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CARTOGRAPHY AND REMOTE SENSING

BULLETIN

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CARTOGRAPHY AND REMOTE SENSING

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IN THIS ISSUE

	<u>Page</u>
1. Editorial	
2. Africa's Cartographic Strategy	1
3. Remote Sensing for Development in Africa	5
4. Contributions from ECA Partner Institutions	8
(a) Post ADOS Strategy for Unified Networks for Africa	8
(b) Some Ideas on the Role of AOCRS and Specialized Centres in the Continental Plan	11
5. The National Corner	13
The Development of Mapping Technology in Ethiopia	13
6. Calendar of Planned Activities	

EDITORIAL

The pre-occupation of the Economic Commission for Africa since its establishment in 1958, has been and remains to find ways and means to meet the challenges of underdevelopment in Africa. Many strategies have been laid; plans of action have been adopted and resolute steps are taken to implement them. One of the actions that has played a critical role has been the Commission's effort in carrying the awareness of its strategies to all peoples of Africa, from grass root to decision-maker through its publications. The publications cover an almost limitless coverage of specialization, policies represented in technical and scientific studies, reports, specialized bulletins, newsletters, etc. The first edition of the Cartographic and Remote Sensing Bulletin is the first publication by the Commission to inform those engaged or even interested in the contribution of Cartography and Remote Sensing of the roles played in the Commission's multidisciplinary effort to address development issues of the continent. It must be added that any successes achieved, have been the result of the excellent co-operation ECA has enjoyed not only with governments of member States but also with sister United Nations Agencies, International and Intergovernmental Organizations, as well as its sponsored institutions. In this connection, expressions of gratitude go to the General Manager of the Ethiopian Mapping Authority, the Secretary General of the African Organization for Cartography and Remote Sensing; and the Director General of the Regional Centre for Services in Surveying, Mapping and Remote Sensing, for their valuable contribution to the first issue of the Bulletin.

The present edition comes out just before the Secretariat enters the era of desktop publishing. In order to fulfill its obligations to publish the Bulletin in 1990, the Bulletin has not been presented in a typeset form. It is planned to publish the Bulletin in the future in both English and French also with a widened coverage and better presentation.

AFRICA'S CARTOGRAPHIC STRATEGY
(Secretariat)

Introduction

United Nations strategy for the development of Cartography in Africa can be traced back to the work of an ad hoc Group of Experts on Cartography in 1949 which studied cartographic policies and practices then recommended ways and means for its development. The first act of the Group was to provide a universally acceptable definition for Cartography, which the United Nations adopted for use. Briefly, the definition embraces all actions from the initial establishment of controls, through surveys to the publication of the final product for instance the printed map sheet.

The report of the Group of Experts whose recommendations were approved and continue to be applied, recommended among other things, that the United Nations must be in the forefront in the promotion of cartography and to take measures to develop it in the regions where it lacked. As far as Africa is concerned, the strategy was effectively launched with the convening of a separate United Nations Regional Cartographic Conference for Africa. The main aim for the Conference was to provide a forum at which more attention could be paid to the African cartography in order to address development problems from within the continent. True also Africa's cartographic issues could be more meaningfully discussed through the regional cartographic conference for Africa. It is proven to be true that the First United Nations Regional Cartographic Conference for Africa which was held at Nairobi, Kenya in July 1963 marks the starting point for laying the strategy for the development of cartography in Africa.

Fundamentally, strategies are drawn up for the purpose of providing the best approach towards solving a problem or in achieving a definite objective. In most cases there must be a set time scale. As time goes on, the problems change their characters as much as the geographical location or phenomenon changes, so also the strategy. If the problems affecting development happen to be many as it is the case in Africa, equally there have to be many strategies. The success of employing several strategies in achieving a well and regularly mapped Africa lies in carefully co-ordinated efforts.

Africa's cartographic strategy

The first strategy for promoting cartography in Africa was to hold United Nations Regional Cartographic Conferences for Africa which are regularly convened by the Executive Secretary of the ECA. To date seven such conferences have been held at various venues as follows:

The first Conference was held at Nairobi, Kenya in 1963.
The second at Tunis, Tunisia, 1966
The third at Addis Ababa, Ethiopia, 1972
The fourth at Abidjan, Côte d'Ivoire, 1979
The fifth at Cairo, Egypt, 1983
The sixth at Addis Ababa, Ethiopia, 1986
The seventh at Ouagadougou, Burkina Faso, 1989.

The Conferences are not only attended by officials of member States of the Economic Commission for Africa, but also by representatives of Associate member countries. In addition, representatives from outside Africa attend in observer capacity. The latter group is mainly made up of participants representing developed countries of Europe and America who share with their African colleagues the results of research and development in methods and tools for the profession. It should be noted that professionals from Africa do also participate in similar United Nations Conferences for Asia and the Pacific as well as that of the Americas.

During the early 80s, poor participation at United Nations Regional Cartographic Conferences called for a review of how effective and relevant the Conferences were. As far as Africa is concerned, the economic squeeze felt by most African countries during the decade was identified as being responsible. But as these Conferences offer the best opportunity to exchange ideas and experiences, and they are the channel for the transfer of technology, the attendance has lately improved reaffirming their usefulness and viability. Therefore, the United Nations has decided to continue holding the Conferences but with more central co-ordination.

The saying that: «The being that does not reproduce itself perishes» is equally true in Cartography. The very first United Nations Regional Cartographic Conference for Africa, realizing the need for a sufficient number of trained professionals and technicians in various disciplines of cartography, recommended the setting up of regional training centres for training in aerial surveys, photogrammetry and airborne geophysical surveys as well as conducting research in these areas within the African environment. This was a strategy to ensure that the existing and newly established national surveying and mapping services were adequately staffed so as to meet national needs for cartographic services. ECA with the co-operation of member States, successfully established in 1972, the Regional Centre for Training in Aerial Surveys located at Ile-Ife, Nigeria. The Centre has continued to grow both in intake and infrastructure wise. With the introduction of Remote Sensing, the name of the Centre was «improved» to take into account this element and now carries «Aerospace» instead of Aerial. At the beginning, courses were offered at technician and operators level. The Centre has now attained the capacity to provide post-graduate courses in photogrammetry as well as in remote sensing: the courses being ran in both English and French languages. The Centre itself has its own strategies; one among many was the launching of its second development plan which in turn has received concrete and commendable support not only from among the participating countries, but also from donor agencies abroad which confirms that the strategy was well executed.

The ECA with the participation of partner institutions will, in the new year, evaluate the performance of graduates from its sponsored training centres to determine the relevance of their training in project execution or whether their knowledge was being applied. The results of the evaluation will help in redesigning the courses at the Centres.

The second United Nations Regional Cartographic Conference for Africa in Tunis asked the Executive Secretary of the ECA to take steps to establish joint centres for specialized services in surveying and mapping. The essence was to provide a service to a group of countries with a facility that would undertake jobs that were beyond the capacity of a single member State or such as that required a third party to conduct activities along common frontiers. The request was a strategy to provide African states with the capabilities to execute projects for themselves or to prepare themselves for the day when mapping agencies of former colonial powers ended grants for cartographic works in Africa.

The resolution or rather the strategy was far sighted when it considered that there were thousands of survey as well as several photogrammetric equipments both government and privately owned which needed maintenance and repair as well as calibration. The Centre at Nairobi, Kenya as expected has rendered invaluable service in this area saving member States valuable and scarce foreign exchange if they were to bring a maintenance engineer every time the instruments required attention. The Centre has build up a strong team of factory trained engineers who are available at short periods of waiting and providing excellent work at no cost for labour to participating member countries.

With the coming of remote sensing, the ECA was requested to set up regional remote sensing centres within the African Remote Sensing programme. One Centre at Ouagadougou, Burkina Faso was regionalized and it offers user assistance service. Like the sister centres at Ile-Ife and Nairobi, it provides short courses in remote sensing. More centres will be established as and when the need and the means justify. A remote sensing Centre for North Africa is being set up at Tunis, Tunisia. A study is underway to determine the distribution and kind of training centre that exist in Africa.

The strategy of institution building as a way of propagating the development of cartography and remote sensing in Africa has led member States to establish what would be regarded as a professional body to look after their interests in cartography. The body set up is the African Organization for Cartography and Remote Sensing created out of the merger of the African Association of Cartography and the African Remote Sensing Council. More information on the organization will be found under the section on: Contributions from ECA partner institutions in this edition.

In laying the foundation for a strong strategy in the development of cartography for Africa, geodesy has figured prominently in all the seven regional cartographic conferences for Africa. The main concern was how to integrate geodetic networks in Africa; at that would not be easy nor feasible without a common geodetic datum. The implications of a fragmented geodesy has far reaching

consequences. Maps specifications cannot be standardized due to different spheroids and multiple geoids leading to multiple projections for maps. To overcome the problems, Africa considered as far back as 1966 'satellite geodesy'. In subsequent years, the African Doppler Observation Survey (ADOS) programme was launched. The results of the programme were published in installments and made available to the countries concerned. The post-ADOS programme was launched and as it progresses and as the countries adjust their national networks to the ADOS zero-order controls, the strategy of providing Africa with a common geodetic datum can be said to be yielding fruits.

The strategy considers the exchange of information and developing awareness both horizontally among professionals, and vertically to decision-makers, to be an effective tool in developing cartography and remote sensing. The approach prescribed was to urge national mapping institutions to exchange visits, information on professional matters and cartographic documents such as annual reports, catalogues, maps etc. The ECA on its part was asked to work hand-in-hand with its sponsored regional centres to organise seminars and study tours for decision-makers in order to sensitize them through exposure to concrete examples of remote sensing at work in the inventory of natural resources, environmental monitoring and early warning for food security, floods, etc., which were hitherto unattainable by classical cartographic methods. Through the sensitization strategy, it is hoped that decision-makers will recognise the important contribution remote sensing has to offer as a tool for planning as well as an effective way in the implementation of projects in many areas of socio-economic development.

Continuing with exchange of information, one other way to ensure effective dissemination of information was to publish an Information Bulletin. This was first recommended in 1966 at Tunis and it came up again 20 years later in 1986 at the Conference which was held during the International Year of Cartography. The resolutions on the bulletin and review were strategies for the publication of this first edition of the Bulletin.

As a follow-up on an earlier recommendation, the ECA organized a seminar on Cadastre in 1979. The seminar which was attended by top civil servants from a number of African countries with lecturers from institutions specializing in land tenure and the cadastre, was of the object to highlight the importance of land rights, land security, and the cadastre in economic development. With the rapid population growth increasing pressure not only on the land for farming or grazing but also for industrial infrastructures, it is most urgent to review land laws to ensure that they are in line with the new economic and national aspirations. In this regard, the strategy is to ensure that information on the cadastre is exchanged and standards are strictly observed within the profession.

The next issue of the Bulletin will discuss other recommendations which form the strategy for the development of a solid cartography and remote sensing in Africa.

In conclusion, the African region working in the spirit of the African Alternative Framework of Structural Adjustment Programmes for Socio-economic Recovery and Transformation (AAF-SAP), and working in close co-operation with regional institutions in the field of cartography and remote sensing, needs to intensify inter-country co-operation in the design, implementation and monitoring of projects in cartography and remote sensing. The strategy is to elaborate joint or co-operative programmes and to interest national private sector groups and give them the necessary support so that there is accelerated completion of development projects with cartographic and remote sensing components.

REMOTE SENSING FOR DEVELOPMENT IN AFRICA
(Secretariat)

The launching of earth observation and meteorological satellites such as LANDSAT, SPOT and METEOSAT into space opened a new opportunity for scientists and planners involved in earth resources management, environmental studies and related fields to acquire repetitively various types of data covering wide areas of the earth surface. For example, remote regions which are potentially rich in exploitable resources became accessible. This improved technology of on board equipment as well as the high resolution of imageries, the rash developments in computer technology with regard to hardware and software, the falling prices and the flexibility in its utilization, enabled to attract a wider range of users.

The experiences collected in the last two decades show that space science technology and its applications can contribute significantly in achieving a sustainable socio-economic development in the developing countries. Reliable information on the natural resources and other aspects of a country is an indispensable component of any national planning and development effort. The information derived from remotely sensed data, both airborne and spaceborne, is used today as a base for the production of maps and photographic material for various purposes such as urban and rural development planning, physical infrastructural development, natural resources management and environmental monitoring. For example, data received from meteorological satellites provide hourly or daily the atmospheric conditions such as cloud cover thus indicating the probability of precipitation. The collection of this data over the years helps in the study of climatic conditions of a region thus enabling to take timely measures against imminently recurring droughts.

In Africa, while there is an increasing awareness of the potentials of remote sensing as a tool for natural resources planning, development and management, detection of hazards and environmental monitoring, including combating drought and desertification, the overall capabilities of most countries in that field remain inadequate for the needs. Though the scope and the degree

of utilization vary from country to country, the common characteristics of the available technology is relatively low and purely application oriented. Major casues can be attributed to the lack of conviction on the part of policy and decision-makers, hence the under developed infrastructure in the scientific and technological institutions.

The United Nations Economic Commission for Africa (ECA), at the request of member States, introduced the promotion of remote sensing technology and its applications in its work programme. The idea has been to encourage the development of institutional capability, programme coordination and promotion of international and regional cooperation in remote sensing and its applications. Subsequently, Ministerial Conferences were held to obtain political support, also expert group meetings were organized and missions conducted to several countries to study the state of the technology and identify their immediate needs.

As a result of these activities, programmes were launched establishing regional institutions for remote sensing and related fields to serve member countries in providing manpower training and user assistance. The idea behind the regional concept was to share the enormous costs by establishing the facilities and to utilize them commonly. In this regard, three regional centres for conducting training and user assistance in remote sensing technology and its applications in Africa were established at Ile-Ife (Nigeria), Nairobi (Kenya) and Ouagadougou (Burkina Faso) in 1972, 1975 and 1977 respectively. ECA provides technical and managerial advisory services to these centres.

The Regional Centre for Training in Aerospace Surveys (RECTAS) at Ile-Ife has developed a separate curriculum for each of the following courses which it runs, namely: operators, technicians, technologists and postgraduate diploma in photogrammetry, cartography and remote sensing. In the case of the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Nairobi, the training is conducted for short periods and usually tailored to the needs of member States in the Eastern and Southern Africa subregion, and in certain occasions for the continent. Emphasis, therefore, is placed on the application of remote sensing data in natural resources and environmental sectors such as mineral resources exploration, agriculture, forestry, water resources development and land use management. On the other hand, the Regional Centre (CRTO) at Ouagadougou, is mainly user assistance oriented and provides training to graduates involved in natural resources planning and development. Owing to changes in the management of the Centre, a new orientation in training programmes is expected in the near future.

Considering that a number of satellites continue to collect data over Africa; such data are either stored in the tape recorders that are aboard a number of those platforms and are subsequently transmitted to earth via other ground stations

or transmitted in real-time to ground receiving stations outside the continent. Steps have been taken to provide African countries with the means to receive and process satellite data. The initial stage towards the establishment of a ground receiving and data processing station within the administration of RCSSMRS in Nairobi has been completed.

On the national level, ECA is involved in promoting remote sensing technology, through supporting the individual member countries in the formulation of projects and in soliciting training opportunities. More efforts are being invested in creating stronger relationships with national contact points. It has been observed however, that many of those trained at the regional centres could not utilize the knowledge they acquired owing to lack of facilities in their respective countries. Another important issue is the frequent movement of personnel within the civil service to the effect that no permanent place is provided to utilize the knowledge and to gain experience within a unit in a national institution.

In order to cope with future needs in the region, ECA in cooperation with other agencies in the United Nations system is developing a regional remote sensing programme. This programme will continue with activities and embark on new elements such as the introduction of space science and remote sensing in particular to the syllabuses of educators at the institutions of higher learning. The outcome will be the indigenization of the technology. Considerations are well underway to sensitize the private sector in utilizing remote sensing technology and its applications in resource management. The ECA is conscious of the potentials of geographic information system GIS as an effective tool that could be easily embraced by national institutions because of its flexibility in integrating data from various sources for resource management. In this regard, GIS features prominently in the ECA medium-term plan which aims at assisting member States in the development of the capacity to acquire GIS for rational exploitation and management of natural resources and the establishment of a cartographic and remote sensing data base.

This contribution is a forerunner to a series of articles in the bulletin that will deal with specific topics in the wide field of space technology and its applications with particular reference to remote sensing in Africa.

CONTRIBUTIONS FROM ECA PARTNER INSTITUTIONS

POST ADOS STRATEGY FOR UNIFIED NETWORKS FOR AFRICA

(Regional Centre for Services in Surveying,
Mapping and Remote Sensing)

1. Introduction

The African Doppler Survey (ADOS) Project started in 1981 and was completed with the publication of the project report in 1986. By that date, forty six out of the fifty member States had participated in the project.

A total of 307 Doppler Points (DPs) were accepted and their adjusted coordinates appear in Volume I - ADOS Report. The points are well distributed throughout the continent because the countries which did not carry out the observations are dispersed that the gaps they create do not affect the required cover of the continent. That means, the available DPs are sufficient to meet the objectives for the ADOS Project which are:

- (i) to provide a zero-order control for future geodetic networks for mapping control;
- (ii) to provide a control for datum unification and strengthening;
- (iii) to provide improved geoidal information for Africa; and
- (iv) to provide coastal calibration points for GEOS C altimetry.

Each country with points under ADOS Project can individually implement objective (i), whilst objectives (ii) and (iii) have to be implemented collectively by all the countries of Africa. The last objective was not achieved because of the way the implementation of the whole project was conducted.

2. Current Status of the African Geodetic Networks

Using the available geodetic data, an analysis was carried out of the status of the African geodetic networks; and it was found that there exists points of varied standards of accuracy scattered across the continent. In the exercise, it was possible to identify 16 datums in use in Africa.

In addition to these datums, 4 major ellipsoids in use, namely:

- (a) Clarke 1880, used by 27 countries
- (b) International Ellipsoid used by 3 countries
- (c) Modified Clarke 1880 used by 1 country
- (d) Bessel Ellipsoid used by 1 country

It should be noted that this variation in the use of the datums is present even between neighbouring states and this fact is one of the main justifications of the ADOS Project. Note should be taken that during the analysis it was not possible to obtain the accuracy of the individual networks, a requirement that must be satisfied before the networks are linked. The two networks which cut across a large length of the continent, are:

- (i) The 30th Arc Meridian network running the length of the continent from the Cape in the South to Egypt;
- (ii) The 12th Degree parallel traverse running from Senegal in the West to the Red Sea in the East.

The precisions of these two networks are well known and if looked at, it could be a good starting point for the post-ADOS Project. However, due to the age of the two networks, they will also require a fresh analysis to determine their relevancy and accuracy.

Furthermore, there is need to have as many common points as possible, so that the ADOS data can be used for the purpose under consideration. This means the ADOS points must be in sympathy with the existing Geodetic Points.

This requirement was looked into and it was found that:

- (i) thirty two countries had provided a number of ADOS points with Geodetic coordinates; and
- (ii) the remaining 8 countries did not provide the information requested.

In addition to these shortcomings, of the 32 countries in (i) above, 10 did not mention the Datums used for their geodetic networks. These facts reveal how complicated the datum unification exercise is going to be.

In the course of ADOS programme, it was realised that like the geodetic data, gravity data was also missing. Various organisations have carried out gravity observations for one purpose or another.

It will be recalled that a few years ago an African Gravity Network Project was conceived, but it was not implemented. Perhaps lack of co-ordination in planning and implementation of projects have caused failure in knowing the situation and status of the gravity networks in Africa as much as that of the geodetic networks.

3. Strategy for Network Unification

Given the above, conclusions can be drawn to the effect that the task of network unification will call for renewed dedication.

In order to implement the post-ADOS programme, the following strategy is suggested:

- (a) A subcommission should be set up to coordinate the project;
- (b) The subcommission should be provided with funds for the execution of the project;
- (c) All Africa should cooperate in this project as it did for the ADOS project and should make available the gravity information;
- (d) The International Association of Geodesy should be requested to share the experience gained by other continents during similar projects;
- (e) The network unification project could also be carried out simultaneously with a unified Geoid and Vertical Datum. This should also be looked into during this project.

4. Conclusion

It should be realised that the tasks involved in achieving the objectives of the project are enormous and costly. This means Africa will, once more, have to mobilize external funding for the project.

Editorial

The text is an abridged version of the paper presented by the Regional Centre for Services in Surveying, Mapping and Remote Sensing at the Fourth Symposium on Geodesy in Africa which was held at Tunis in Tunisia from 21 to 25 May 1990. The symposium was organized by the Commission for Geodesy in Africa.

(Secretariat)

CONTRIBUTION OF THE AFRICAN ORGANIZATION FOR CARTOGRAPHY AND REMOTE SENSING (AOCPS)

SOME IDEAS ON THE ROLE OF AOCRS AND SPECIALISED CENTRES
IN THE CONTINENTAL PLAN

(Secretary General, AOCRS)

Abstract

The author lists the AOCRS objectives, those of the specialized centers, the work performed so far and some new development ideas to be realized. He recalls that the main objective of the specialized African organs should be the development or the creation of operational national institutions able to adapt new technologies to their local conditions. A great help could be given to member countries in the organizational field related to cartography and remote sensing.

It is a great pleasure that we contribute to the first issue of the Cartographic Bulletin, which responds to the call in resolution 12(vi) of the sixth United Nations Regional Cartographic Conference for Africa in 1986. A word about the AOCRS, it came into being in 1938 as a result of the merger of the African Association of Cartography, and the African Remote Sensing Council. The object was to rationalize and harmonize activities of the institutions sponsored by ECA and OAU taking into consideration the rapid evolution of geography science which, without the Organization, its disciplines of cartography and remote sensing could be unduly divided.

Fundamentally, the objectives of the Organization are (for the purpose of this bulletin) summarized as being: the promotion of the development of cartography and remote sensing in Africa, co-ordination of major survey, mapping and remote sensing activities among member States; assisting in establishing closer relationships among nations and institutions in matters of cartography and remote sensing; support the transfer of technology through workshops and conferences; and to play a bridging role between Africa and developed countries concerning the development of the two disciplines.

The focus is to strengthen the geographic data base at national level for social-economic wellbeing of the people. With this in mind, AOCRS and the specialized centres are at the disposal of member States to assist them in acquiring the necessary means for self-reliance in the execution of projects and safeguarding national interests and in the better utilization of donor funds.

In this spirit, regional centres which for many years now have carried out important tasks in training, which is expected to continue in a pragmatic manner and remain firmly on the ground so as to respond to the needs in human resources development. It is not too early to see the Centres embarking on the recycling

exercise for former graduates in order to keep them in touch with the latest of the techniques developed in the field. The success of the venture will depend upon how much the Centres keep in touch the former trainees, as well as the countries to know of their needs and suggesting solutions.

On the other hand, certain heavy investments are not viable unless they are shared and utilized at regional level. This is particularly true in satellite data reception and processing; in geodetic data compilations, or in bulk map printing. It calls therefore, for joint efforts through regional centres to handle such tasks. The Nairobi Centre has demonstrated itself as a model in this regard.

One important channel for the transfer of technology considered laborious but often overlooked up to this day, concerns documentation of scientific and technical publications. There exists abundant and precious material which grow continually yet are not in the possession of our countries. Moreover, a number of our countries have highly qualified scientists, though few in number, they are capable to integrating as well as adapting our needs into the available technologies. The result could be simplified approaches that would improve the quality of our outputs. The same scientists could assist in enriching our archives with all forms of publications which would contribute to our universities and in the tasks of drawing up standards and specifications in surveying and mapping.

In conclusion, it is increasingly evident that in the area of operations, AOCRS and the Centres could render immense services regarding matters of institutional building and in the contribution towards the development of earth sciences. Equally in our mission to propagate co-operation among States, it could be suggested also to consider carrying out better co-ordination of activities at national level.

Examples of duplication of efforts, bad utilization of human resources and materials are to be seen all over. With due respect to national sovereignty and related susceptibility, AOCRS and the regional centres are well placed to provide expert advice that will enable countries prepare national programmes which are useful and achievable for rational development where cartographic and remote sensing inputs are indispensable.

Editorial

The text contributed by the Secretary General of the African Organization for Cartography and Remote Sensing was submitted in French. As the present issue is only in English, it was necessary to present the contribution in an abridged form taking care to maintain the message as contained in the original text. The full text will appear in the French edition of the Bulletin.

(Secretariat)

THE NATIONAL CORNER

THE DEVELOPMENT OF MAPPING TECHNOLOGY IN ETHIOPIA
(General Manager, Ethiopian Mapping Authority)

SUMMARY

The Ethiopian Mapping Authority is engaged in the important task of meeting the country's ever-growing demand for resource data base which is necessary for the socio-economic development activities. Provision of resource data involves the application of surveying, mapping and remote sensing techniques. The paper outlines the progress attained and the impact of technology transfer on the production of land information.

Land information is the basic input for all rational planning, management and development of a country's natural resources endowment. It is a since-qua-non tool for land-based and land-attribute resources inventory, exploration, exploitation and utilisation for steering general social and economic developments. Most developing countries lack the necessary land information mainly due to low technological capability in the field of surveying, mapping and remote sensing. The situation is further aggravated by the fact that the importance of resource data base is little understood both by planners and the user community.

The Economic Commission for Africa (ECA) has long appreciated the lack of sound land information in the continent and lays great importance and emphasis on the development of member States' capabilities in the fields of surveying, mapping, remote sensing and related disciplines. With this objective of promoting cartography in the continent the secretariat of ECA has convened Regional Cartographic Conferences (UNRCCA). The high level priority accorded to resource data base in Africa is also reflected in the resolutions and recommendations of ECA Conference of Ministers and OAU Council of Ministers adopted at various occasions geared to the development of cartographic activities in the continent. African organization for Cartography and Remote Sensing and the Commission for Geodesy in Africa (CGA) and the Regional centres are directing efforts towards the advancement of cartography which further testifies the dire need for standardised resource data base in the continent.

The major role of production of land information in Ethiopia is within the domain of responsibilities of the Ethiopian Mapping Authority (EMA). It is now over three decades since the Authority had its inception as a unit in the Ministry of Education with the primary goal of producing school maps. In

later years as several socio-economic development programmes were laid out, a wider use of land information for planning purposes was largely initiated and general cartographic activities were thus undertaken for the production of different types of maps.

The growth in demand for land information in the country over the past two decades has led to diversification in map production techniques and methodologies which resulted in upgrading skills of personnel and acquiring modern equipment necessary for the strengthening the cartographic institution.

The territory of Ethiopia covers over 1.2 million square kilometers of land mass as well as the coastal water of the Red Sea along a 1200km shore with several territorial islands. To expand on the geography of the country i.e. altitude, location, climate, significant features, i.e. rift valley etc. with a diverse physiology and a variety of geological and hydrological characteristics, is rich in minerals, marine life, water resources and an equally rich soil to support livestock and agriculture. By availing the necessary resource data base for proper and rational use of these resources EMA plays a central role in the country's short and long term economic development strategies. In its present institutional organisation EMA undertakes several specialised activities to meet the growing demand for resource data base for the national socio-economic development. The technologies adopted in land information acquisition range from conventional to highly automated methods. In the formulation of EMA's priority programmes due considerations are made to user institution demands and to the guidelines laid down by the Lagos Plan of Action and to various resolutions and recommendations of regional and international cartographic meetings.

One of the major priority activities of the EMA is the production of topographic maps which are prepared at appropriate scales required for development purposes. EMA has so far produced topographic, land use, tourist and road maps covering the whole country at scales from 1:2,000,000 to 1:250,000. The ongoing national topographic mapping programme which is at the scale of 1:50,000 already covers about 30% of the country. Topographic maps are also prepared at larger scales for town planning, farmland irrigation, and related construction projects.

Analytical photogrammetric plotters were recently introduced as a measure of upgrading the technology in order to meet the growing demand for topographic maps by individuals as well as institutions. An orthophoto projector is also acquired to supplement the conventional line mapping and for accelerated and inexpensive method of orthophoto map production. In addition, SPOT imageries with radiometric, orthometric and geometric corrections are being used in the production of 1:50,000 image maps for parts of inaccessible areas of the country. The method was also applied on a pilot project for image map production and is found to be very convenient for updating the existing standard topographic maps at the scale of 1:50,000.

The topographic maps produced conventionally and by modern techniques have a wide application in major national development sectors such as in agriculture, water resources management, land use, town planning and forestry.

The production of maps generally requires certain ground control points. As a basis for the ground control activities, the national survey network was established by conventional methods with some Doppler survey points observed on bilateral arrangements. At present it is planned to introduce the Global Positioning System (GPS) as a rapid and effective method for extension and upgrading of the geodetic control network.

In addition to providing the necessary ground control data for topographic mapping, large scale mapping for construction works are prepared exclusively by conventional surveying without involving the use of aerial photographs.

Resource data base in raster form are acquired by remote sensing technology using terrain data captured from space and aerial platforms. In conventional mapping, aerial photographs are the essential media for stereoscopic plotting. Aerial photography is executed on contract basis with organisations possessing aircraft and aerial camera facilities while the photolaboratory processing of the photographs are exclusively undertaken by EMA. The photographs are of such scales as to enable large and small scale topographic map production. The country is covered by aerial photographs of scales ranging from 1:40,000 to 1:50,000. Although some of these are fairly old they find use in areas where recent maps are not available. Photographs at scales ranging from 1:8,000 to 1:20,000 of major towns, agricultural areas and hydroelectric dam sites are also available.

Remote sensing imageries from satellites are acquired from the well-known data sources on bilateral and international arrangements. Visual interpretation of these data is carried out by analogue equipment such as zoom transferscope. In the last couple of years digital image processing of remote sensing data has been introduced with possibilities for enhancement, classification, geometric and radiometric correction, scanning, inkjet plotting and Computer Compatible Tape (CCT)- drive. Imageries generally used are from satellite systems such as SPOT, LANDSAT & NOAA-AVHRR.

Satellite based remote sensing method has been found to be ideal for monitoring and management of data for resource studies. It will supplement small scale topographic mapping and should provide the basis for map revision. The remote sensing unit in EMA needs further strengthening to enable precision correction, data merging and orthophoto and topographic map production. It will require more modern equipment and facilities such as a high capacity computer, digitizer, plotter, film writer and colour laboratory processing equipment.

Currently, thematic maps covering various topics such as geological resources, soil classification and land use are prepared mainly upon request from user institutions. The multicolour national atlas covering over seventy topics is in circulation for the use of researchers, planners, educators and user institutions. Geographical research for the preparation of the national gazetteer is underway along with thematic map production. This would also contribute towards standardizing geographical names.

So as to support the high level computation and adjustment requirements, a Prime mini-computer is installed in the Authority. This assists in computer training programmes and could handle word processing works of EMA, augmenting the recently acquired Monotype word processing facilities.

Upgrading computer facilities to a large data base capability and supporting it with improved and extended remote sensing image processing techniques and an appropriate Geographic Information System (GIS) would facilitate proper management of resource data bases for planning purposes. It is planned that the system will handle both vector and raster data bases. Land information in different media such as digital line maps, precision corrected SPOT scenes and land-attribute tabular informations will form the data base allowing access, transfer and retrieval of geocoded information to user organisations in a central resource data base management system.

Although remarkable achievements have been attained in the area of manpower training and development, it is still far from being adequate compared to the needs of EMA. As none of the institutions in the country offer training in the various disciplines of mapping, the development of skilled manpower had depended on training abroad and this in no way can satisfy national requirements. To date about 90 surveyors, cartographers, photogrammetrists and other experts have got their training abroad of which 60 are working in EMA and only 20% of these are professionals.

The long term solution in this regard is obviously to develop a national capability to offer training at all levels. To this effect EMA has already taken the first stride by introducing a six-month in-house training course for technicians. 25 trainees, drawn from EMA and other governmental organizations, will be trained annually on the basic theory and practice of surveying, photogrammetry, map preparation and remote sensing. The programme has proved so relevant and successful that EMA now envisages a plan to upgrade and widen the course contents with an eventual objective of having all its technologists trained in the country. Concerning the training of professionals, EMA has made a proposal to the government to see to it that a national institute for surveying, mapping and remote sensing is established, alternatively, the courses should be introduced in our universities. Until facilities are available in the country EMA has no alternative but to continue with the training programmes abroad.

In conclusion, the demand for land information is increasing at a rate far beyond which EMA could cope with the existing means. The introduction and transfer of new technologies is the basis for raising production capabilities to meet the general requirement for resource data bases. To EMA this means more financial resources, trained manpower and expanded infrastructural facilities.

CALENDAR OF PLANNED ACTIVITIES DURING 1991

1. Economic Commission for Africa

<u>Activity</u>	<u>Venue</u>	<u>Date</u>	<u>Sponsor</u>
Regional Seminar on remote sensing for decision-makers in Africa	Nairobi, Kenya and Ouagadougou Burkina Faso	10-14 June 17-22 June	ECA, FAO UN Hq. & Sweden

2. United Nations Space Applications Programme

Schedule of Training Courses and Workshops

UN Workshop on Basic Space Science	India	30 April-3 May	India, UN & ESA
Regional Seminar on Remote Sensing for Decision Makers in Africa	Nairobi, Kenya and Ouagadougou Burkina Faso	10-14 June 17-22 June	ECA, UN, FAO & Sweden
Third Workshop on Microwave Remote Sensing (ECA Region)	Maspalomas, Spain	10-14 June	UN, ECA & FAO
Int. Training Course on Global Change & Resources Management	Sioux Falls, South Dakota, USA	8 September- 4 October	USA, UN & FAO
UN Workshop on Natural Disasters	Beijing, China	16-20 September	China, UN, ESCAP & UNDRO
15th UN/FAO Course on Remote Sensing Applications	Rome, Italy	date to be determined	UN, FAO & Italy
UN Workshop on Space Technology Applications	Montreal, Canada	3-5 October	Canada IAF
Training Course on Hydrology and Agrometeorology	Argentina	21 October- 8 November	UN, FAO, WMO, ESA & Argentina

7. Publications

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| (a) Compendium on land tenure policies and the cadastre | Publication of the Economic Commission for Africa | 1991 |
| (b) Cartographic and Remote Sensing Bulletin | Second edition | 1991 |
| (c) Accessions List (1991) | Annual | 1991 |