THE UTILIZATION OF GEOINFORMATION TECHNOLOGY FOR AGRICULTURAL DEVELOPMENT AND MANAGEMENT IN EGYPT

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ABSTRACT

Remote Sensing (RS) can provide valuable and timely information about natural resources and environment, which are very important for sustainable developments. Geographic Information Systems (GIS) provide indispensable tools for decision-makers. Both RS and GIS techniques are considered very important geometric tools, which are fully utilized in the developed countries. However, in the developing countries, the utilization of such advanced technologies differs from one country to another due to one or more of the following reasons; a) lack of tools and infrastructure, b) inadequate training, c) lack of coordination between aid agencies, d) too much emphasis on technology push rather than on application, e) restrictions and regulations, and f) lack of basic information and maps. The experience of Egypt, as a developing country in the utilization of earth observation satellite and aircraft remote sensing data in agricultural fields can be represented in National Authority for Remote Sensing and Space Sciences (NARSS). Different types of applications have been conducted at NARSS using the advanced geometric tools (i.e. Landsat and SPOT imageries, GPS, GIS,..). In addition to NARSS, there are many Remote Sensing and/or GIS units distributed in other agencies and public institutions. A review of some studies on agricultural development of some region in Egypt using different remote sensing and GIS technology is outlined. Private Sector roles and contributions in socio-economic development in Egypt is discussed. Suggestions and recommendations to enhance the cooperation and coordination between the different partners (i.e. data producers, data users, funding agencies, government and decision-makers, and universities) are presented.

KEYWORDS: Agriculture, geoinformation, , mangegmanet, remote sensing.

INTRODUCTION

The United Nations Conference on Environment and Development (UNCED), "Earth Summit", which took place in Rio de Janeiro in 1992, has focused the world's attention on the alarming state of environmental degradation caused by growing population pressures and shortsighted development strategies which have not taken into account protection of the natural environment. One of the main UNCED documents, the Agenda 21, identifies the main causes of environmental degradation and recommends a set of specific activities essential for the achievement of sustainable development and management of natural resources. High on the priority list of Agenda 21 is the availability of reliable, geographically specific information on natural resources and the environment. Such information is required by decision-markers for national planning of development strategies and their implementation. The existing geospatial information, although readily available in industrialized countries, is often either incomplete or outdated and thus not compatible with modern management requirements in developing countries. Consequently, the decision-makers in developing countries, who need such information most, have the least chance of obtaining it. Furthermore, most developing countries have neither the capabilities nor the resources to undertake the extensive mapping and monitoring programs required to fill the geo spatial information gaps.

This paper aims at presenting the status of geo information technology application in Egypt, through the presentation of the activities of main public institutions. The role of private sector in socio-economic development is also discussed. Recommendations and suggestions for internal cooperation between public and private sectors in Egypt are given. In addition recommendations and needs for regional cooperation are also highlighted.

REMOTE SENSING APPLICATION FOR NATURAL RESOURCES MONITORING AND MANAGEMENT:

In the first views of the Earth from space in the early sixties, scientists found that there are much more than the ampleness and spherically praised by the poets. The wealth of potential information that could be derived from such space photographs and images was evident, but it took nearly a decade to appreciate the amount of information available and to learn how to use it.

The full benefits of earth observation satellite technology could be realized if the earth's resources were managed on a global and dynamic basis. Traditionally, however, man's activities planned and co-ordinated on a local or national resources can be periodically updated.

Therefore, the effective use of satellite data requires new approaches to both international, regional and national resources management activities. Most of the uses of earth observation satellites have been so far in national programs and for static mapping applications. The more and more technology becomes operational, international and dynamic application for the general benefit of mankind on earth will gain more grounds.

The experience of Egypt, as a developing country, in the utilization of earth observation satellites and other aircraft remote sensing techniques in some applications for natural resources assessment and evaluation can be represented in its National Authority for Remote Sensing and Space Sciences (NARSS), formerly called Remote Sensing Center (RSC), which was

established in early 1970's. It may be considered the most advanced and sophisticated experience in the transfer and utilization of such advanced technology in this part of the world.

THE NATIONAL AUTHORITY FOR REMOTE SENSING AND SPACE SCIENCES (NARSS) IN EGYPT:

NARSS has accumulated a large inventory of Satellites Computer Compatible Tapes (CCTs) from Landsat 1, 2, 3, 4 and 5. Multispectral Scanners (MSS) and Thematic Mapper (TM) imageries covering all of Egypt and some surrounding countries in the Middle East and Africa have been acquired. SPOTand ERS data of some regions of Egypt are also available.Conceming the technical and administrative Personnl, about 128 staff members and technicians are engaged with Narss. They are distributed as follows: Agriculture (3); Soils (5); Water resources (1); Geology (4); Mineral resources (2); Computer specialists (4); Photo lab. operators (5); Drawing (4); Documentation (1); Architecture (1); Air craft crew (12); and Administration (80).

OTHER GOVERNMENTAL INSTITUTIONS UTILIZING REMOTE SENSING DATA AND GIS IN EGYPT:

The following Public Institutions have remote sensing and/or geographic information system facilities. Each of these units uses the geo information technology in specific application.

Remote Sensing Unit, Soils and Water Institute, Agricultural Research Center. Soils and agricultural applications are the main tasks of this unit.

Desert Research Center, Ministry of Agriculture and Land Reclamation. It has NOAA receiving station, Remote Sensing and GIS unit. The main concerns are the establishment of environmental databases for the desert areas in Egypt.

Ministry of Water Resources and Irrigation and its affiliated institutes. It uses geo information technology for water resources assessment and development, irrigation and drainage planning.

Information and Decision Support Center (IDSC), Presidency of Ministrial Cabinet. It applies GIS technology for natural resources management and development, as well as, land use planning.

Egyptian Survey Authority. It applies GIS and photogrammetric techniques for producing topographic maps of Egypt at different scales (1:2.500-1:250,000).

Egyptian Geological Survey and Mining Authority (EGSMA). It works mainly in mineral exploration and geologic mapping.

Universities: Aerial photo interpretation and GIS application.

Egyptian Meteorological Authority (EMA).

HUMAN RESOURCES:

The following table (1) shows the number of Egyptian experts specialized in the field of remote sensing and photogrammetry in public institutions in Egypt.

Table 1:Number and Distribution of Remote Sensing Experts in Egypt

Education level	Ph.D.	M.Sc.	Diploma	B.Sc.	Total
Geographic distribution :					
Cairo	33	16	6	23	78
Alexandria	6	4	3	5	18
Others	11	-	1	5	17
Total	50	20	10	33	200
Institutions :					
Universities	25	5	3	7	40
Research Institutes	15	4	-	3	22
Others	10	11	7	23	51
Total	50	20	10	33	200
Specialization :					
Image Interpretation	41	14	3	13	71
Image Processing	4	5	2	5	16
Photogrametry	2	1	-	-	3
Others	3	-	5	15	23
Total	50	20	10	33	200

Source: National Society for Remote Sensing Applications (1999).

NATURAL RESOURCES ASSESSMENT AND EVALUATION IN EGYPT

The Egyptian Authority for Remote Sensing and Space Sciences (NARSS) has been one of the few centers in the world which applied Landsat imagery interpretation, both visual and digital as early as 1971, with the launching of the first U.S.

Landsat program. The experience of NARSS in this respect is unique and may well serve as a conscious example for the developing countries of the world at large, and for arid and semi-arid regions in particular.
It is not possible in this paper to examine all of the applications and projects which have been implemented in Egypt using satellite and aircraft remote sensing data and Geographic Information System. Many of these projects can fall under one or more of the following categories:

Land use - land cover mapping:
The land surface of Egypt (1,000,000 km^2) consists of about 96% desert, and only 4% of its total area is agricultural land of the Nile Valley and Delta (Figure 1).

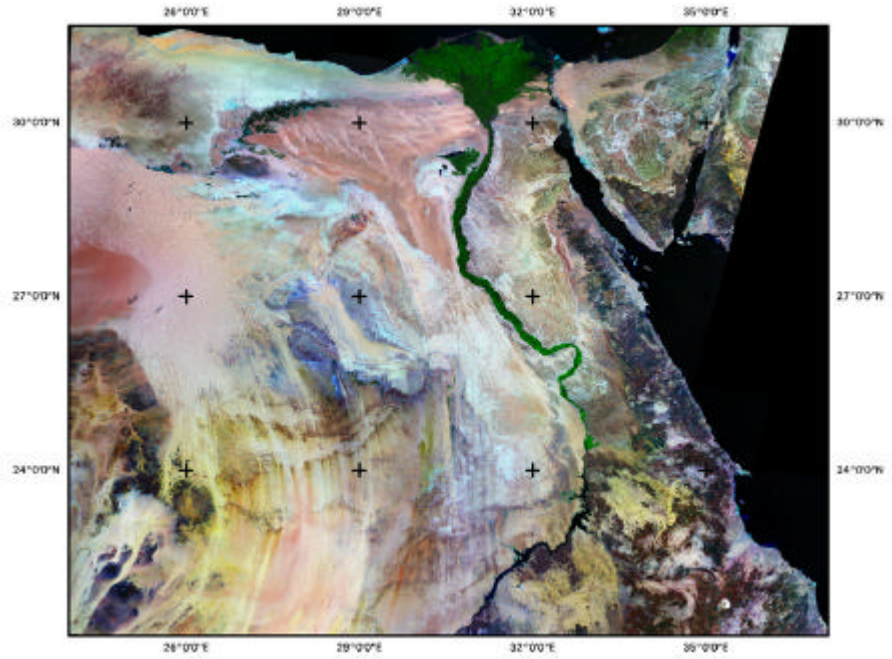

Figure 1: Landsat mosaic of Egypt

Therefore, there is severe pressure and demand, dictated by the growing population, on this limited area of agricultural land. The demand of this growing population for housing, utilities, services and infrastructure has been steadily taking away valuable acreages of land from this limited agricultural area. A loss estimated to be at the rate of about 30,000 acres per year, makes this problem a very serious one if let uncontrolled. Therefore, land use patterns are constantly changing, commonly with agricultural land being converted to urban use.

If land in Egypt, both in this traditional agricultural area and in desert type areas, is to be allocated to its most appropriate use, planners must have two types of information: information on current land use patterns; and information on potential land capability.In the first case satellite data, with the aid of computer categorization and classification and supplemented by ground truth data, proved to be a valuable tool in providing up-to-date information on regional land use patterns. Also, repetitive satellite coverage proved to be very helpful in monitoring changes. In the second case, satellite data, with aircraft and field observations, can provide valuable information on soil types, potential groundwater resources, mineral resources, and other parameters, which can be used, in conjunction with information from other sources through GIS application. The main objective is to determine suitability of other non-agricultural areas and establishing new communities away from the limited valuable agricultural area.

Landsat images in various forms of digital processing, at scales ranging 1:100,000 to 1:250,000 were successfully used at NARSS for such studies and for producing land use map for most of Egypt.

Another very important project of NARSS is the production of the Landsat map atlas of Egypt at a scale of 1:250,000. This atlas includes more than 70 sheets compiled on UTM universal system of cartographic maps of Egypt, and each is made of several parts of Landsat scenes. Masaicking of these scenes is executed on computer discs at NARSS, Digital Processing Laboratory, with radiometric and geometric corrections, as well as, enhancement by special software application.This atlas is serving as a valuable basis for updating and completing the 1:250,000 cartographic and Land use maps of Egypt.In addition, there are two other Landsat map atlases of Sinai Peninsula (60.000 km^2) to scale of 1:100,000 and 1:50,000 using MSS and TM data, respectively.

The Remote Sensing Unit of Agricultural Research Center (ARC) has used SPOT data to produce SPOT based Land use/ Land cover maps of the cultivated land of the Nile Valley and Delta about 35.000 km^2 at scale 1:100,000.

Soils and land capability mapping:

Different remote sensing and land information as well as geographic information systems were used for land resources assessment and evaluation. Landsat based soil maps of most Egypt were produced of scale 1:100,000. Land capability maps of Sinai Peninsula and other desert areas were also produced by NARSS staff.

The National Authority for Remote Sensing and Space Sciences is currently responsible for producing soils and capability maps for the major national projects. After the compilation of soil and potentiality maps of Sinai Peninsula (60000 km^2) (Figure 2) , the soil team is engaged in producing maps for Siwa Oasis (25000 km^2), Darb Al Arbein project (34000 km^2), Tushke national project (500000 acrs), and Halaib Shalatein region (18000 km^2).

NARSS was cooperated with FAO to produce soil map of Egypt (1:M) in digital format with relevant databases.

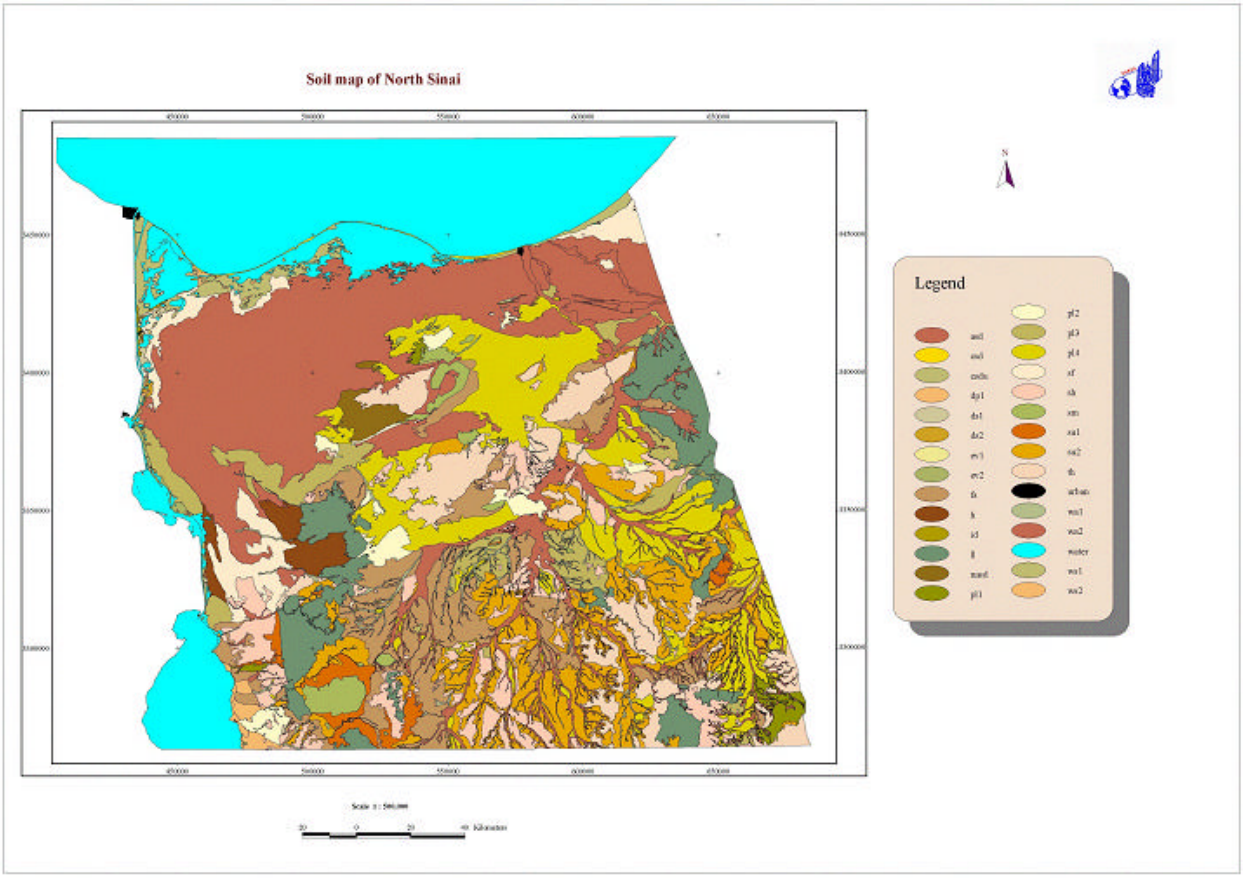

Figure 2: Soil Map of Sinai Peninsula

Water Resources:

The interpretation of Landsat images for large areas in the desert of Egypt has been going on for more than twenty years, and its comparison with the pertinent information on groundwater aquifers in these area deciphered a considerable number of questions regarding the conditions, sources and potentials of groundwater.

Various features are interpreted which have strong bearing on groundwater in the arid environment. These include the nature of geological and lithologic units, structural lineament, present and old drainage systems, distribution and form of water pools, geomorphic units, weathering surfaces, desert soils, sand dunes and dune accumulations, growths of natural vegetation and agriculture and salt crusts and other expressions of salinization. The same features could be utilized in the regional exploration and management of groundwater aquifers in the arid zones.

There are many impressive examples which illustrate the significance of satellite image interpretation on the regional conditions of groundwater which could be traced and interconnected over several tens or even several hundreds of kilometers. A striking example is illustrated by the occurrence of fresh to brackish groundwater in the Mediterranean Sea coastal zone of the Western Desert where the groundwater is found in the form of lenses floating on the saline sea water. This phenomenon is caused by the presence of certain highly porous and permeable detrital limestone beds which belong to a geologic unit, extending along the coast, called Alexandria Formation. This latter unit has been delineated, along a distance on the coast for some five hundred kilometers, accurately and in a short time by the interpretation of Landsat satellite imagery.

The investigation of Shuttle Imaging Radar (SIR-A) combined with Landsat Multispectral Scanner (MSS) data of the southwestern desert of Egypt revealed buried drainage patterns and valleys covered with sand; some of these valleys were measured as wide as the Nile Valley. It is expected that there is significant groundwater from the past geologic period, which may be used to irrigate large areas in this region. The results can also be used to estimate the water storage capacity of the area. Additional hydrologic investigations can now be localized in areas with the greatest potential for water yield. .

Land use Planning:

An Integrated Natural Resources Information System (INRIS) for Assessment and management of natural resources of North Sinai Peninsula has been carried out by national experts at the Information and Decision Support Center (IDSC). Landsat TM data and GIS techniques were successfully utilized to produce this system. The main natural resources considered in (INRIS) were; land, water, mineral, energy and humane resources. The system is also used for land use planning in Sinai. In cooperation with the Italian Environmental Program in Egypt, a detailed land use map of Siwa oasis the western desert of Egypt, based on Aerial photograph (1:10000), was produced.

Tuschke Project:

One of the major agriculture development project in the desert area of south Egypt is Tushke Project. It located to the west of lake Naser ,south Egypt. The project area covers about one melion acers ,from which about 540,000 acers will be selected for agricultural uses. The selected areas will be irrigated from two sources of water. The ground water will be the main water resources for irrigation ,followed by the Nile water in the high flooding seasons.

Attempets were carried out to select the suitable areas for agricultural using the conventional methods. Due to the high cost and time consuming of the ground survey in such an extrimely arid lands, the government decided to upply new technology, remote sensing and GIS, for land use planning in the project area. Multisensors remote sensing technique was applied to map the land resources of the project area. Landsat thematic mapper and SPOT panochromatic imigeries were analysed to map the different land units of the area. Data merging technique was performed to map the physiographic units in the area, which have strong relation with soil type. Then, field studies were carried out to identify and evaluate the potentialities of land resources for agriculture.The land capability for agriculture was determined using land evaluation mathematical model and found that the land capabilities rang between grad III and VI.

The produced maps were used by the ministry of water resources and irrigation to determine the layout of irrigation canals within the project area. The ministry of agriculture to determine the crop colander and land use of the project also used the maps.

Agriculture Monitoring

Crop Monitoring:

Remote sensing technology was utilized for many decads to monitor crop conditions, infection of different deceases , plant health, crop conditions,….The Landsat images at four dates, 1982,1986, 1994 and 1999 were used at NARSS for monitoring vegetation quality in Salheya area of Egypt(figure 3).

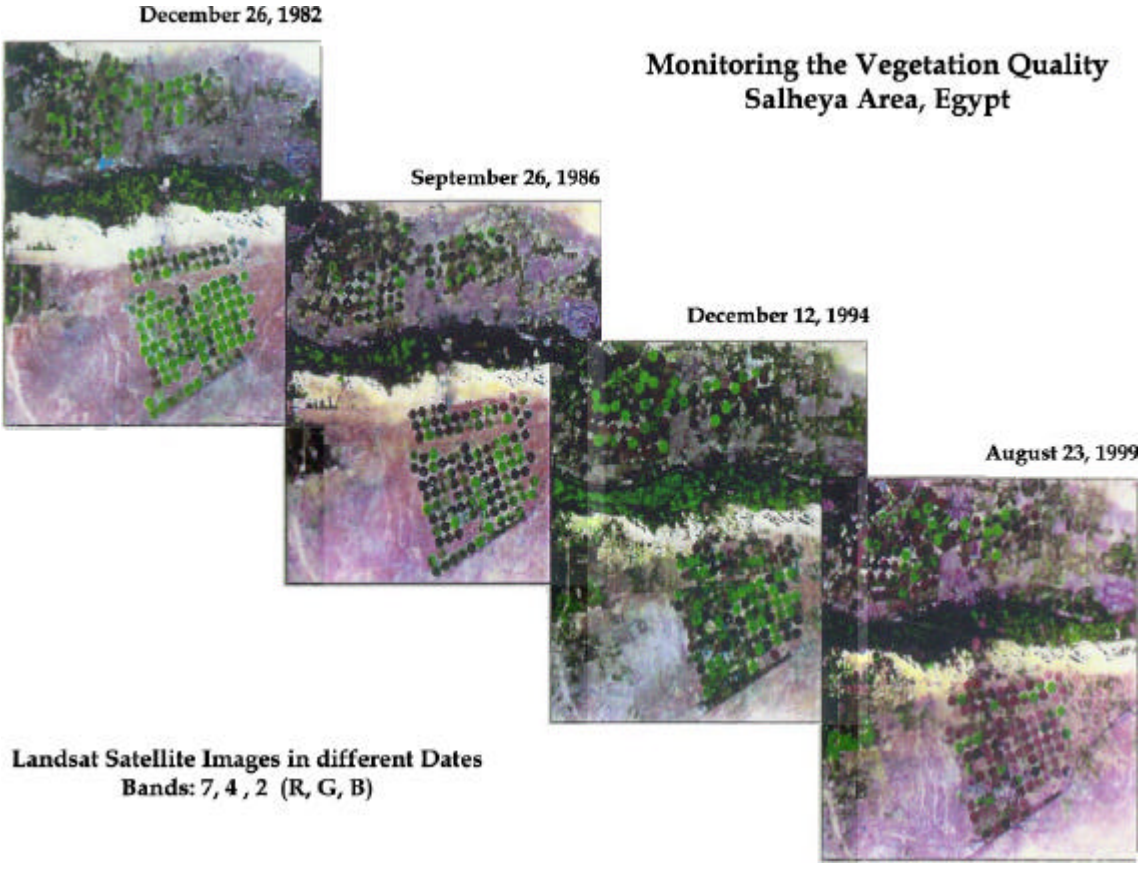

Figure 3: Monitoring the vegetation quality, Salheya area , Egypt

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