's territory, are sparsely inhabited. About half of Egypt's residents live in urban areas, with most spread across the densely populated centers of greater Cairo, Alexandria and other major cities in the Nile Delta (United Nations, 2012). The study area is located nearly in the middle of Egypt (Fig. 1), where several known and unknown archaeological sites are at risk of destruction from urban sprawl and expanding development. Population growth is the main factor driven urban sprawl (Bradley, 2008). El Minya Governorate have a high population growth i.e., 3.1% per year

(CAPMAS., 2012) and hence the urban sprawl over the archeological sites in the desert fringes of the Nile valley is expected. El Minya governorate divided into nine administrative districts includes 9 cities, 57 local units, 346 village, 1429 hamlets and Naga in addition to the new city of El Minya. The governorate is one of the most highly populated governorates of Upper Egypt. Estimated population of the governorate reaches to 5 million people. Table 1 shows residents at El Minya Governorate have amounted to about 4.8 million in 2012. These people are distributed among both rural and urban areas. The largest concentrations of them are in rural places. About 3.9 million people were recorded in rural places (81.2%) and urban population reached to 900,000 thousand people (18.8%). El Minya district contains the largest population of about 880,000 thousand inhabitants, Mallawi district is considered the second one of about 810,000 thousand people and then Samalut district comes third with a

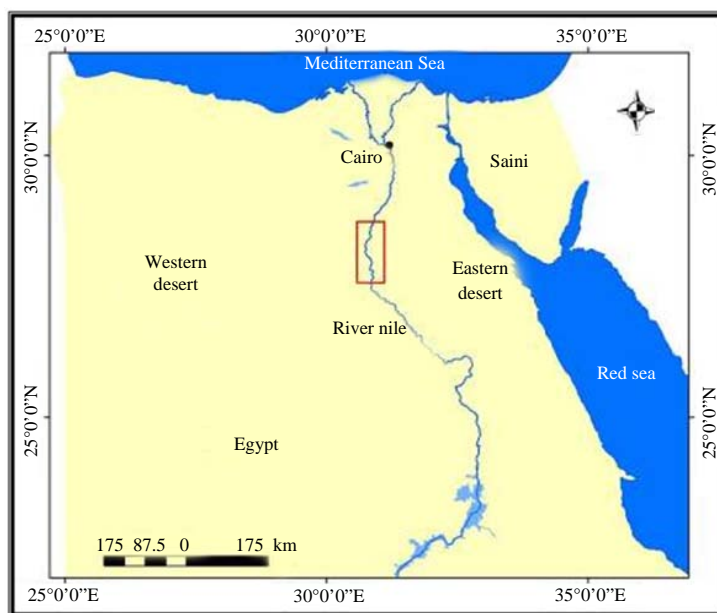


Fig. 1: Location map for the study area (red outline)

Table 1: Distribution of the population in El Minya Governorate on the level of urban and rural in 2012

Districts	Urban			Rural			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Al-Adwa	9345	9016	18361	112404	107412	219816	121649	116428	238077
Maghagha	44001	43031	87032	210687	202960	413647	254688	2445991	500679
Bani Mazar	46681	44832	91513	221836	219845	441681	268517	264677	533194
Matay	27210	26744	53945	109938	110873	220775	137148	137581	274729
Samalout	53728	51499	105227	294356	275407	569763	348084	326906	674990
El-Minya	135480	136050	271530	313488	293987	607475	448968	430037	879005
Abu Qurqas	33545	33050	66595	244328	227110	471438	277873	260160	538033
Malawi	82271	78695	160966	333032	314427	647459	415303	393122	808425
Dayr Mowas	23561	23188	46749	150890	147899	298789	174451	171087	345538
Total	455722	446105	901827	1990959	1899884	3890843	2446681	2345989	4792670

Source: CAPMAS (2012)

Table 2: Distribution of the population in the studied archaeological sites in 2012

Sites	Population	Percentage
El Bahnasa	19379	20.3
Bani hasan	21795	22.8
El-Ashmunein	14253	15.0
Tuna El-Gabal	14919	15.6
El -Sheikh' Abadah	95680	10.0
Tel El Amarna	15918	16.3
Total	95832	100.0

Source: CAPMAS (2012)

population of nearly 675,000 thousand people. Matay district is characterized by less population with 275,000 thousand people. Total populations at the six archaeological sites are nearly 100,000 thousand inhabitants. Population distribution at these sites is shown in Table 2. The data indicate that Bani Hassan came first in the size of population with the total number of about 21,795 people. El Bahnasa site represents the second rank where the total number of population reached to 19379 people. Tell-El-Amarna comes as a third place with

number of population reached to 15918 people. Tuna El-Gabal and El-Ashmunein village comes in fourth order with nearly the same number of population, 14,919 and 14,253 people, respectively. El-Sheikh' Abadah is characterized by small number of inhabitants about 9568 people.

MATERIALS AND METHODS

Remote sensing and GIS are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analysis of earth's system function patterning and change at local, regional and global scales (Wilkie and Finn, 1996). Overtime such data also provide an important link between intensive localized ecological research and regional, conservation and management of archeological areas. The basic premise in using remote sensing data and GIS for change detection is that the process can identify change between two or more data that is uncharacteristic of normal variation. In the current study the

impact of urban sprawl will be assessed by using the satellite data and GIS. The topographic maps (scale 1:50000) of the year 1992 and Landsat-8 images of 2014 were employed to detect the urban sprawl in six archeological sites at El-Minya Governorate (i.e., El-Bahnasa, Bani-Hassan, El-Sheikh Abadah, Tuna El-Gabal, El Ashmunein and Tel El-Amarna). Topographic maps produced in 1992 at scale 1:50000 of the investigated sites were used to map the urban areas exist in 1992 by using Arc-GIS 9.2 software. Satellite images of the year 2014 were used to map the urban areas exists at 2014. The images were geometrically corrected using ground control points from topographic maps. Contrast stretching was applied on image by using ENVI 4.7 software (Lillesand and Kiefer, 2000); urban areas were automatically separated using the maximum likelihood classifier (ITT., 2009). Figure 2 represents the mosaic of satellite images of the investigated sites acquired in 2014.

RESULTS

We can summarise the urban sprawl on the archeological sites in as follow:

El-Bahnasa: Figure 3 represents the urban areas in 1992 and 2014 around El Bahnasa archeological area. The data indicate

that a great increment in the urban areas have occurred during 1992-2014. The urban area was estimated to be 2.1 km² in 1992 and 5.9 km² in 2014. This indicates that the annual rate of urban sprawl in this area is 0.17 km per year.

Bani Hasan: Urban area around Bani Hassan archeological sites have been increased from 5.4 km² in 1992 to 8.9 km² in 2014. The annual rate of urban sprawl in this area was estimated to be 0.16 km per year. In this area most of the urban sprawl was occurred on the expense of the desert fringes and arable lands. Figure 4 represents the urban areas in 1992-2014 around Bani Hasan archeological sites.

El-Sheikh' Abadah, Tuna El-Gabal and El-Ashmunein: The distances between the archeological sites of El-Sheikh-Abadah, Tuna El-Gabal and El-Ashmuneinare are small, so the impact of urban sprawl is the same on these areas. The urban areas in El-Sheikh 'Abadah, Tuna El Gabal and El Ashmunein in 1992 and 2014 are illustrated in Fig. 5. The given data indicate that the urban areas were increased from 5.3 km² in 1990 to 8.9 km² in 2014. The annual rate of urban sprawl is 0.16 km per year (the same as Bani Hasan).

Tel El-Amarna: Urban sprawl over Tel ElAmarna area was done, the total area of urban settlements in 1992 was 2.8 km²

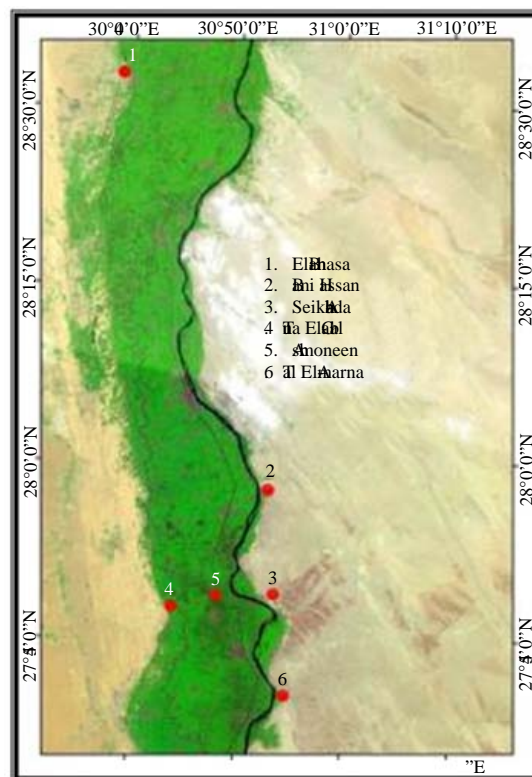


Fig. 2: Landsat-8 mosaic of the investigated sites (bands 7, 5, 2) acquired in 2014

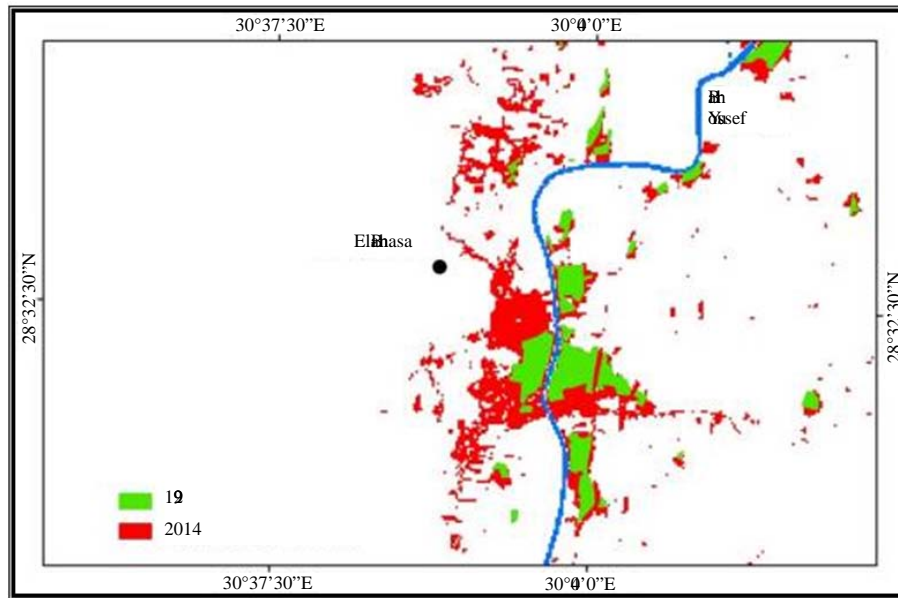


Fig. 3: Urban areas in 1992-2014 around El-Bahnasa area

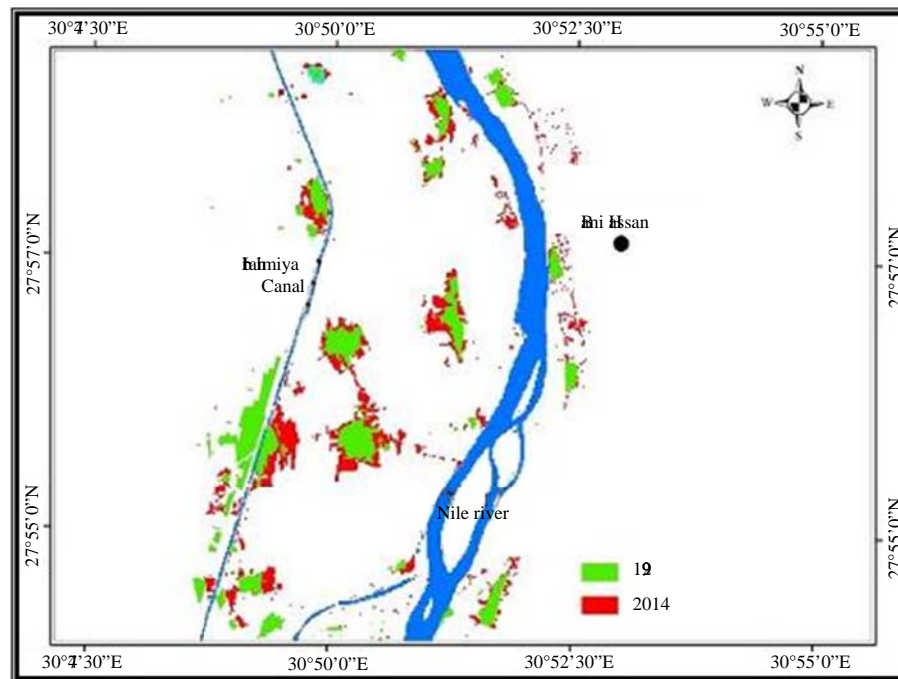


Fig. 4: Urban areas in 1992-2014 around Bani Hasan area

increased to 5.2 km² in 2014. The annual rate of urban encroachment in this area was estimated to be 0.11 km per year. This rate is low compared with the other archeological areas due to the geographic location of Tel ElAmarna. Figure 6 represents the urban areas closed to Tel ElAmarna in 1992 and 2014.

DISCUSSION

Anthropogenic and human activities were started by the beginning of Roman period where Bani Hasan and Tel El-Amarna tombs were used as houses and churches by Coptic (Fig. 7). Alterations that hint to fires inside the temple are

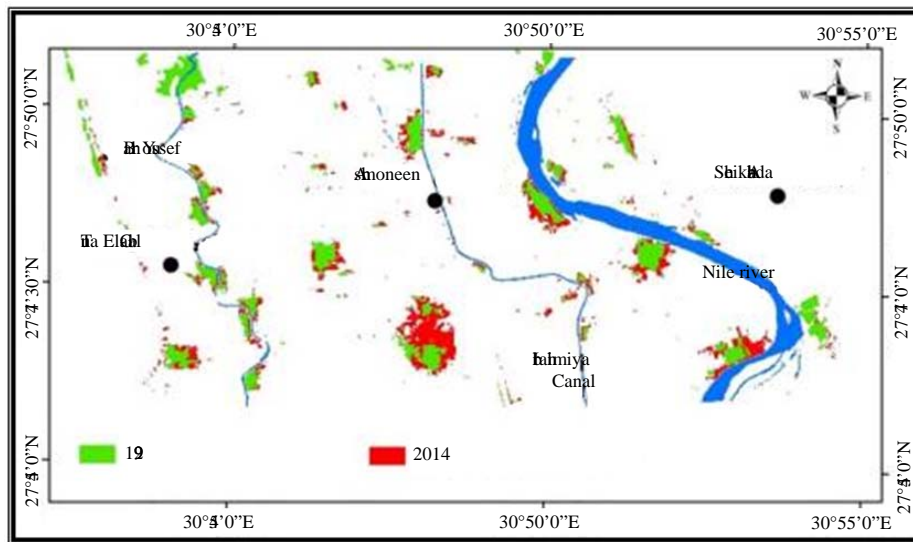


Fig. 5: Urban areas in 1992-2014 around El-Sheikh' Abadah, Tuna El-Gabal and El-Ashmunein areas

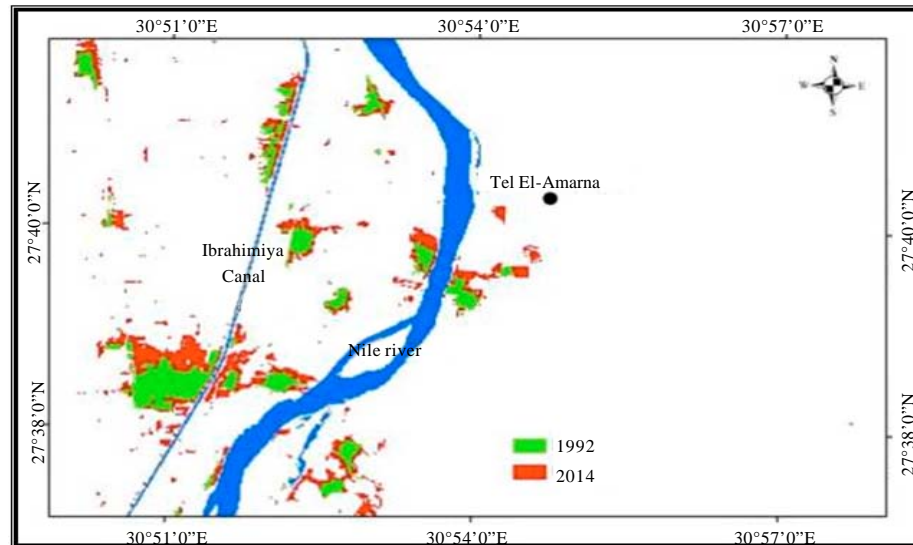


Fig. 6: Urban areas in 1992-2014 near Tel El-Amarna

frequent, same results were reported by Maghazy *et al.* (2012). On the walls there are many relics of smudge from candles and torches. The surfaces are black and react more to heat impacts. Also the stones of some temple at El Ashmunein, El Bahnasa and El-Sheikh Abadah were recently used as a building material. The temple is not yet open for tourists but locals are moving inside the ruins. They walk on the capstones, touching and scraping off the loose parts representing man-made damage, the same phenomena was mentioned by Abdulla *et al.* (2008). Former restoration activities like very rude cleaning procedures, emergency interventions using incorrect conservation materials and procedures have provoked

considerable loss of surfaces. Another important factor is the biological action because the biological effect is very dangerous, especially on the reliefs of the archaeological sites (Elnaggar *et al.*, 2010). It should be applying suitable techniques to reduce the biological action on all the monumental sites, several researchers emphasized this opinion e.g., El-Hissy *et al.* (1991) and Domsch *et al.* (2007). The negative effects and encroachments of human activities have no limit but could be monitored from the reality of field studies and measurements in each site (Shaw, 1987). The size of these infringements was determined to introduce recommendation to the officials and decision makers. This could reduce



Fig. 7: Alter of Coptic Church inside Bani Hasan tombs



Fig. 9: Animal grazing and cultivation activities inside El-Bahansa site



Fig. 8: Urban areas closed to the border of El-Ashmunein site



Fig. 10: New tombs inside El-Sheikh Abadah archeological site

aggravation and draw the attention of the risk caused by some inhabitants. For example at El Ashmunein archeological area transgresses and flagrant residents of the recent village around the archaeological sites (through building of new houses and grazing animals) were observed (Fig. 8). On the other hand El-Bahnasa archeological site is subject to continuous infringements where the people building graves and cemeteries adjacent and inside the archeological area; such phenomena were mentioned by UNESCO (2006). It was observed that many of residences build their houses above Islamic and Romantic places. This area is also subjected to severe neglect through grazing, animal husbandry and littering (Fig. 9). At Tel El Amarna and El Sheikh Abadaha there are many infringements by population on the archaeological areas where some of them cultivate some areas and others constructed new houses. Also the antique thieves destroyed many valuable monumental things throughout random digging (Fig. 10). In Bani Hassan and Tuna El Gabal area the encroachments of the population on the archaeological lands represented in building of houses and new graves the main encroachments is the thieves destroyed most the tombs (Hanna, 2013).

CONCLUSION

Most of urban sprawl in El Bahnasa archeological site was occurred on the expense of agricultural land and arable areas. Now the urban settlements are located at a distance of 0.5 km from this area, thus El Bahnasa is located under a high risk of urban sprawl impact. The urban areas in Bani Hasan archeological sites are located at a distance of 1.2 km from the archeological areas of Bani Hasan. So the area is affected by a moderate risk of urban sprawl. The distance between the archeological sites of El-Sheikh' Abadah, Tuna El Gabal and El-Ashmunein and the nearest urban areas are 2.1, 0.35 and 0.15 km, respectively. On view of this the sites of Tuna El-Gabal and El-Ashmunein are highly threatened by the urban sprawl while El-Sheikh' Abadah is slightly affected. The distance between the archeological sites of Tel El-Amarna and the nearest urban area is about 1.0 km. Therefore, the impact of urban sprawl on the archeological sites of Tel El-Amarna is expected to be moderate.

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