

IMAGES ARE AN OUTSTANDING EVIDENCE ON RAPID DEVELOPMENT “A PERFECT EXAMPLE FROM UNITED ARAB EMIRATES (UAE)”

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ABSTRACT:

Before 1960's, UAE was a poor developing country, and almost there were no real signs of civilization. During the 1970's two important things happened: H. H. Sheikh Zayed Bin Sultan Al Nahyan, the president of UAE, and the other Emirates rulers get together and established the United Arab Emirates and considerable oil findings were discovered. The UAE Leadership has proved to have deep future vision; in three decades the country jumped from a negligible relatively backward scattered emirates to a well developed and civilized country.

Development is very obvious; from tents and sandy tracks to tower buildings and highways, from desert to green belts of palm trees and vegetables in all parts of the country, and most important, education, healthcare and all other services became the best in the region. Urban development was so sharp; someone who left the place 10 years ago can hardly know his location and services in all sectors became the best on the international level. The oil money was properly invested in development.

UAE Air Force Space Reconnaissance, used satellite and aerial images for the past 20 years and successfully utilized images from various sources including aerial photographs, Russian satellites images, SPOT and Landsat images and recently, in late 2000, established a National Ground Station with direct reception of IKONOS, IRS and KOMPSAT satellites imagery data and with nationals controlling all stages of data reception, processing, analysis and production.

The attached images are an obvious outstanding proof on the rapid development which has been achieved in the past few decades in all life aspects, which in the mean time reflects how wise the leadership is and size of efforts and plans which have been steadily put in action in the benefit of the people and their future.

1. INTRODUCTION

1.1 Motivation & Aim

Being in a satellite receiving station and continuously acquiring images of UAE and surrounding countries and because UAE is undergoing extensive development for the past three decades, we decided to express this development revolution by using different kinds of imagery, as a proof on rapid development. This will hopefully enhance the application of high-resolution imagery, in particular, in planning, mapping and research purposes.

1.2 Location and general information

UAE is located in SW Asia, east of Saudi Arabia, with about 600 km of coastline of the Arabian Gulf (figure 1) and on the east it has 100 km coastline on the Indian Ocean. UAE area is about 83,000 Sq. Km and population is ~3.75 millions; 2002 census.

The sand and gravel desert dominates most of the country, with steep mountains in the north and northeastern parts. Apart from Al Ain city, all major cities lie on the coast including Abu Dhabi, the capital of UAE.

The weather is warm and sunny in winter, and hot & humid in summer. UAE's confirmed oil reserves is 97.8 billion barrels; ~9% worldwide, with yearly revenues \$ US15-20 billions/year.

1. 3 Summary of recent UAE history

In 1966 H.H. Sheikh Zayed Ben Sultan Al Nahyan, the present president was chosen as ruler of Abu Dhabi and later in 1971, H.H. Sheikh Zayed Bin Sultan Al Nahyan, along with H.H. Sheikh Rashid Al Maktoum and other Emirates rulers get together and initiated the Federation of the seven Emirates, hence United Arab Emirates was established; Seven Emirates One Nation. A new era of development started.

Some development started in the late 1960's but was remarkable in the mid-1970's with more oil discoveries and prices jump, attracting 100,000's of workers and technicians from many parts of the world who shared in the development.

2. UAE DEVELOPMENT FACTS

The rapid development of UAE's towns and villages from small oases in the 1950's to large modern and fully functional cities required a heavy investment in infrastructure. Roads, airports, seaports, housing, sewage, electricity, water and telecommunications networks have all been developed to meet the demands of a high-tech society (UAE Yearbook, 2003). Tens of billions of \$US have already been invested in infrastructure at both federal and emirate levels. In housing, 1000's of villas, low income houses and land parcels have been granted to nationals, residential complexes that have a high standard services. Agriculture development is very obvious, with an area of 270942 hectares incorporating more than 40

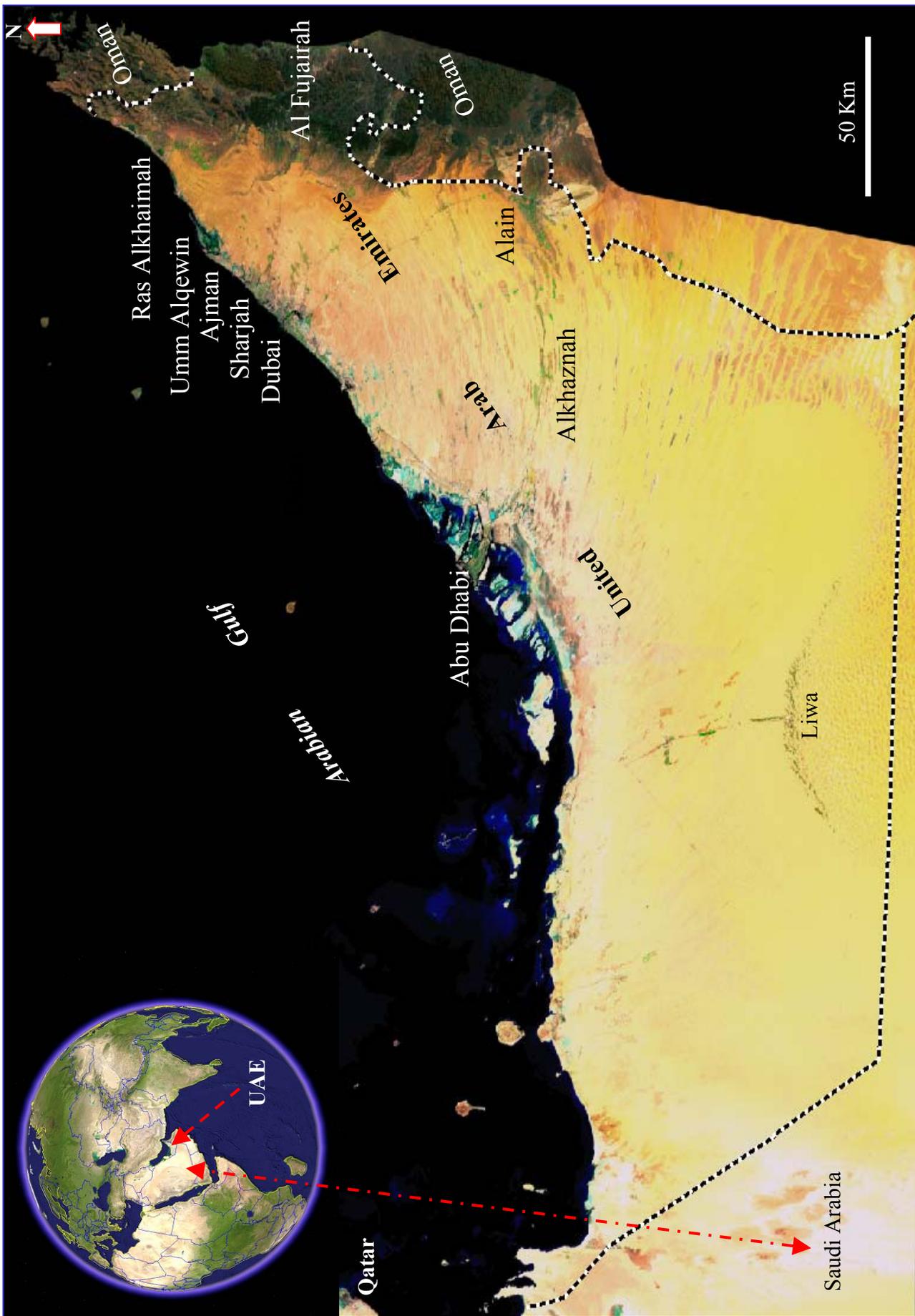


Figure 1. Location of the United Arab Emirates (UAE); the seven united Emirates are named.

million palm trees, vegetables, crops and fruits; e.g. Liwa farms (figure 1).

The paved highways exceeded 4000 km, with first class and fully lightened and serviced highways linking the major cities. Major recreation and housing projects such the expansion of Abu Dhabi Korniche (2003-2005) and the Palm Project of Dubai are going on. Jabal Ali Free Zone has more than 2300 companies registered (UAE Year Book 2003). UAE is classified as one of the best in information & technology applications; ranked as top among Arab countries and 21st worldwide with more than 25% of the population subscribed to Internet services (Alsuweidi, 2004). In education, number of schools jumped from 20 with 4000 students in year 1962 to 747 with 556,500 students in year 2001/02, with a budget of \$ US 1.4 Billions for 2001/02. Schools changed from huts with students setting on the sand in the 1950's (Ronald Codari, 1990) to first class modern ones. UAE women are sharing in the workforce by 41% in education sector and 34 % in health sector. The electrical energy generated exceeded 8000 MWhr and water generation is around one billion gallons/day. The country has 6-international airports (e.g. Dubai; figure 2).

On international level UAE is becoming a regional and global trade & tourism hub and a center for important exhibitions such as International Defense (IDEX), IT (GITEX) & Dubai Air Show. UAE give \$ US 10's millions of aid yearly to poor countries and has funded many projects in over 50 developing countries worth of \$ US 6.2 billions. H. H. Sheikh Mohammad Bin Zayed Al Nahyan initiated the UGS project and it was operational in year 2000, with the help of Space Imaging, the leading world company in high resolution imaging satellites business.

3. METHODOLOGY & INPUT DATA

The main aim of the study is to emphasize the rapid development, which has been achieved in UAE during the past three decades with the use of images. The study involves first collection of imagery data and reports & documents. Internet surfacing of UAE government sites was useful. Five Landsat images covering the major cities of Abu Dhabi, Dubai and Alain dated 1973, 1984, 1990 & 1995 were collected and IKONOS images collected in 2003 by UAE, UGS were used. The built-up parts of both Abu Dhabi & Dubai were vectorized from images and areas were determined. In addition, municipality maps were rectified, classified and used for correlation purposes. ERDAS Imagine software was utilized for image processing, enhancement, vectorization & classification. A number of images and maps were scanned using a large format scanner.

4. DATA ANALYSIS AND RESULTS

The study involved acquisition of historical Landsat MSS (1973) and TM images (1984, 1990 & 1995) and compilation of references on UAE development. Landsat MSS & TM bands 4, 3 & 2 false color composite (figures 2 & 3) and composite of TM bands 7, 4 & 2 (figure 1) parallel with recently acquired IKONOS images were used for vectorization of built up areas in Abu Dhabi & Dubai cities.

Generally speaking Abu Dhabi city is calm, well organized and most recent development is devoted to outside the island in the E, SE and NE directions, because the island is almost fully developed. The Lulu island and some more small islands have

been recently established just west of Abu Dhabi island, on which remarkable recreational and residential/commercial projects will be developed. Dubai city has largely expanded, particularly along the SW coast and to the east, with more emphasis on tourism/recreational and industry.

Using an old aerial photograph of Abu Dhabi dated 1951 (figure 2), the built-up area which was simple and scattered huts, tents and some houses is estimated to be around one Sq. Km. In 1973, the built-up area (figure 3, table 1) was about 15 Sq. Km and in 11 years time it was doubled about 5 times rising up to 82.9 Sq. Km. In 1984, however, the 1973 Landsat MSS image provide a rough estimation and many vacant areas must have been included. In the years 1984-1995 a sort of steady expansion was there, with an average expansion of 10 Sq. Km / year; ~ 8-12%. Landsat TM images permitted better estimate of urban expansion than MSS, but still some exaggeration might be there.

| Year / image type | Abu Dhabi area Sq. Km | Dubai area Sq. Km |
|-------------------|-----------------------|-------------------|
| 1951 Air photo | 0.9 | N A |
| 1973 Landsat MSS | 15 (6 /yr) | 13 NA |
| 1984 Landsat TM | 82 (6.2 /yr) | 82 (6.5 /yr) |
| 1990 Landsat TM | 128 (7.6 /yr) | 112 (5 /yr) |
| 1995 Landsat TM | 160 (6.4 /yr) | 128 (3.2 /yr) |
| 2003 IKONOS | 262(12.75/ yr) | 238 (13.75/yr) |

Table 1. UAE cities expansion estimates from images

IKONOS images of Abu Dhabi and Dubai collected by UAE UGS in late 2003 were enhanced and built-up areas were accurately vectorized (figure 3). The area of Abu Dhabi city and associated surrounding towns such as Alshahamah, Musaffah, Almafraaq & Baniyas considerably expanded in the past 8 years from 160 to above 260 Sq. Km. Still some parts of these towns are not included because they fall outside the sample area selected (figure 3). These towns are fairly recent and undergoing rapid expansion especially in the past two years.

Dubai city on the other hand has developed rapidly and the built-up area (only in the sample area; figure 3) jumped from ~13 Sq. Km. In 1973 to 82 Sq. Km. in 1984, 128 Sq. Km. in 1990 and reaches 238 Sq.Km. in 2003 (table 1). However, two large areas are not included, the Emirates road and Jabal Ali, parts which has undergone a severe expansion, particularly in the last three years. We should also keep in mind the vertical growth in the city center, Sheikh Zayed Street and Aljumeirah areas.

The Musaffah industrial area has doubled four times; from 11 Sq. km in 1984 to 16 Sq. Km in 1990 and from 18 Sq. Km. in 1995 jumped to 40 Sq. Km in 2003. It is very obvious from Landsat TM bands 7,4,&2 image that a real revolution in agriculture is there, particularly in the middle of the desert, namely in Liwa, Alain and SE of Ras Alkheimah (figure 1).

Scanning, rectification and classification of city expansion maps (UAE National Atlas, 1993), enabled us to make absolute areas of city expansion samples from Abu Dhabi & Dubai. Abu Dhabi built-up area was 11.2 Sq. Km in 1969, 15.5 Sq. Km in 1974 increased to 34.9 Sq. Km in 1980 and 42.9 Sq. km in 1990.

This implies rapid growth in the late 1970's after the jump in oil prices and slow growth in the 1980's. Similarly in Dubai the city area was doubled from 25.3 Sq. Km in 1976 to 58.2 Sq. Km in 1980 and in 1988 it reaches 67 Sq. Km.

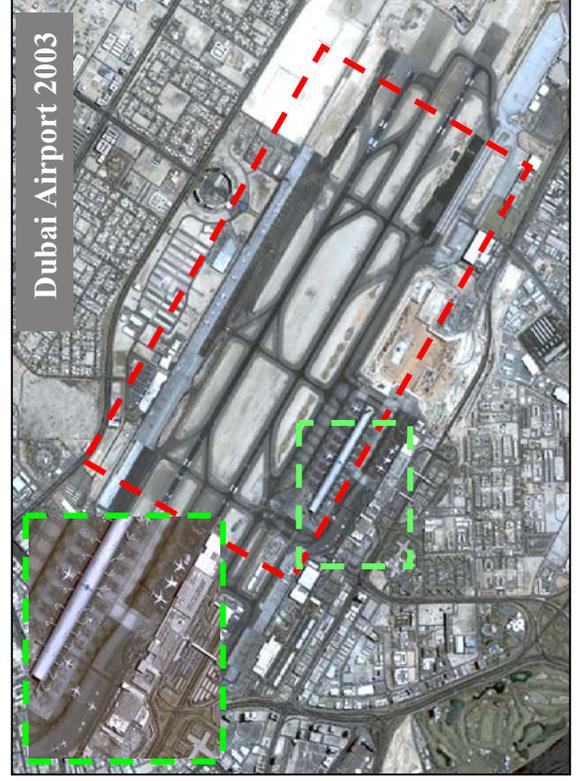
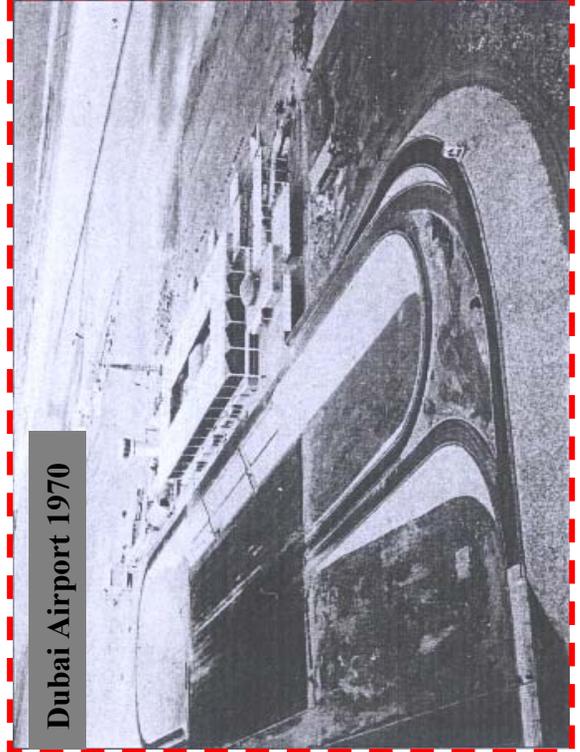
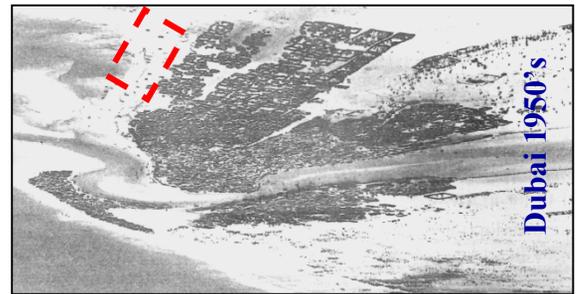
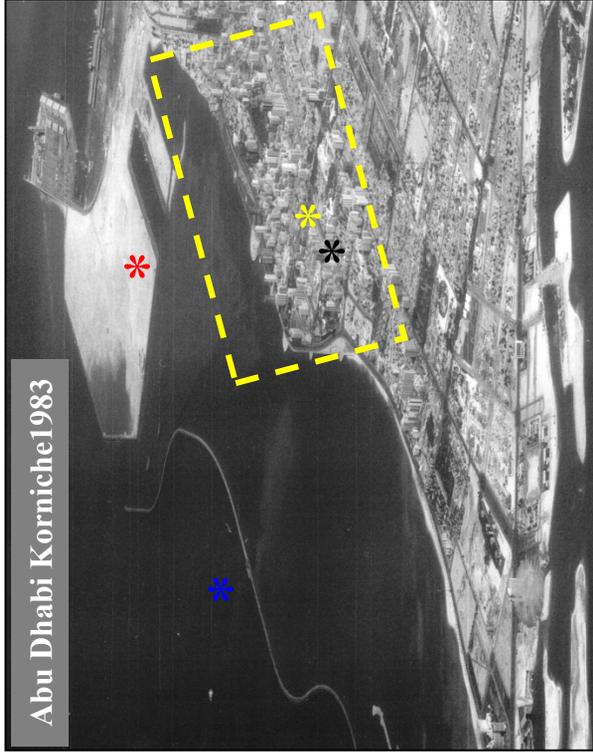
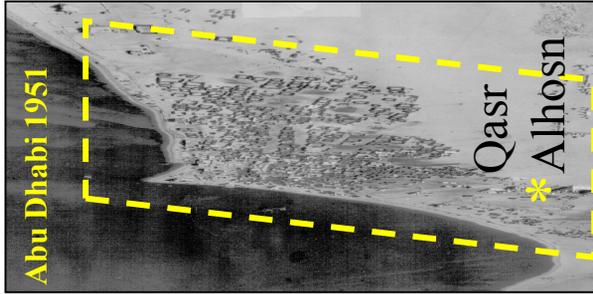


Figure 2. Historical development of Abu Dhabi & Dubai cities from images.

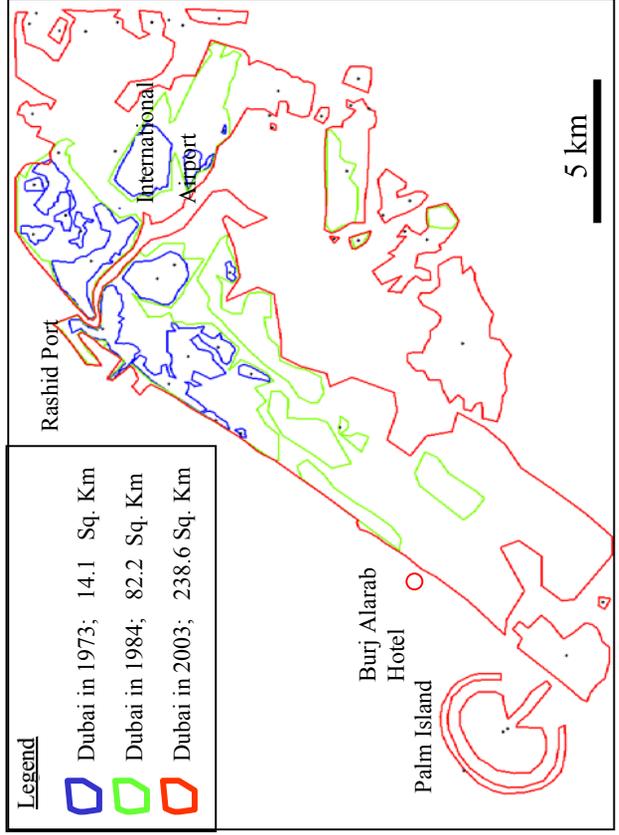
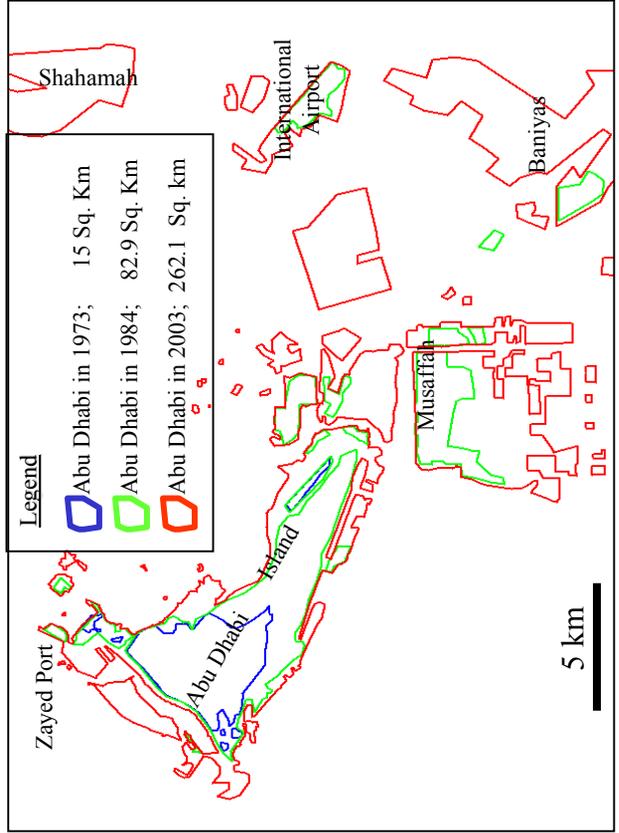


Figure 3. Expansion of Abu Dhabi and Dubai cities in thirty years, using Landsat and IKONOS satellites imagery.

It should be clear that cities and villages in other Emirates have also undergone considerable development and although may not be of the same rate as Abu Dhabi & Dubai, but still all Emirates have equal basic services of education, health, electricity...etc.

5. CONCLUSIONS

5.1 Images of different kinds stands as a historical record of facts and changes, things, which help current and future generations to have an honest, look at development rates. UAE proved to be an excellent case study with rapid development in the past 30 years.

5.2. The wise policy of H. H. Sheikh Zayed Ben Sultan Al Nahyan, the UAE president, and other UAE Emirates rulers combined with proper utilization of the oil money was behind this great achievement; a move from a poor non-developed to a highly civilized society, which was a kind of miracle.

5.3 IKONOS imagery were superior in delineation and identification of urban development classes, whereas Landsat MSS image was poor and only shown major roads and building clusters, with fair estimates from Landsat TM images.

5.4 Availability of images is a crucial factor in all studies dealing with historical development, especially in the past about 50 years. In case of UAE, having a national Ground Receiving Station, parallel with good bilateral relations with the world community, facilitates the acquisition, processing and analysis of images.

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7. ACKNOWLEDGEMENTS

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