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COUNTRY REPORT ON THE CURRENT STATUS OF SURVEYING, MAPPING AND
CARTOGRAPHIC ACTIVITIES - INDIA

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**FIFTEENTH UNITED NATIONS
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FOR
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KUALA LUMPUR (MALAYSIA), 11-14 APRIL 2000

**COUNTRY REPORT
ON
THE CURRENT STATUS OF SURVEYING, MAPPING AND
CARTOGRAPHIC ACTIVITIES**

INDIA

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1. INTRODUCTION

History of Systematic Topographical Mapping in India dates back to 1767 when the Office of the Surveyor General of Bengal was established at Calcutta. Since then the department, over the period of years, has established Offices in all parts of the country and have over 16,000 employees to support the mapping activities. Beside topographical maps, Survey of India is preparing small scale maps in fulfilment of the international commitments of maps for air and sea navigation. Other cartographic and mapping agencies such as National Hydrographic Office, National Atlas and Thematic Mapping Organisation and Remote Sensing Organisations are looking after large scale map requirements for sea navigation, thematic maps and remote sensing requirements respectively. The National Space Programme, which has already placed a number of indigenous remote sensing and mapping satellites in the orbit, is fully geared to meet the requirement of remote sensing data for planning of various developmental projects.

Cartographic standards and practices followed in India are well established. Most of our mapping is done by modern techniques. It is based on proper network of geodetic control, using photogrammetric extension of control. We have also entered the field of automated cartography since the early 80's. Survey of India has established three digital cartographic centres and has started the creation of digital cartographic database of our topographical sheets on 1:250,000, 1:50,000 and 1:25,000 scales. Digital Cartographic Data bases for 1:250,000 scale maps have already been created for almost entire country. Topographical coverage on 1:250,000 and 1:50,000 scales have been completed and being revised at regular interval. Mapping on 1:25,000 scale is being taken up for developing areas. As on date, 45% land coverage has been covered on this scale.

Government of India is committed to the recommendations of Agenda 21 at the Rio Conference in 1992. Cartographic and surveying support of National Surveying Organisations is already dovetailed with the planning process for sustainable development in India.

Survey of India alongwith other sister organisations are making their training facilities available to candidates of Government and Non-Government organisations with in the country and also of various countries in the region. .

Survey of India has initiated setting up a Geomatics Centre for dissemination of information to various agencies involved in spatial development activities.

2. MAJOR INSTITUTIONS/ ORGANISATIONS INVOLVED IN CARTOGRAPHIC ACTIVITIES

Major organisations/Institutions involved in Cartographic activities in India are listed below. This list is not exhaustive. Important activities are explained briefly later.

- (a) Survey of India (SOI) - The National Surveying & Mapping Organisation.
- (b) National Atlas and Thematic Mapping Organisation (NATMO) - National Thematic Mapping Organisation.
- (c) Indian Space Research Organisation (ISRO), Space Application Centre (SAC), National Remote Sensing Agency (NRSA), National Natural Resources Management System (NNRMS) - Acquisition, Application and GIS activities concerning Remotely Sensed data.
- (d) Indian Institute of Remote Sensing (IIRS) - Training in Remote Sensing and allied techniques.
- (e) State Remote Sensing Centres - Application of RS data at state level planning.

- (f) State Cadastral Organisations. - Cadastral, Revenue & settlement activities.
- (g) Universities & Educational Institutions. - Post Graduate Degrees in Cartography, Photogrammetry & Remote Sensing.
- (h) National Hydrographic Office (NHO). - Responsible to provide Hydrographic support and services to Merchant Marine and Indian Navy.

2.1 SURVEY OF INDIA

The major responsibilities of the Survey of India (SOI) are enumerated below:-

- (a) Provision of Geodetic planimetric and height Control Network, Geodetic and Geophysical Surveys for tunnel alignment, dam deformation and crustal movement studies etc.
- (b) Provision of Topographical cover in Surveying and Mapping for the entire country to meet the national requirements, including those of Defence Forces.
- (c) Compilation/ Mapping and Production of Geographical Maps, e.g. Railway Map, Road Map, Political Map, Physical Map etc., and Aeronautical Maps and Charts.
- (d) Preparation of maps of the International Map of the World (IMW) Series and the World Aeronautical Chart (WAC) Series as an international commitment to the International Civil Aviation Organisation (ICAO).

- (e) Surveys for Development Projects, e.g., Power and Irrigation, Mineral Exploration, Urban and Rural Development, etc.
- (f) Surveying and Mapping of Forest areas, Large Cities and preparation of Guide Maps of cities/towns and places of interest.
- (g) Standardisation of Geographical names based on Phonetics and participation in the international body set up by U.N.O. for this purpose.
- (h) Promotion of Research & Development activities in all fields connected with Surveying and Cartography, e.g., Geodesy, Photogrammetry, Thematic Mapping, production of three-dimensional maps, printing techniques etc.
- (i) Introduction of modern technology in the related fields and indigenization of equipment as an aid to import substitution. This includes computerisation of data, use of electronic data processing, introduction of computer - based cartography system and development of instruments and material indigenously to increase self reliance and cut down the drain on the foreign exchange reserves.
- (j) Collaboration with Training Organisations, Educational Institutions and Scientific bodies on specific projects to promote Research and Development activities.
- (k) Support to Third World Countries by providing Technical know-how and expertise in the field of Surveying and Cartography and Survey Education, e.g., Nigeria, Afghanistan, Kenya, Iraq, Nepal, Sri Lanka, Zimbabwe, Indonesia, Bhutan and Mauritius.

In addition, the Surveyor General of India acts as the Adviser to the various Ministries of the Government of India, on all Surveying and Cartographic matters. The Survey of India also renders advice on the specifications on Surveys and furnishes the necessary data and maps to various Departments of the States and Central Government for Defence, Development and Planning purposes.

2.2 NATIONAL ATLAS AND THEMATIC MAPPING ORGANISATION (NATMO)

National Atlas and Thematic Mapping Organisation under the Department of Science & Technology, Government of India is one of the premier cartographic organisations of the country. The National Atlas Organisation as it was known earlier was established in the year 1956. It was renamed as National Atlas and Thematic Mapping Organisation or NATMO in short in the year 1978 to give this institution a broad based responsibility in the field of thematic cartography and geographical research.

Major activities of NATMO are summarised as below:

- (a) NATMO has prepared atlases in different languages & revises these atlases.
- (b) Atlases on Agriculture, Forest, Irrigation, Tourist, Water resources Development etc. have been prepared.
- (c) NATMO and SOI are engaged in preparation of District Planning Map Series on 1:250,000 scale.
- (d) Indian Ocean Atlas is being prepared.
- (e) Student Reference Atlas for students of class VIII and above.
- (f) Socio-economic Atlas for Planning and related studies.

- (g) Modernisation and introduction of Digital techniques, remote sensing and GIS.
- (h) Training facilities in Thematic Cartography including printing and preparation of Atlas are available.
- (i) Adviser to Central and State Governments in the matter of atlas and thematic Cartography.

As the name speaks, NATMO specialises in production of maps and atlases on different scale and diverse themes. These maps and atlases have served as very useful tools for depiction of socio-economic, political, demographic and cultural structures of the States of the Indian Union. NATMO is also converting these maps into digital form.

2.3 INDIAN REMOTE SENSING PROGRAMMES:

Indian Remote Sensing programmes have demonstrated tremendous capability by successfully launching operational remote sensing satellites. IRS-1A was launched on March 17, 1988 and since then IRS-1B, IRS-1C, IRS-1D, IRS-P3 and IRS-P4 (Oceansat-1) were launched at regular intervals to make IRS series the main stay for meeting the country's data requirements. IRS-1C/1D are the latest being the state-of-the-art civilian remote sensing satellites providing images at 5.8 m resolution. It has opened up tremendous opportunities to utilise the voluminous geo-information on various aspects of environmental and natural resources. The coming years will witness launch of many national and commercial satellites which promise even higher resolution for stereo-images from satellite platforms. Indian Remote Sensing satellite, Cartosat scheduled for launch in the year 2000 offers panchromatic stereo-images at a spatial resolution of 2.5 metres. A few commercial remote sensing satellites such as orbview - 3/4, Quick Bird etc. capable of acquiring panchromatic stereo-images at metre and even sub-metre resolutions are also planned in the years to come.

Data Processing of RS imageries is being carried out for multifarious uses by SAC, NRSA, NNRMS, SOI, State RS Centres, Universities & IITs.

2.4 NATIONAL HYDROGRAPHIC OFFICE (NHO)

The history of the Indian Hydrographic Department dates back to the 17th century, when Hydrographic Surveys were first undertaken by East India Company. The National Hydrographic Department, then known as the Marine Survey of India was established by Captain Dundas Taylor in 1874 at Calcutta. The department was shifted to Dehra Dun and renamed as Naval Hydrographic Office in 1954 and National Hydrographic Office in 1998.

The National Hydrographic Office is one of the leading Surveying/ Cartographic Departments of the World, utilising the most modern (state-of-the-art) surveying ships, surveying equipment and techniques. It adequately meets the needs of the Navy, the Seafarer and other agencies. The principle products of the Department are the Nautical Charts and Nautical Publications which are of world repute and without which a mariner would lose safety at sea.

Major activities of NHO are summarised below:

- (a) The Department conducts Hydrographic and Oceanographic surveys for production of navigational charts and Publications, Marine Developmental activities, scientific marine research, Coastal Zone Management and so on. The increased marine activity and the economic liberalisation, have added a commercial dimension to the hydrographic and Geophysical Surveys.
- (b) The various types of surveys undertaken by the department can be broadly classified as:-
 - (i) Navigational Surveys.
 - (ii) Special Defence Surveys.

- (iii) Oceanographic Expedition.
 - (iv) Special Surveys for delineation of maritime boundaries.
 - (v) Pipeline and Under Water cable routing.
 - (vi) Contract Surveys towards any type of marine data collection. The Department has been authorised to execute survey contracts in India and abroad.
- (c) The Department is responsible to provide the Oceanographic support to the Indian Navy and exchange data with national organisations. The oceanographic cruises are co-ordinated by the Chief Hydrographer for collection of Physical Oceanographic Data. The Department has always been taking part in the Scientific 'monsoon exercises' towards the simultaneous collection of Ocean Meteorological data, world over.
- (d) The Department is responsible for imparting hydrographic training in the country. The Hydrographic training institute at Goa is the only institution in the country providing formal education in hydrography.
- (e) The hydrographic School which is recognised as the regional training centre for the Africa, Persian Gulf, Indian sub-continent and the South-East region, regularly trains personnel from the countries in this region. The school so far has trained about 165 students from abroad.
- (f) As a national authority on Hydrography, the Chief Hydrographer is responsible for standardisation of the Hydrographic instruments within the country. While he is fully responsible for evaluation, procurement and maintenance of Hydrographic and Oceanographic instruments on board survey ships, he is also the adviser to other survey organisations on the accuracy standards of survey instruments.

The nautical charts and allied nautical publications produced by NHO have built the reputation of the organisation all over the world for their accuracy and fidelity for the oceanic information and have proved their value for the maritime applications all over the world. At present, Digital Hydrographic digital databases of 136 out of 320 nautical charts have been created.

3. MAJOR ACTIVITIES

3.1 TOPOGRAPHICAL SURVEYING & MAPPING

Being the primary agency for topographical mapping Survey of India is responsible for the preparation of the maps covering the territory of India. It brings out maps on 1:250,000 and 1:50,000 scales which are updated regularly depending upon the development plans of the country. It has also taken up the task of bringing out maps on 1:25,000 scale depending upon the requirement for development planning. SOI maps serve as base map for development planning in various disciplines and are extensively used to bring out thematic maps.

Increase in the developmental activities of an area results in its cultural transformation. These changes the entire facet of the topography of the area. The impact of changes in the environment needs to be reflected as revised information in our topographical maps, mainly intended for general planning, by an up-dating process on a continuing basis.

1:250,000 scale maps (about 400 sheets), useful for general planning, are compiled from 1:50,000 scale maps. At present revision cycle of 1:250,000 scale maps is 5 years and that of 1:50,000 scale maps is 15 years.

Government of India is taking major steps to dovetail the surveying and cartographic activities in various processes of planning for sustainable development. Various Ministries under the Government have already initiated a number of projects to evaluate methodologies aimed at identification of essential data for sectorial planning in various fields including identification of factors

responsible for hazards, their survey and cartographic efforts required in the planning process. Some of the projects already undertaken are as follows:-

- (a) Natural Resources Data Management Systems (NRDMS).
- (b) Development of Remote Sensing based Hydrological model for Watershed Management.
- (c) Panchayat level Resources mapping for Decentralised planning with peoples participation.
- (d) Integrated Watershed Management Systems.
- (e) Terrain evaluation for natural resources management.
- (f) Development of database on landslides at National level.
- (g) Engineering database for landslides.
- (h) Watershed Development using Remote Sensing Terrain Information System.
- (I) Integrated watershed Management using GIS techniques.
- (j) Identification of Wastelands in India through District level Mapping.

3.2 **ROLE OF SURVEYING, MAPPING AND CHARTING IN THE IMPLEMENTATION OF AGENDA 21**

Recognising the importance of Agenda 21 for initiating the planning for sustainable development, Government of India has taken steps to dovetail the activities of surveying and mapping agencies with major development projects in the country. Various projects have been undertaken by various organisations to develop suitable land management systems, including development of GIS and LIS, and compile land resources inventory using remote sensing techniques and topographical maps. The Ministry of Rural Areas and Employment is also aiding the cadastral survey development in the States to develop technique and improve land registration systems. Department of Ocean Development and Department of Science and Technology have also undertaken multidisciplinary projects to prepare database for assessment and management of coastal areas and special maps are already being prepared to meet the requirement of spatial planning.

Important developments in the specific field of surveying and mapping are listed below:-

3.2.1 AUTOMATED MAPPING PROJECTS - DEVELOPMENT AND APPLICATION OF DIGITAL CARTOGRAPHIC DATA BASES INCLUDING DIGITAL TERRAIN MODELLING

The automated mapping was introduced in SOI way back in 1981 when the Automap System was installed in Automated Cartographic Cell of SOI at Dehra Dun. Subsequently three more centres, namely, DMC (Dehra Dun), DMC (Hyderabad) and MCC (Dehra Dun) were established in 1986 to operationalise automated cartography in SOI.

The basic input for automated mapping is the digital cartographic data base (DCDB). At present SOI has almost completed DCDBs on 1:250,000 scale. The creation of DCDB on 1:50,000 and 1:25,000 scale is in progress.

The SOI has also brought out the following maps by automated cartography:-

- (a) Motoring Atlas of India on 1:2.5 M scale.
- (b) Motoring Map of India on 1:4 M scale.
- (c) District Planning Maps for districts based on DCDB on 1:250,000 scale. The slope maps shown as insets on these maps were generated automatically using the DEM.

3.2.2 GEOGRAPHIC INFORMATION SYSTEM

Geographic Information System (GIS) with better visual geographical description and spatial data analysis of available information is gaining popularity as a tool of planning and monitoring of developmental projects. In the present global scenario of degraded environment and depleting natural resources survival instinct of the human being is driving the development of GIS technology at a rate much faster than expectation of many of us belonging to the field of

cartography. However, the growth of the technology, as natural to any fast growing disciplines, is not necessarily proportionate in its various dimensions.

GIS started with the discipline of Cartography in the 1970's with creation of digital cartographical database to accelerate the map making process and was then known as the computer-aided-mapping technology. Later, with the addition of topology and wide range of attributes to the spatial data this information system appealed to a much wider variety of professionals - from geographers to professional surveyors, civil and communication engineers, land records managers, urban planners, environmental scientists and professionals and administrators. Some of the earlier grown GIS packages are in the form of automated mapping for urban management, land information system for cadastral and land records management etc. Now a days GIS has entered into many more application areas.

The Survey of India under its research and development programmes has undertaken development of GIS application softwares for rural management and cadastral mapping. A brief on some of the major activities/ achievements in GIS related activities is highlighted as under:

- (a) Development of software and application for GRAM GIS package:

Under an ongoing UNDP assisted project on "GIS Based Technology for Local Level Development Planning" coordinated by the Deptt. of Science & Technology, GRAM GIS Package is being developed at CSRI, I.I.T. Bombay, Mumbai in collaboration with Survey of India.

A prototype version of this package has been developed covering digital data input module, topology creation, query processor, raster analysis, image processing, terrain modelling and display functions. The evaluation of prototype system is being carried out at SOI to improve the package and its capabilities.

(b) Cadastral Surveys:

With a view to standardise and modernise the procedures for cadastral surveys in various states, a pilot project called "Angul Nalco Cadastral Survey Project" was taken up in Dhenkanal District of Orissa comprising of 396 villages. The project was aimed at utilising the stereo-photogrammetric and digital mapping technology for generating cadastral map products on 1:4000 and 1:2000 scales. The technology was developed around indigenously developed software and component hardware for generation of data for Land Information System (LIS) and Geographical Information System (GIS). The project has been completed and necessary information has been made available to state authorities.

(c) Creation of Digital data base for various users:

Survey of India is creating Digital Data Base of topographical maps on various scales for departmental use and also for various user agencies such as;

- (i) Airport Authority of India
- (ii) Directorate General of Hydro Carbons
- (iii) Border Roads Organisation
- (iv) Creation of Digital Data Bases for Parliamentary and Assembly constituencies for Election Commission of India.
- (v) Creation of Digital Data Base on 1:25,000 scale for districts identified under NRDMS project of DST.
- (vi) Forest Survey of India.
- (vii) Kerala Telecommunication Department.

(d) Development of Data Exchange formats:

Introduction of digital technology in cartography and use of Digital Cartography Data Base (DCDB) to bring-out updated maps was initiated in SOI in early eighties for

in-house activities. Complimentary developments associated with the uses of DCDB within the department such as formulation of map data structure, development of data exchange formats, translators etc. were undertaken. In the process, Survey of India has designed and developed a National Standard Exchange Format for Digital Vector Data (DVD), and it was released to the Nation on 30 June, 1992 by Shri PV Narasimha Rao, the then Prime Minister of India.

(e) **Geomatics Centre:**

Survey of India has proposed a Geomatics Centre at Delhi for collection of cartographic and geophysical data and to centralise the facilities for dissemination of data to various agencies at a single window. This will enable dissemination of desensitised data sets to users and providing data sets to users and providing data base for the production of thematic maps and use in GIS environment. The centre is also aimed at providing consultancy and undertake development projects in the area of micro watershed planning, irrigation schemes, urban and rural landuse and infrastructural planning etc.

3.2.3 ADOPTION OF GEOCENTRIC REFERENCE SYSTEM

Organisations engaged in the assessment of data on regional and global basis are already utilising the Geocentric Reference System. Its adoption for topographical mapping in India will have to be evaluated. Many Research and Development programmes in the country are already using WGS-84.

3.2.4 CADASTRAL SURVEYING AND MAPPING IN ASIA-PACIFIC REGION

The national mapping agency, Survey of India, is already participating in various technological upgradation programmes of the

State Govt. in Cadastral Surveying activities. Application of a uniform technology is not possible in India on account of vast differences in the requirement of land management and topography from state to state. It is for this reason that, except for a limited transfer of technology in setting up the land information system (LIS), the cooperation programme on Asia Pacific Region basis may not be very helpful. Experts/organisations of the region may however, be encouraged to participate in the cadastral surveys and setting up of LIS in a few districts of the state so that their suitability can be assessed. Govt. of India will also be willing to depute their experts for similar technology transfer if proposed, by any country of the region.

3.2.5 REMOTE SENSING IN CARTOGRAPHY

Remote Sensing is the technique of determining the characteristics of the earth's terrain and of the environment by interpreting and analyzing the spectral image as seen from a space satellite.

It has an important application in cartography. By using computers the remotely sensed data can be processed for image enhancement, geometric correction and extraction of cartographic features.

Survey of India (SOI) is equipped with Digital Image Processing and Analysis Systems which have been successfully used to update topographic maps from SPOT, LANDSAT(TM) and IRS 1 A/B imageries. SOI has also used SPOT(PAN) stereo imagery, for updation of topographic maps and generation of Digital Elevation Models, on analytical photogrammetric plotters.

SOI has made use of satellite imagery in the following pilot projects:

- (a) Preparation of Image maps of Delhi and Bombay from SPOT and TM imageries.
- (b) Updation of 16 topographic maps on 1:50,000 scale using SPOT Stereo imagery.

- (c) Preparation of thematic maps related to forestry, hydrology and land use for the EEC funded project of Watershed Management Board.

However, the use of satellite imagery has not been fully operationalised in Survey of India due to its limited resolution. With the launch of IRS-1C/ 1D satellite with an image resolution of 5.8 metres and with the launch of CARTOSAT-1 slated in 2000, with an image resolution of 2.5 metres, it is expected that SOI will be in a position to make operational use of these imageries for updation of topographic maps on 1:250,000 and smaller scale.

3.2.6 **LEGISLATION ON SURVEYING AND MAPPING**

The question of legislation relating to Surveying and mapping activities is under consideration of the Govt. of India. The legislations covering the Cadastral Surveys are already existing in a number of states and efforts are being made to standardise them for the purpose of legislation in the remaining states. Larger issues, such as copyright access to data, scope & legislation on GIS infrastructure etc. are under consideration.

3.2.7 **DEVELOPMENTAL SURVEYS - HYDEL, IRRIGATION AND MULTI-PURPOSE DEVELOPMENT PROJECTS**

The developmental activity in the country, in Post-Independence period, was conceived and given in the shape of 'FIVE YEAR' plans to define the goals for achievement, to earmark the potential and monitor the progress.

The Project Surveys are characterised by their large scale, normally on 1:10,000 to 1:15,000 with height information represented by closer Contour Intervals (normally 0.5 to 5 metres).

The various Central and State Government Agencies have been projecting urgent requirements for large scale surveys for NATIONAL DEVELOPMENTAL ACTIVITIES in various parts of the country.

3.2.8 MAPPING OF CITIES/TOWNS/PLACES OF INTEREST

Maps of important cities and places of tourist interest are a pre-requisite for the promotion of tourism. Survey of India has published Guide Maps and a new series of Tourists' interest for important cities.

3.2.9 PRE-INVESTMENT SURVEY OF FOREST RESOURCES

In order to provide Forest Inventory information for effective Forest Resources appraisal and general land use planning in the Forestry Sector, the Survey of India, in collaboration with Forest Survey authorities under the Ministry of Agriculture & Irrigation, has been preparing 1:25,000 scale special purpose maps.

3.2.10 HYDROGRAPHIC SURVEY

The National Hydrographic Office (NHO) is responsible to prepare navigation chart and publication covering North Indian Ocean and carryout Hydrographic surveys of territorial waters of India. NHO have 7 chart series ranging from 1:10,000 to 1:10 M scale, so far NHO has published 310 charts of North Indian Ocean. Automatic Cartographic Section was started in 1981. The publication of NHO are used by Indian and foreign mariner for marine transportation, coastal zone management, marine limit exploration ocean etc.

3.2.11 SURVEY EDUCATION AND UTILITY MAPS

A map awareness drive has been launched by Survey of India to bring map consciousness amongst our people. High qualities, attractive maps on art paper in convenient folded versions, reasonably priced on various themes viz. Antique Map Series, Discover India Series, State Map Series, District Planning Map Series, Tourist Map Series and Trekking Map Series are being printed for public to increase the awareness towards environment. The Department,

through Indian National Cartographic Association (INCA) is co-ordinating map awareness and survey education programmes with many Educational and social organisations.

3.2.12 **GEODETIC SCIENCE RELATED ACTIVITIES**

Geodetic activities which are pre-requisite for any map making, had to play a major role in achieving the desired objectives. Some of the major geodetic activities being carried out by Geodetic & Research Branch, Survey of India are mentioned below:

- .. Establishment of primary planimetric and height control for National control framework and mapping.
- .. Geophysical surveys including Gravimetric, Geomagnetic and Geodetic astronomical surveys.
- .. Three dimensional position fixing with the help of satellite technique. Outlying islands of India have been connected with main land using GPS technology.
- .. Tidal observations to determine Mean Sea level vis-a-vis datum for height control and for prediction of tides for navigational purposes.
- .. Provision of Geodetic and Geophysical control for development projects within the country and for neighbouring countries under aid program.
- .. Geodetic and allied geophysical studies for monitoring of Crustal movement, Dam Deformation, Verticality of archaeological structures, earthquake prediction etc.
- .. National and International collaborative activities in the field of Geodesy and Geophysics.
- .. Redefinition of Indian Geodetic datums is in progress in order to refine existing parameters.

3.2.13 MAPPING FOR INTERNATIONAL CIVIL AVIATION ORGANISATION

As an international commitment, maps on 1:1 Million scale 'Carte Internationale du Monde' (International Maps of the world) of the area of responsibility of India are produced by SOI. Each sheet covers an area of four degrees of Latitude by six degrees of Longitude and is based on International spheroid. India is responsible for publishing 26 sheets in this series.

In addition, Aeronautical maps on 1:1 Million Scale on the same layout as CIM maps and in conformity with the specifications laid down by ICAO, extending to 21 sheets in the area of responsibility are also published and maintained as part of International Commitment.

3.2.14 HUMAN RESOURCE DEVELOPMENT

Survey Training Institute of Survey of India located at Hyderabad is one of the premier Institutes of excellence in Asia for imparting training in various disciplines of survey. The Institute was set up under UNDP programme in 1967 and since then it has acquired a very high reputation and standing in SAARC and other developing countries. It has, through collaboration with ITC, the Netherlands, and Jawahar Lal Nehru Technological University (JNTU), Hyderabad recently upgraded its courses to enable its trainees to join M.Tech. programme at JNTU and to provide specialised training in digital cartography and other advance subjects.

Till now about 13,200 trainees have successfully completed their courses. This number includes about 1450 trainees sponsored by other Central/State departments and about 350 foreign trainees.

Indian Institute of Remote Sensing (IIRS) is a premier institute for training of scientific and technical personnel in the application of remote sensing techniques, functioning under the parent body of National Remote Sensing Agency (NRSA), Department of

Space, Govt. of India. This institute has been conducting regular training Post Graduate Diploma Courses in the application of airphoto interpretation, remote sensing techniques in the field of Geology, Geomorphology, Hydrology, Engineering Geology, Forestry & Ecology, Agriculture & Soils, Water Resources.

3.2.15 RESEARCH AND DEVELOPMENT

Research and Development Directorate of SOI aims at carrying out application type of research in the discipline of Surveying and Mapping. Data base by Survey of India (SOI) forms the base for various GIS activities in India. Besides SOI is also engaged in indigenisation programmes of components of photogrammetric instruments.

Inhouse development of GIS by concerned agencies in India involved in development planning is also receiving prime importance in view of our commitment towards Agenda 21.

Besides SOI, other Cartographic organisations such as National Remote Sensing Agency (NRSA), National Atlas Thematic Mapping Organisation (NATMO), National Hydrographic Office (NHO) etc. are also engaged in research and development activities directed towards adoption of improved technology, development of hardware and software as import substitution and user oriented GIS packages.

3.2.16 DISTRICT PLANNING MAP SERIES

Much attention is being focused now-a-days on regional development planning, for which 'district' has been chosen as unit. The government plans to boost co-ordinated developmental activities upto block level to develop the resources within the area, for bringing-out economic prosperity and welfare of the people. With this background, production of the District Planning Maps of all the states in the country has been taken up based on the topographical maps on 1:250,000 scale published by SOI. These maps will form an important base information to planners in the implementation of Agenda 21.

Following eight thematic informations are shown in DPMS:-

- (i) Relief and Slope
- (ii) Rock and Minerals
- (iii) Industries
- (iv) Soils
- (v) Pollution
- (vi) Climatic Conditions
- (vii) General Land use and Cropping Pattern
- (viii) Irrigation and Hydrogeology.

4. CONCLUSION

Government of India, realising the importance of sustainable developments as outlined in Agenda 21 of the United Nations Economic and Social Council Conference held at Rio-de-Janeiro has already initiated programmes in various disciplines to upgrade the information technology. Survey of India alongwith other major organisations engaged in cartography are in the process of developing data centres capable of being responsive to the need of the administrators and planners engaged in the field of sustainable development. The need for streamlining infrastructure in the field of GIS, LIS and other requirements of the planning data is also being reviewed from time to time with a view that lack of information does not form any impediment in the developmental activities. Major steps are also being taken to embark on research and development programmes and associated mapping projects to identify the environmental factors responsible for hazards. The process of integrating the capabilities of various data generating organisation is also under consideration. Regional co-operation in this field of technology is a welcome step which will go a long way in helping similarly placed countries in exchange of information and learn from each others experience.

