MONITORING URBAN GROWTH IN OMAN USING REMOTE SENSING AND GIS, SEEB WILAYAT CASE STUDY

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ABSTRACT

This study aims to monitor and analyze urban growth in Al-Seeb Wilayat, Oman using satellite images and GIS between 1991 and 2003. Aerial Photos of 1991 and satellite images of 2000 and 2003 were used to map urban growth and detect urban land use change. The results of this study show that the total built-up area has expanded by 27.93 % between 1991 and 2003, while the residential area has expanded significantly by 64 % between 1991 and 2003 with average annual rate of 5.3 %. These results agree with ancillary data analysis where the annual rate of housing was 5.1% in the same period. This means that the total accuracy of remote sensing and GIS analysis is 96.1%. These results emphasize the potential of using satellite images and GIS in monitoring urban growth where these technologies can save time, effort, and money comparing with traditional approaches.

INTRODUCTION

Urban growth is a recent phenomenon in Sultanate of Oman and it is a result of national development plans that started in the 70th of the last century. In the past, urban growth in Sultanate of Oman could be described as fluctuating. The economic conditions and land resources have played major roles in determining the levels and patterns of urban growth before 1970s. Oil explorations led to economic flourishing in all aspects of development. Educational development is a major element of development plans in Oman. Therefore, Sultan Qaboos University was established as the first university in the Sultanate in 1986 in Al-Seeb Wilayat to achieve national development objectives. Seeb Wilayat is the largest Wilayat in the Sultanate of Oman. The university attracted students from all over the Sultanate and created a unique trend of urban expansion based on this new educational service. This study will monitor and analyze urban growth in Al-Seeb Wilayat using satellite images and GIS between 1991 and 2003.

The main intention of this study is to create historical land use database for Seeb Wilayat which can be used to understand urban growth and predict its direction for the same area. The potential land use will be presented using detailed classification scheme with high resolution. Therefore, the following land use classification system (table 1) has been developed after reviewing all existing land use classification systems (Geomatics, 1999).

Residential	Industry	Highway
Commercial	Mosques	Main Roads
Government	Education	Local Roads
Agriculture	Parks	

Table 1. The proposed land use classification system

Further objectives of this research are to identify and assess socio-economic data to characterize the potential integration of high resolution satellite remote sensing imagery and ancillary data in providing data particularly for urban growth (Abdou Azaz, 2001).

METHODOLOGY

.Arc View used to integrate the available data sources. IKONOS images for two periods (2000, 2003) with one Quikbird for 2003 were used. These types of images have a high spatial resolution (1 meter) which helped classification to be a straightforward task. The individual residential and commercial blocks, transportation

infrastructure are all simply distinguishable and can be confidently categorized. However, there were some problems in distinguishing some blocks directly from images, but these were overcome by field visits or direct questionnaire to experienced people or by using other datasets.

The most recent image which is IKONOS 2003 was placed on a layer with ancillary sources and digitized. Moreover, road network was added to the project in another layer. Up to date plots data and planned plots from the Ministry of Housing, Electricity and Water were placed in an additional layer. From this integrated data, land use polygons were created of an appropriate size (2500 m^2 minimum polygon size), and were classified according to the adopted land use classification system. Then, the second IKONOS image for 2000 was placed in a separate layer. A copy of last digitized land use map which is derived from IKONOS image 2003 was placed at the top of the IKONOS 2000. The land use change was tracked by eliminating any land use feature that could not be identified in the IKONOS 2000 image and adding any land use feature to the database (Singh, 1989). Aerial photos of the 1990s were used for historical data. Aerial photos, satellite images and printed map for 1990s are illustrated in figure 1.
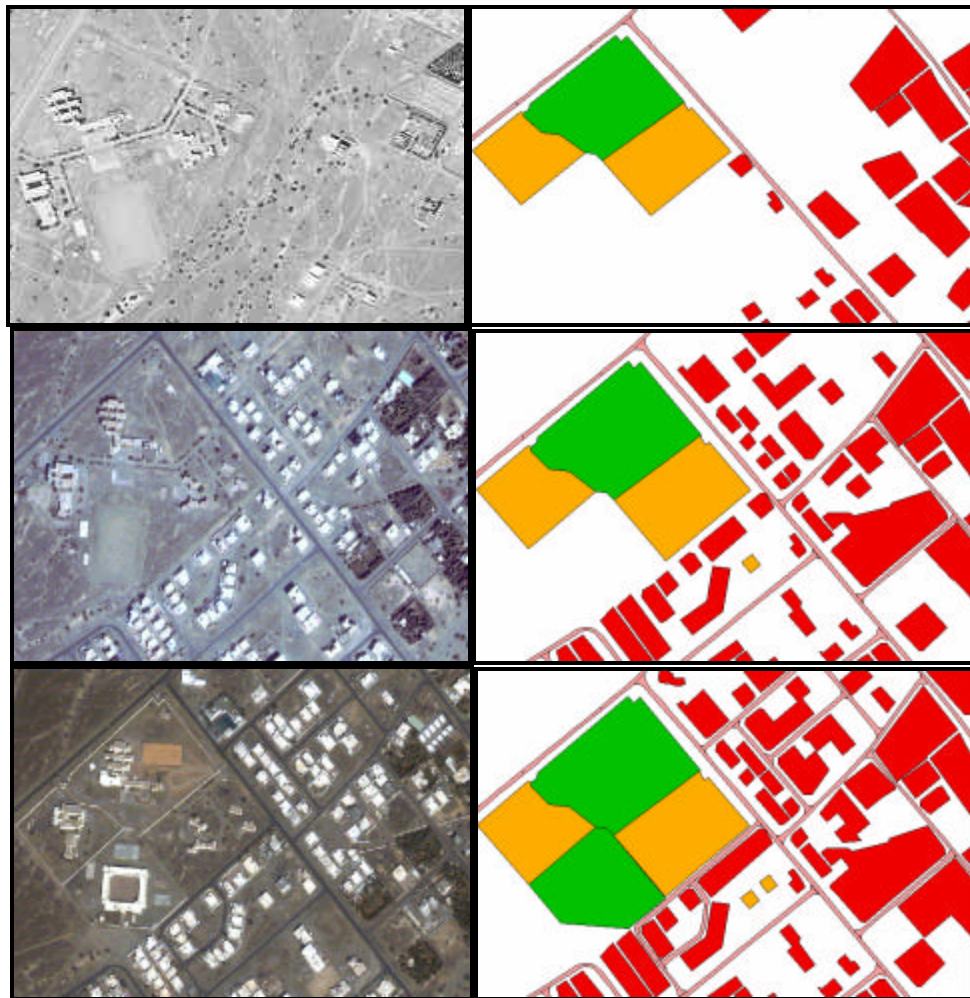

Figure 1. Images and layers of area of study (Top: 1991, middle: 2000, bottom: 2003)

RESULTS

Results of this study show that the total built-up area increased by 27.93 % from 22.77 km² in 1991 to 29.13 km² in 2003 with annual growth rate of 2.3 %. The detailed land use change is presented in table 2.

Land Use Type	Area km^2 1991	% 1991	Area km^2 2000	% 2000	Area km^2 2003	% 2003
Residential	6.96	30.55	10.19	38.12	11.38	39.06
Commercial	0.86	3.78	1.00	3.61	1.05	3.60
Government	4.57	20.05	4.70	17.56	4.70	16.12
Agriculture	0.38	1.68	0.05	0.18	0.18	0.61
Industry	2.85	12.50	2.85	10.64	2.86	9.80
Mosques	0.05	0.20	0.06	0.23	0.08	0.27
Education	5.84	25.65	5.97	22.32	6.44	22.09
Parks	0.00	0.00	0.03	0.13	0.03	0.12
Highway	0.50	2.19	0.53	1.98	0.53	1.82
Main Roads	0.47	2.07	0.55	2.04	0.72	2.47
Local Roads	0.30	1.33	0.85	3.19	1.18	4.03
Total	22.77	100.00	26.73	100.00	29.13	100.00

Table 2. The detailed land use change in the area of study

CONCLUSIONS

Residential land use has the largest share of the built-up area in all times. It formed about 30.55 % in 1991 and become 39.06 % in 2003. Residential land increased by 64% between 1991 and 2003 with average annual growth rate of 5.3%. However, Local roads category made the record in growth rate, this class increased by 293% in the same period with average annual growth rate of 24.4%. Main roads category also raised by 53.2% (4.4 annual growth rates). These figures appeal some important questions such as "Did road network lead to residential expansion or vice versa? To answer such question, there is a need to model or simulate urban growth in the area of study using an urban growth model. This shall be a theme of further study.

Most of land use categories experienced expansions at different rates; however, the only category that decreased is agriculture. This class reduced by 52.6% in the period of study with rate of - 4.39 % annually. Also, this call another important question; for which class, agriculture lost more than half of its area? The area of agriculture was very small already (0.38 km^2) in 1991 and shrunk to 0.18 km^2 in 2003. Does that relate with urban expansion or any other causes such as climate conditions? This will be also subject of further study.

References

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