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ESCAP INTER-GOVERNMENTAL MEETING ON REMOTE SENSING AND SATELLITE SURVEYING, HELD IN BANGKOK, JUNE 7-13,1977.

The Inter-governmental meeting on Remote Sensing and Satellite Surveying of the Economic and Social Commission for Asia and the Pacific (ESCAP) was held at Bangkok from 7-13 June 1977. The meeting was participated by 134 delegates from fifteen ESCAP member countries and six international organizations.

Bangladesh was represented by the following:

(1) Dr. Anwar Hossain — Representative
Principal Investigator (Director-General)
Bangladesh ERTS (Landsat) Programme &
Chairman, Bangladesh Atomic Energy Commission.

(2) Mr. Shamsul Huda — Alternate
Deputy Secretary
Science & Technology Division
Ministry of Education
Government of Bangladesh.

(3) Mr. M.A.H. Pramanik, — Alternate
Chief Investigator, ERTS Programme and
Principal Scientific Officer &
Director (Instrumentation), SARC
Bangladesh Atomic Energy Commission.

(4) Mr. M.U. Chaudhury, — Alternate
Chief Investigator & Secretary,
ERTS Task Force &
Deputy Secretary, Forest, Fisheries &
Livestock Division
Ministry of Agriculture.

(5) Mr. Kazi Afzalur Rahman, — Alternate
Liaison Officer of Bangladesh to ESCAP
Embassy of Bangladesh, Bangkok.

Dr. Anwar Hossain, Principal Investigator, Bangladesh ERTS (LANDSAT) Programme and Chairman, Bangladesh Atomic Energy Commission who was the leader of Bangladesh delegation, was elected as Chairman of the Technical and Drafting committee of the meeting.

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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Intergovernmental Meeting on Remote Sensing
and Satellite Surveying

7-13 June 1977
Bangkok

DRAFT REPORT
OF THE
INTERGOVERNMENTAL MEETING ON REMOTE SENSING
AND SATELLITE SURVEYING

The meeting discussed latest developments in the ESCAP countries in the field of Remote Sensing and Satellite Surveying. The concept of regionalisation of country facilities, research and development activities in the field of Remote Sensing and Satellite Surveying, and Training programmes and proposals in the field were discussed.

Bangladesh's favourable geographic position for a regional ground receiving station has been strongly projected in the meeting. Bangladesh also offered to host a regional centre for Remote Sensing and Satellite Surveying for the ESCAP countries in Dacca. In the field of regional training programmes, Bangladesh offered to extend the scope of the Training workshop in Remote Sensing to be held in Dacca in December 1978 to ESCAP to sponsor the same for regional participation.

Bangladesh's proposal for the research and development in the field of flood forecasting & water resources management, and coastal zone monitoring using Satellite Remote Sensing Technology was accepted in the meeting.

The meeting also discussed the strenghtening of activities of the ESCAP Secretariat to ensure progressive sharing of experience and knowledge in the field of Remote Sensing and Satellite Surveying in the region.

A report of the meeting prepared by the Technical and Drafting Committee headed by its Chairman Dr. Anwar Hossain, and adopted by the meeting, is enclosed.

I. ORGANIZATION OF THE SESSION

1. The Intergovernmental Meeting on Remote Sensing and Satellite Surveying was held at Bangkok, Thailand, from 7 to 13 June 1977.

Attendance

2. The meeting was attended by representatives of the following ESCAP member countries: Australia, Bangladesh, France, India, Indonesia, Iran, Japan, Republic of Korea, Malaysia, The Netherlands, Pakistan, the Philippines, Thailand, United Kingdom of Great Britain and Northern Ireland and United States of America. A representative of the Federal Republic of Germany also attended in accordance with paragraph 9 of the terms of reference of ESCAP.

3. An official of the United Nations Outer Space Affairs Division attended. The following United Nations bodies and Specilized Agencies were also represented : the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Also represented were the secretariat of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) & CNRET.

Opening of the session

4. The Special Assistant to the Executive Secretary, Mr. H. Rudy Gontha, read out a message from Mr. J.B.P. Maramis, Executive Secretary, and officially opened the session.

5. In his message, the Executive Secretary referred to the study mission which had visited interested countries in the region to assess their intentions and needs in relation to the use of satellite data, with a view to planning appropriate action at national and international levels. This study had been made possible by the financial and technical support of the Government of the

/Nether-lands

Netherlands, and the Government of Indonesia had made available an expert in surveying and mapping to participate in the mission.

6. The study report had attracted widespread attention, and with other papers being presented to the meeting, brought out many issues to be considered. The basic purpose of this meeting was to determine the actions that should be taken by Governments and by international bodies in order to ensure that this relatively new technology was available and actually used to the extent appropriate, by all countries. The importance of continuing close co-operation among UN bodies, in their efforts to support countries in this important field, was stressed.

Election of officers

7. Mr. Sanga Sabhasri (Thailand) was elected Chairman of the meeting and Mr. Kardono Darmo Juwono (Indonesia) was elected Vice-Chairman. Mr. K.R. Rao (India) was elected Rapporteur.

8. The meeting constituted a Technical and Drafting Committee. Mr. Anwar Hossain (Bangladesh) was elected as its Chairman.

Adoption of the agenda

9. The Meeting adopted the following agenda:

(1) Opening of the meeting

(2) Election of officers

(3) Adoption of the agenda

(4) Recent international developments in the field of resource satellites

(5) Latest developments in the ESCAP countries in the fields of remote sensing and satellite surveying

(6) Consideration of issues raised in the report of the ESCAP Mission "Remote sensing and satellite surveying"

(a) "Regionalization" of any proposed national facility

/(b)

(b) Research and development in interpretation and use of imagery - requirements, available facilities, current programmes and proposals

(c) Training - requirements, available facilities, current programmes and proposals

(d) Development of a system for exchange of up-to-date information in the region

(7) Other matters

(8) Adoption of the report

(9) Closure

II. RECENT INTERNATIONAL DEVELOPMENTS IN THE FIELD OF RESOURCE SATELLITES

10. The meeting reviewed progress and plans, based on brief oral statements and written reports covering activities of an international nature, of particular concern to countries of the ESCAP region in connection with satellite programmes, with emphasis on resource satellites. The principal features are outlined below.

UN outer space affairs division:

11. The Scientific and Technical Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space had noted in detail the developments in satellite remote sensing in the ESCAP region.

12. The Legal Sub-Committee was still discussing legal aspects of satellite remote sensing, but had recommended that the United Nations should play a role of co-ordination in the area of satellite remote sensing. A Sub-Committee on Outer Space Activities, referred to as the ACC Sub-Committee, had subsequently been established and had its first meeting in September 1976 at FAO Headquarters in Rome.

/13.

13. Several United Nations departments and organizations and specialized agencies such as the United Nations Department of Economic and Social Affairs, Centre for Natural Resources, Energy and Transport (ESA/CNRET), FAO, UNESCO, the World Bank and other executing agencies for UNDP projects had already felt the need for using satellite remote sensing data. FAO had established a unit for remote sensing and an analogous development was taking place in the ESA/CNRET. Countries would find in the two centres, when they were fully developed, all the necessary advice for introducing remote sensing methods into their economies. However, a third centre to cope with other areas of application may be considered, if developments so require, possibly in a developing country depending upon its viability.

14. There were several way in which the United Nations could exercise its potential co-ordinating role and assist countries in the ESCAP region to utilize satellite remote sensing for their benefit.

15. The first wide area was dissemination of information, in particular that covering the available satellite systems for remote sensing. There was already more than one space segment available at present and more satellite systems could be expected in the near future (the United States LANDSAT system; the Soviet Union's operational remote sensing system for natural resources and environmental observation; the planned European remote sensing programme; the Indian experimental earth observation satellite SEO; the French Systeme probatoire d'observation de la terre). The selection of the most convenient satellite system or observing method would therefore depend on the problem to be solved and thus on the priorities which the countries perceived. Some satellite systems, especially if repeated coverage is desirable, would require regional or national ground receiving stations. Other systems could operate without such stations and the sensing State could provide the product such as an image or a magnetic tape.

/16.

16. The second area in which the United Nations could assist developing countries was in training and user education. The United Nations Space Applications Programme had organized seminars and training courses, had sent missions into countries or regions, and had awarded fellowships.

17. The third area of United Nations involvement was technical assistance and co-operation. At present, only the UNDP channel was open. When the two centres were fully developed their role might be more important.

18. Various possible options were available for the efficient utilization of remote sensing technology in matters relating to social and economic development of the ESCAP region. Among such options which had recently been given wide recognition in the Scientific and Technical Sub-Committee on the Committee on the Peaceful Uses of Outer Space, was that of a regional approach in matters relating to remote sensing. The Sub-Committee had reaffirmed its belief that countries should give thought to the possibility of combining remote sensing facilities with those for training and user education that could be made available to other countries in the region.

19. Countries might consider priorities in their economic needs to take account of all possible satellite systems for remote sensing which were being experimentally operated or which were in the planning stage, to decide whether and when regional receiving stations were to be established, or whether such stations should operate on a national basis, and to consider how the new technology was to be introduced into the economies of those countries.

Centre for Natural Resources, Energy and Transport (CNRET)

20. CNRET was, in the context of remote sensing and satellite surveying, mainly concerned with technical assistance to developing countries. The Centre provided technical back-stopping, supervision and monitoring to all projects undertaken by the United Nations Office of Technical Co-operation

/which were

which were concerned with geology, mineral exploration, transport, surveying and mapping (including hydrography), energy, water resources and coastal and ocean economics and technology.

21. CNRET also worked closely with other substantive offices in the Department of Economic and Social Affairs and the Outer Space Affairs Division, on matters connected with remote sensing from satellites.

22. Typical activities of CNRET in remote sensing included mineral exploration and water resources investigations, for which photogeology and airborne geophysical surveys had been used in most projects. In recent years the benefits of satellite imagery had constituted a significant addition to the available data sources.

23. Another important application of remote sensing lay in the field of flood-plain management, for which special studies had been undertaken directly and commissioned by the Water Resources Branch of CNRET in recent years. The Transport Section of the Centre had made use of remote sensing techniques, as had the Cartography Section.

24. CNRET had also provided training in utilization and interpretation of remote sensing data to counterpart personnel. For more advanced training, most CNRET-supported projects included provision for fellowships at specialized research and teaching institutions, while special seminars were occasionally conducted on particular subjects.

25. The principal resource provided by CNRET was the knowledge and experience of its professional staff, who were accustomed to using a wide range of methods for the solution of problems. Remote sensing constituted an exceptionally important group of such methods.

26. No single method, however, was an end in itself, and for best effect a number of different approaches would be needed. To achieve this would

/require expertise

require expertise in particular professional disciplines, even more than competence in a single technology. CNRET was seeking to achieve this synthesis, and was currently planning a specialized unit which would enable expansion of many of its activities.

United Nations Environment Programme (UNEP)

27. UNEP had initiated a Global Environmental Monitoring System with far-reaching activities in three main areas. For resource monitoring, a combination of ground and remote sensing data would be used, including aerial photographs and LANDSAT imagery, to assess changes in vegetation cover. The programme would be carried out in co-operation with FAO.

28. Under the pollution monitoring programme, UNEP in conjunction with WMO's World Weather Watch would utilize collecting systems including polar orbiting and geostationary satellites, aircraft, ships and terrestrial stations.

29. Under natural disaster monitoring, UNEP intended to support a global or regional monitoring system, in co-operation with the Office of the United Nations Disaster Relief Co-ordinator (UNDRO).

Food and Agriculture Organization (FAO)

30. Over 50 FAO projedts throughout the world currently included a remote sensing component. Aerial photography had been used in numbrous FAO-executed projects such as forest inventories, agro-industrial development projects, irrigation projects, land capability surveys, river course mapping, land-use studies and soil mapping. In a UNDP/FAO project in Surinam, the Canadian Forest Management Institute had been experimenting with the use of airborne radar altimetry for determining tree heights. Landsat investigations were being carried out by FAO in several countries, employing satellite imagery in providing maps at scales of 1:250,000 of areas not already mapped; in updating existing small-scale maps; and in providing thematic maps useful to field studies.

/31

31. FAO's Remote Sensing Unit at its Rome Headquarters assisted in remote sensing aspects of project formulation, provided additional support to field programmes and gave guidance on request from member countries. Equipment would be installed shortly at Headquarters in Rome to enable full analysis of Landsat tapes in association with computer methods.

World Meteorological Organization (WMO)

32. The present and planned satellite programmes of WMO called for both near polar and geostationary satellites to form part of the space based sub-system of the integrated Global Observation System (GOS). ITOS, NOAA-5, GOES-1, SMS-2, SMS-1, ATS-1, ATS-3, METEOR and NIMBUS-6 provided operational and experimental data during 1976. The plan for 1976-79 clearly indicated that the objective is to provide reasonably complete coverage of the globe. The satellite sub-system will consist of two polar orbiting satellites (USA and USSR) and five geo-stationary satellites (one each from USSR, ESA, and Japan and two from USA).

International Programmes of the U.S.A.

33. The specific objectives of the Earth Resources Survey Programme of the National Aeronautics and Space Administration (NASA) were to increase its capability for remote sensing of the earth and to apply the results to agriculture, land use, water management, mineral and petroleum exploration, and the improved accuracy of world maps. To do this, NASA had launched satellites called Landsat-1 and Landsat-2. The first satellite had been launched in 1972. The second in 1975. Both were still in orbit although Landsat-1 had experienced technical difficulties.

34. Landsat-1, which would be five years old in July, had no tape recorder capability and could transmit data only in three of the four spectral bands of the multispectral scanner. Landsat-2's sensors were in order and it had one tape recorder which was still functioning. Therefore, NASA's capacity to

fulfil the many requests for a large volume of recorded data on areas outside the range of ground stations was severely limited.

35. Landsat-C was tentatively scheduled for launch early in 1978. It would have increased capabilities over Landsat-1 and 2. On Landsat-C the multispectral scanner would have an additional band in the far infrared (thermal) region which was expected to significantly improve the capability of classifying crops, vegetation and soils. The Return Beam Vidicon (RBV) cameras which had seen relatively little use on Landsats 1 and 2 will be reconfigured on Landsat-C. Instead of three cameras and three spectral bands, two panchromatic cameras would be used to cover the same 185 km wide swath that the multi-spectral scanner covers, but the RBV would provide twice the spatial resolution of the multi-spectral scanner, i.e., about 40 metres.

36. NASA did not plan to have a Landsat-C investigations programme as it had with Landsat 1 and 2. Data from Landsat-C, however, would continue to be available to all requestors through the EROS Data Centre and from foreign ground receiving stations. Requests for tape recorded data coverage would be evaluated in terms of the quantity and frequency of data requested, the scientific and technical merit of the project for which the data were being requested, and the competing demands on the tape recorder. In the long run, however, NASA's ability to provide tap recorded data would always be limited, and the best interests of regional areas would probably be served by the establishment of a ground receiving station somewhere in the region which could provide data on a regular basis and in near-real time.

37. NASA was currently planning a fourth Landsat to be launched in 1981. Landsat-D would have a new sensor called the Thematic Mapper which would provide increased capability both in spectral resolution (6 bands) and in spatial resolution (nominally 30 metres) compared to the current Multispectral Scanner.

/This increased

This increased capability would enhance the value of remote sensing data in many areas including mineral and petroleum exploration and the application of crop inventory techniques to small field agriculture.

38. In conjunctionwith the Thematic Mapper, an improved data acquisition processing, dissemination, and analysis system was being planned to bring data to users in a shorter time period. In the Landsat-D timeframe, NASA would also be using the Trackingand Data Relay Satellite System (TDRSS), two geostationary satellites used to relay data to a single receiving station to be lodated in the Southwestern United States. TDRSS would be used to relay data from serveral earth orbiting satellites as well as the Space Shuttle. For Landsat-D, TDRSS would be used to relay data of the United States and a limited amount of data for areas outside the range of foreign ground stations to the US ground station. From there the data would be retransmitted to a central processing and dissemination centre. TDRSS would not replace foreign ground stations. Landsat-D would continue to transmit data in real time to ground stations where users could more conveniently have access to a regular, continuous supply of data in near real time.

39. In addition to the Landsat series of spacecraft, NASA had plans for three other remote sensing satellites to be launched in 1978: Seasat, the Heat Capacity Mapping Mission (HCMM) and Nimbus-G.

40. It was planned to launch Seasat in mid-1978, and it would operate for about a year. Technical information on the satellite is given in Annex-1.

41. The Heat Capacity Mapping Mission would be a one-time small dedicated satellite with a one year design life which would measure day and night temperature differences to determine the thermal inertia of the earth's surface. HCMM data were expected to help indicate plant stress, measure soil moisture, map thermal effluents and ocean currents, locate geothermal areas, and

/predict runoff

predict run off from snow fields. Data could be read out only via direct transmission to ground stations and the format of the transmissions would be compatible with Landsat ground stations. Further technical information is given in Annex 2.

42. Nimbus-G would demonstrate the feasibility of monitoring air and water pollution from space. Among the instruments onboard, the Coastal Zone Color Scanner (CZCS) would attempt to obtain data of water quality including mutrient content from measurements of water color. The scanner would map water surfaces in six spectral bands with a spatial resolution of about 500 metres.

43. The United States Geologidal Survey (USGS) had carried out a number of remote sensing activities each year, including workshops and seminars, consultation and planning activities, and co-operative remote sensing projects. Among others, USGS had provided training and technical assistance to the Philippines, a short course on the instrumentation of hydrologic monitoring stations to India and assistance to Landsat image analysis programmes in Thailand.

44. The USGS was providing the leadership in a new project entitled "Remote Sensing and Mineral Exploration" which had been approved as part of the International Geological Correlations Programme (IGCP). The new project would provide a mechanism for international collaboration in the identification of features related to mineralization, based on remote sensing.

45. Two training programmes (workshops) for transfer of knowledge of both applications and methods in satellite and aerial remote sensing for earth resources and environmental analysis, had been developed and conducted by USGS personnel of the EROS Data Centre in 1976. Two more workshops were scheduled for calendar year 1977 at the Data Centre, and two additional sessions would be conducted in 1978.

/The European

The European Remote Sensing Programme

46. The 10 Member States which supported the European Space Agency (ESA) were at present taking the policy decisions which would lead to the development and launching of European earth resources satellites. A decision had already been taken to start the EARTHNET programme which would set up a European network for the reception, preprocessing, archiving and dissemination of data received from earth resources satellites.

47. ESA considered that it was most important that data generated by the European remote sensing satellites should be used by developing countries, and the satellites would, therefore, be gloval like Landsat. The first satellite launch was planned for 1983 with an optical payload (visible and thermal IR). High resolution microwave sensors (SAR) were planned for the second payload, possibly in 1986.

48. Studies by earth scientists had indicated that the main applications interest was in regular monitoring of dynamic phenomena of the land and ocean surfaces. Data continuity could only be guaranteed in areas of frequent cloud cover by using high resolution synthetic aperture radar (SAR). Some applications would be able to rely entirely on SAR sensing (e.g. soil moisture measurement, canopy penetration), but others (e.g. crop monitoring) would require optical sensing for identification purposes and all weather microwave sensing for the regular study of variations to detect crop changes under all weather conditions.

International Development Research Centre (IDRC)

49. IDRC was also organizing applied research programmes in the field of remote sensing and satellite surveying in the developing countries including Bangladesh.

/III.

III. LATEST DEVELOPMENTS IN THE ESCAP COUNTRIES IN THE FIELDS OF REMOTE SENSING AND SATELLITE SURVEYING

50. The meeting reviewed progress in the region, on the basis of oral statements and written reports on developments since the visit of the ESCAP mission. Since all the information contained in the written reports likely to be of general interest could not be included in the report of the meeting, it was agreed that the secretariat should compile this information in a second report for distribution to the countries. This report should include the reports of New Zealand and Sri Lanka which had been submitted but not presented at the meeting. The main points brought out in the presentations at the meeting were as follows.

Australia

51. The Australian Department of Science was responsible for the support of civil space research programmes including remote sensing by satellite. Applications of remote sensing technology in such fields as mapping, environment, mineral resources, agriculture and land use were undertaken by various Federal and State Government departments and agencies, tertiary institutions and private industry.

52. Australia was continuing to take an active interest in satellite remote sensing ofthe earth through the United States Landsat programme. The Commonwealth Scientific and Industrial Research Organization (CSIRO) was undertaking a pilot study into the feasibility of using Landsat imagery in a broad ecological survey of Australia, covering landforms, soils, vegetation cover, land use and climate. This would be the first ecological survey of the continent and an invaluable tool in land use planning, both for development and conservation.

53. In the field of meteorology, Australia was, as part of the Japanese Geostationary Meteorological Satellite (GMS) Programme, providing a turn-around ranging station as well as establishing a station to receive data

/from this

from this satellite for distribution to metecrology centres in the Australian region. In the field of Geodetic Surveying and Mapping, photomaps at 1:500,000 and 1:250,000 were being produced of parts of the Australian Antarctic Territory using Landsat imagery controlled by classical geodetic fixes or radio doppler techniques. A complete set of Landsat photomaps (at scales of 1:1,000,000 or 1:500,000 depending on population density) covering the whole of South Australia was being prepared.

54. Resulting from an investigation of the potential demand for satellite remotely sensed data, a proposal had been submitted to the Australian Government for the establishment of national ground facilities for the reception, processing and analysis of Landsat data. The Government was currently considering the proposal.

55. There ware extensive facilities throughout the country for the processing and visual interpretation of aerial photographs and for the analysis of airborne geophysical survey data. A few research laboratories had limited facilities for the computer processing and analysis of Landsat satellite data, but no commercial facilities were available at present.

56. Training in remote sensing technology was mainly carried out in [illegible] universities as part of undergraduate and post graduate courses in applied science, biology, geology, geography and surveying. The only specialist course was a two-year part-time Graduate Diploma in Remote Sensing offered by the South Australian Institute of Technology. The Australian Mineral Foundetion had organized a workshop course "Photo-interpretation for survey and exploration geologists". All such courses were open to nationals of any country providing they met the qualification requirements. No regional courses were offered by Australia. Students from developing countries, however, could receive in-house training at the Bureau of Mineral Resources of the Department of National Resources, Canberra.

/Bangladesh

Bangladesh

57. The Bangladesh Landsat Centre had been established, and was carrying out research and development activities.

58. Applications of remote sensing images in Bangladesh included: map mosaics; land use maps of the coastal areas; a study on reafforestation; estimation of a sample winter crop; a study of drainage patterns and a study of land accretion in the Bay of Bengal. Many additional studies of water resources, land use patterns and crop productivity were planned.

59. With the help of bilateral and multilateral aid, Bangladesh planned to set up a self-contained Remote Sensing Centre which would be equipped with a satellite ground receiving station and be used for receiving data from both resource and meteorology satellites. After installation of that station, Bangladesh would be in a position to host a Regional Centre for Remote Sensing and Satellite Surveying, in Dacca.

60. Bangladesh was in a favourable geographic position for a regional ground receiving station and in order to receive Landsat and meteorological data, a dual-purpose ground receiving station for Bangladesh was a very important matter.

61. The first national seminar on remote sensing was held in Dacca in 1975, organized by the Landsat Task Force. Under its current UNDP programme Bangladesh proposed to hold a workshop on remote sensing in Dacca towards the end of 1978. If the concept of a Regional Remote Sensing Centre at Dacca were approved by ESCAP, Bangladesh would also offer to extend the scope of the workshop to a Regional Training Workshop for satellite remote sensing under ESCAP sponsorship.

/India

62. Facilities for analysis of remote sensing data (acquired from satellite or aircraft) were now available in India in the following modes: (a) Off-line mode using a general purpose computer; (b) Interactive mode, using special computers; (c) Manual and photo-interpretation techniques; and (d) Hybrid combinations of (a) to (c). India had found that techniques (manual, automatic and hybrid) which combined satellite, aircraft and ground observation data in a conjunctive manner led to economically optimum results.

63. Major activities in the field of remote sensing included: A pilot project using remote sensing techniques for a land-use inventory of Orissa State in 1976; and an in-house training programme in which one quarter scene of a Landsat image in the Punjab was analysed using off-line computer-supervised classification techniques. Projects in the fields of forestry, hydrology, geology and land use were in progress.

64. The Space Application Centre of the Indian Space Research Organization (ISRO) was engaged in research and development activities. The ISRO project for the proposed Indian Satellite for Earth Observation (SEO) was going ahead as planned.

65. In the field of training, India had offered to hold a United Nations/FAO sponsored Training Workshop/Seminar on Remote Sensing in the latter half of 1978. The NRSA could offer, for instance, training facilities in the application of photo-interpretation, which training will be extended with remote sensing next year.

66. India renewed its offer to locate a regional Landsat earth station in India. As a result of facilities already available and India's experience in the field of satellite communications, the Landsat Station could be established at a comparatively low cost in a short time. The planned site was Hyderabad, but India was willing to take another site into consideration if this would better fit into the regional coverage.

/Indonesia

Indonesia

67. Multistage and multisensor remote sensing had been selected as the most efficient data acquisition method for a National Resources Survey and Mapping project which had been started in 1976, financed by the Government of Indonesia and a World Bank loan. This project was being co-ordinated by the National Co-ordination Agency for Surveys and Mapping (BAKOSURTANAL). The project would be carried out in three stages, which would involve images ranging from a scale of 1:100,000 increasing to a scale of 1.20,000.

68. On the question of a ground receiving station (GRS), Government policy was oriented towards the creation of national capability in the field of space research, for which the National Aeronautics and Space Research Institute (LAPAN) was mainly responsible. LAPAN would start by building weather satellite (APT) ground stations, of which two were already operational. Work was in progress on a third experimental GRS which would probably be of a multipurpose nature, designed to receive satellite data of Landsat and post-Landsat systems. The main purpose of such a station would be training in reception, processing and dissemination of Landsat remote sensing data in close co-operation with their prospective users. The costs of the experimental ground station would be off-set by the acquired experience and by baing able to have specifications for the future operational station on the identified local needs rather than on imported models developed for different conditions.

69. Since the hosting of the Joint UN/FAO Regional Seminar on Remote Sensing Applications in Jakarta in Novemver 1975, Landsat imagery had been used in the fields of land-use, geology, ecology, geomorphology and mapping. Two governmental institutions, the BAKOSURTANAL and the Geological Survey of Indonesia (GSI), have included Landsat imagery as standard procedure in their systematic mapping systems.

/70

70. The GSI, with technical assistance from Japan, had completed the first phase of a major mapping-exploration programme covering an area of 36,300 km^2 in central Kalimantan, in which Landsat imagery had been used to obtain information on geomorphology, geology and geological structure, and possible zones of mineralization.

71. Other remotely sensed data used included: multispectral photography; thermal scanner imagery; and SLAR imagery. In consideration of the various remote sensing systems it seemed likely that the SLAR images would become important, because of large areas of Indonesia subject to cloud cover most of the time.

72. In the second-to-last paragraph on page 5 of the mission report, the third sentence should read as follows: LAPAN, while co-ordinating the Landsat investigations, carries out research in data acquisition, data processing and developed ideas on equatorial earth resources satellites. Further more, in relation to page 6, LAPAN had conducted studies concerning the technical matters of the planned Ground Station. Steps toward its realization had been initiated since 1976.

Iran

73. An Iranian Remote Sensing Centre was being organized within the plan and Budget Organization under the title of Satellite Application Project. This project would be effectively responsible for the acquisition and subsequent distribution of data to users within Iran as well as neighbouring countries. The project included:

(i) The Tracking and Receiving Facility: This facility had been procured and was presently in the process of being shipped to Iran. It was expectdd to be operational by late 1977.

(ii) The Electronic Data Processing Facility: The contract for this system had been awarded and it was anticipated that the system would be

/operational

operational in the first quarter of 1978.

(iii) Photographic Data Processing: The proposal for establishing a photographic data processing system was presently being evaluated. It was planned that this system would be operational in the first quarter of 1978.

(iv) Data Management: The procurement of a data management system was presently in the process of being contracted. This system was planned to be operational by mid 1978.

74. In addition to above activities, the Satellite Application Project was involved in several research pilot projects concerning earth resources disciplines and utilizing remotely senseddata, and was engaged in procuring a state of the art digital image processing system for automatic classification and analysis of the acquired data.

75. The project had also been active in the training aspect of remote sensing technology. As an example, a trainging course in fundamentals of remote sensing was recently carried out for newly recruited personnel. In addition, a series of seminars and workshops had been initiated for the domestic user community. Such activities would be extended however to serve the regional as well as international needs.

76. Several other organizations in Iran had been utilizing remotely sensed data particularly Landsat imagery.

77. The Geological Survey of Iran (GSI) had established a remote sensing section utilizing Landsat data for its geological and mining projects. Several investigations such as neo-techonics, igneous rocks inventory, structural geology and mineral application had been carried out successfully. In addition, GSI, with the co-operation of other countries, had initiated the following projects:

/(a)

(a) Regional investigation concerning igneous rocks and copper mineralization (with Cento).

(b) Geotraverse investigation (with two German universities).

(c) Training course in application of Landsat data in geology (with USGS), Tehran 1976.

78. The Department of Informatics ofthe Ministry of Agriculture and Natural Resources had developed over the past few years a number of well equipped data analysis laboratories and had been engaged in application of Landsat data in various investigations concerning agricultural resources. Other organizations involved in the field of remote sensing application were: Ministry of Energy, National Iranian Oil Company, National Geographic Organization, and Environmental Institute of Iran.

Japan

79. In the field of satellite surveying, the budget to constract the experimental earth observation satellite LANDSAT ground receiving station by the National Space Development Agency of Japan (NASDA) had been authorized by the Diet. The design ofthe station including its location and equipment were yet to be finalized. The main features ofthe station are as follows: (a) Its location would be in the Tokyo area, rather than Okinawa; (b) The possible area to be covered would have a radius of about 2,700 km (5° elevation); (c) Construction was planned to be completed in 1978 and data reception begun in 1979; and (d) Data to be obtained included imagery and computer compatible tape.

80. A study on long-range domestic earth observation satellites with emphasis on the mission definition and the sensor selection for the first satellite had been implemented. The first satellite was planned to be launched around 1983, and research and development of the remote

/sensing

sensing devices for possible use on the satellite was under way.

81. Studies on the application of earth observation satellite data in the fields of environment monitoring, map making and fishery were under way.

82. Among other activities in the field of remote sensing were: the five year programme to observe the ocean by airplane and ship to develop analytical techniques; a study of optimum data processing techniques; monitoring of ocean currents and activities of submarine volcanoes by aerial infra-red thermography and multiband photos respectively; a four-year programme to cover 360,000 km^2 of land by colour aerial photography; and experimentation on monitoring air pollution with laser radar.

83. Meeting plans for July to December 1977 included seven symposia on the national level. On the regional level the Government of Japan would organize a Training course on Digital Analysis for 7-10 days late in 1977; and a Group Course on Offshore Prospecting from 5 May to 10 December 1977, with 10 days of interpretation training included.

Korea

84. The Ministry of Science and Technology had been actively engaged in promoting the application of remote sensing methods in the investigations in geology, forestry, oceanography, coastline geomorphology and littoral face classification.

85. A remote sensing division was set up in May 1976 in the Korean Research Institute of Geoscience and Mineral Resources for investigations in geology. Consideration was being given to expanding this division to cover other disciplines and to be developed into a remote sensing centre for Korea.

86. Korea at present had a coumputer 108-2A (digitizing system) for interpretation work. It had plans to obtain other equipment such as zoom transferscope, film recorder, data colour image enhancement system and projection.

87. Regarding training activities, a 4-week course in photo-geology was held in Seoul in early 1977. A workshop was planned to be held in the near future with the co-operation of the USGS and University of Arizona.

88. Korea at present was not considering the setting up of a ground receiving station. It was planned to obtain Landsat imagery and training in data processing from Japan, when a receiving station was set up in that country.

Malaysia

89. Malaysia was making studies with a view to establishan integrated remote sensing centre inthe Directorate of National Mapping.

/Pakistan

Pakistan

90. As part of its overall scheme of remote sensing technology applidations, the Pakistan Space and Upper Atmosphere Research Committee (SUPARCO) had set up in Karachi a Remote Sensing Applications Centre (RESACENT). SUPARCO had been designated by the Government to proceed further with the planning of facilities including a ground receiving station, with a view to ensuring maximum utilization of the remote sensing technology.

91. Applicatons of satellite remote sensing included floodplain mapping for determination of the areal extent of the 1973 and 1976 floods in the Indus Basin and an investigation of water resources from Landsat based snow surveys in the northern part of the country. Under a United States AID grant Programme and in collaboration with the Environmental Research Institute of Michigan (ERIM), SUPARCO has carried out an investigation on the morphology of the Indus delta and adjoining coastal belt of Pakistan.

92. Except for the months of July and August Pakistan had clear skies and, therefore, the present spectral bands in the visible and near infrared did not constitute any serious constraints. On the other hand the spatial resolution limited the utility of such data, particularly in the estimation of crop yields.

93. Regional/international training programmes were planned, in addition to national seminars. A United Nations sponsored Regional Training Seminar on Remote Sensing Applications had been hosted by the Government of Pakistan and organized by SUPARCO at Karachi from 17 to 28 January 1977.

94. Pakistan's own training requirements were in the areas of operation and maintenance of ground receiving stations and associated facilities, and preprocessing and machine-aided interpretation of satellite remote sensing data. The satellite remote sensing applications programme

/could be

could be substantially supported throufh dissemination of up-date information by ESCAP on the remote sensing activities in the region, perhaps in the form of periodical bulletins.

95. Pakistan should be included with India, Indonesia and Japan referred to in the fourth paragraph of page 6 of the Mission report, which at that time had a national space agency.

Philippines

96. Two agencies were carrying out remote sensing research and applications in the Philippines; the Natural Resources Management Centre (NRMC), and the National Committee on Mineral Exploration and Survey Operations (NACOMESO), both administratively under the Department of Natural Resources.

97. The NRMC was created in October 1976 and was given the responsibility of developing the country's capability in the utilization of memote sensing technology in the inventory and management of natural resources and environment. The Centre had recently installed an Image 100 Multispectral Data Analysis System for computerized interpretation of imageries.

98. It was in the NACOMESO, created in July 1970 and composed of technical personnel fwom the Bureaus of Mines, Forest Development, Lands, Soils, Fisheries and Aquatic Resources, Coast and Geodetic Surveys, Plant Industry, Budget Commission, Philippine Air Force, and the Philippine Navy, that the Philippines started participating in the Landsat Programme.

99. NACOMESO's projects and activites included the following: aerial photography of the Agno River Area with a total coverage of 180 km^2 whihh aimed at determining the total destructive effects of floods in Contral Luzon in July-August 1972; marine seismic surveys of Tayabas - Monpong Pass, aeromagnetic survey of NW Luzon; NACOMESO-ERIM project on the interpretation and utilization of low - altitude multispectral photography to supplement

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the interpretation of LANDSAT imagery of the Island of Mindoro; aerial photo-mapping by sequential multi-spectral imagery spaced weekly for study of pollution pattern of Manila Bay, Pasing River and the Metro Manila area. The First Asian Seminar and Workship on Remote Sensing held at the University of the Philippines was also sponsored by the NACOMESO.

100. NRMC remote sensing projects being carried out were: forest inventory of the Philippines utilizing thirty LANDSAT secenes for the period 1972-1976 and ground data, analyzed with the use of the Image 100; mangrovas and wetlands inventory preparation of mineral potential map, earthouake susceptibility map and updated geological map; land use survey and assessment; and environmental analysis of Manila Bay and Laguna Iake ecosystem. A ten-man team was trained in Maryland, USA, in late 1976, on the use and operations of the Image 100 equipments.

101. The philippines had no concrete plans for a ground receiving station for LANDSAT data, but expected to continue to acquire the necessary satellite remote-sensed data from the EROS Data Centre and from neighbouring countries that might establish receiving stations. It expected, however, to acquire a multispectral seanner and an aircraft platform to be used for data acquisition.

102. The philippines would be hosting and co-sponsoring with the Enriro-nmental Research Institute of Michigan (ERIM) the Twelfth International Symposium on Remote Sensing of the Environment. The Symposium will be held in Manila in April 1978.

Thailand

103. The Thailand National Remote Sensing Programme (TNRSP) operated through the National Remote Sensing Co-ordinating Committee established in September 1971. The Committee is composed of the Secretary-General of the National Research Council (NRC) as Chairman.

104. The RNRSP Working Unit performed co-ordination functions and was supportive of other government agencies that were involved in single resource studies in such fields as forestry, agriculture, land use, hydrology, and geology. Landsat imagery had been used extensively to carry out studies in those fields. Facilities recently completed at TNRSP and other agencies including user service and data handling, interpretation and photographic laboratories, and others, were offered by Thailand to ESCAP countries for regional training and dissemination of Landsat data.

105. Among the major successful investigations in the use of Landsat imagery are the inventory of existing forest land and monitoring of the change in forest areas, the watershed management, the identification of shifting cultivation and hill-tribe villages, the preparation of land use maps, crop resources survey, the preparation of techonic maps and discovery of major faults and fractures, and the determination of reservoir areas. Co-operation of TNRSP contributed to the successful implementation of a computer software package at the Asian Institute of Technology for the machine processing of Landsat computer compatible tapes.

106. Thailand had proposed to host a regional receiving station and data dissemination facilities for the ASEAN countries in the meetings of both the ASEAN permanent Committee on Science and Technology at Jogyakarta and the Association of Science Co-operation in Asia (ASCA) at Tokyo but no decision was made. Thailand considered it was the most appropriate location for a regional centre for data reception and dissemination in Southeast Asia since it has access to computer facilities especially at the AIT thus minimizing the cost of investment. Therefore Thailand had never decided in early 1976 not to have a ground receiving station in the near future as stated in the report of the ESCAP mission page 7, paragraph 2.

/107.

107. In the meantime Thailand has already set up a budget to implement its plan to establish a national receiving station. Choice of the type of the station depends on the cost/benefits study. The site would be located near the Telecomunication Satellite Receiving Station at Sri Racha.

108. Since early 1973 Thailand had conducted one national and one international advanced training workshop in remote sensing, and was planning to organize a seminar on applications of Landsat-2 data to national development during late June 1977. The TNRSP also planned to organize an interregional workshop on remote sensing applications for development planning in January 1978 at Bangkok.

Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP)

109. CCOP had carried out studies of LANDSAT images of six transects in the region within the framework of the International Decade of Ocean Exploration (IDOE) programme. Subsequently a consultant with experience in digital processing techniques of LANDSAT data had been engaged on the co-ordination of a joint research programme between CCOP and Stanford University on the genesis of the lowland coastal areas of Malaysia in relation to tin exploration, based on digital analysis of LANDSAT data.

Committee for Co-ordination of Investigations of the Lower Mekong Basin

110. The Lower Mekong basin covered 630,000km^2 of total watershed area, which could be represented in approximately 37 frames of LANDSAT imagery. It had taken six man-years to produce three maps, of which the land use map was distributed to the meeting. The pedo-geomorphology and land capability maps had been finished, but had not yet been printed. The scale of I:I,000,000 was suitable for regional planning, but not for detailed analysis, since some areas were inaccurate and the results of interpretation could not be verified. The Mekong Committee had just completed the pattern recognition package using the AIT computer in March 1977. The programme was now operational.

IV. CONSIDERATION OF ISSUES RAISED IN THE REPORT OF THE ESCAP MISSION "REMOTE SENSING AND SATELLITE SURVEYING"

111. Apart from consideration of the specific issues listed in the agenda, there was some discussion on the report itself. The mission was commended on the work it had done in assessing the situation and in producing a report which provided a very useful basis for the planning of further action. At the same time, some delegations felt that insufficient weight had been given to the proven practical value of remote sensing data for a range of activities in resources appraisal, development and management, and in mapping generally. Reference was also made to the social and other benefits often associated with applications of satellite data, and to its particular advantages in speed of coverage and repetitive data when required.

112. With regard to the table on page 15 of the report, it was agreed that the secretariat should compile a revised table incorporating data for receiving stations located in Pakistan, Bangladesh and Thailand. In all cases the coverage should be based on the assumption of full use of the range, which would be assumed to be a radius of 2,200 km. Under the number of countries, there should be an indication also of complete or partial coverage, and in view of the many variable factors affecting cost, information on that aspect should not be included. The table should be submitted to the countries concerned for verification prior to general distribution.

113. With regard to the development of regional programmes generally, the meeting was informed that the Economic Commission for Africa had recently decided to establish a Council for remote sensing. It had also been decided that regional receiving stations would be set up at Kinshasa (Zaire) and Ouagadougou (Upper Volta), and that there would be five centres for training and user assistance-one in conjunction with each of the receiving stations, and others at Nairobi (Kenya), Cairo (Egypt) and Ile Ife (Nigeria).

/(a)

(a) "Regionalization" of any proposed national facility

114. The meeting noted the information which had been provided on plans for establishment of receiving stations, which is summarized as follows. In the case of Iran work was proceeding and the station was expected to be operational in late 1977. The station to be established in Japan in the vicinity of Tokyo would be operational in 1979. The Government of Bangladesh had dicided in principle to establish a receiving station, and was seeking financial support for its development as a regional station. In the case of India, the need for establishing a station had been recognized and a decision would emerge soon. However, preliminary technical designs had been prepared. In the case of Indonesia, Pakistan and Thailand, decisions to establish a station had been made, but the details and timing had yet to be determined.

115. The meeting noted that with the stations mentioned above, and assuming a coverage equivalent to a radius of 2,200 km, most of south and southeast Asia, other than the philippines and eastern Indonesia would be covered by at least two, and in many cases three or even four stations. It was therefore suggested that the countries concerned might consider the implications of this, in the planning and establishment of receiving stations for resource satellite data. The possibility of developing a network of receiving facilities in the region was also raised.

116. In view of the fact that countries were likely to continue to depend largely on NASA space segments to provide data, it was agreed that the attention of NASA might be drawn to the tendency for countries to develop national ground receiving stations, so that the implications of this trend might be kept in mind in the development of future programmes.

117. In this connexion the meeting acknowledged with gratitude the great benefits that had been associated with the NASA spade programme in opening up this technology for the use of countries around the world.

118. Attention was drawn to the value of the Principal Investigator concept in the Landsat programme, and it was suggested that countries developing ground stations should consider similar programmes with any co-operating countries. The importance of the earliest possible contact with NASA by countries planning ground stations was also stressed, since the reaching of agreement on a memorandum of understanding could require a good deal of time. There were also other legal questions to be considered.

119. Attention was also drawn to the need to consider cost effectiveness, and opportunity cost not only in terms of possible use of the resources for other types of development, but more particularlyin terms of use of funds for supporting activities such as inter-country or regional programmes in training and research.

(b) Research and development in interpretation and use of imagery - requirements, available facilities, current programmes and proposals

120. The meeting noted the information submitted under agenda item 5 regarding changes in available facilities and major items of equipment, subsequent to the mission report.

121. The meeting considered a number of suggestions for topics on which research and development might be carried out in a number of countries, with continuing liaison in each case in an endeavour to ensure progressive sharing of experience, and adequate coverage of the issues involved. The suggestions are summarized in the following list:

Principles and methods

(i) Optimum use of manual/digital interpretation

(ii) Optimum use of satellite/airborne/ground data

(iii) Relative merits and cost effectiveness of general purpose and interface computers

/(iv)

(iv) Low-cost interpretation, e.g. for universities.

Problems or tasks

(i) Natural resource inventory

(ii) Mapping of volcanic areas

(iii) Land evaluation

(iv) Land use mapping

(v) Forest management

(vi) Crop monitoring and prediction

(vii) Environmental monitoring - pollution

(viii) Flood forecasting and water resources management

(ix) Coastal zone monitoring

(x) Fish resources assessment

(xi) Cartography.

122. In considering these suggestions, the meeting felt that the first two matters concerning principles and methods might usefully be built in to most of the topics under problems or tasks.

123. It was agreed that countries should be asked to consider this list, and to provide comment as follows:

(i) Suggestions of additional topics which were of particular concern, and were likely to benefit significantly from a co-ordinated research programme.

(ii) Identification of items in the amended list concerning which it was proposed in the immediate future to continue or begin research, and in relation to which contact with other interested countries was desired.

(iii) In relation to each topic identified, the name and address of the office with which contact might be established and maintained by other countries and by the ESCAP secretariat.

/(iv).

(iv) In relation to the topic "Crop monitoring and prediction", an indication of crops which were of particular importance to the countries, and on which there was an interest in research on monitoring and prediction.

124. The secretariat was requested to analyse the replies received, to disseminate the results to the member countries, and to the extent possible, to assist in obtaining support for co-ordinated research activities as requested by the countries.

(c) Training - requirements, available facilities, current programmes and proposals

125. The meeting noted information provided in the country reports under this heading.

126. With regard to seminars, workshops and similar meetings, it was noted that plans were being made as follows, for activities up to the end of 1978:

(i) UN training seminar on remote sensing applications, Baku, USSR: 3-19 October 1977. Participants would be selected from candidates nominated by governments of developing countries and project funds would cover the costs of international travel and subsistence. The closing date for nominations which should be submitted through the UNDP Resident Representative was 30 June. Data interpretation would relate particularly to geology, forestry, agriculture, cartography, hydrometeorology and natural disasters.

(ii) Seminar on digital analysis of remotely sensed data, Japan, for about 10 days at the and of 1977. The course, for about 10 participants from the ESCAP region, financed by Japan, would include an outline of the theory involved, on-the-job training, and visits to operational centres and instrument manufacturers. Formal advice would be sent to countries in the near future.

(iii) Workshop on use of satellite data, Bangkok, January, 1978. This would be the third in a series of such workshops, the main purpose being

/to exchange

to exchange experience among countries of the region, with invited experts as lecturers. The workshop should also provide feedback to authorities responsible for provision of space platforms. UN support would be sought to meet the costs of international transport for participants from other developing countries, local costs being met by the Thai Government.

(iv) International symposium on remote sensing of the environment, in conjunction with the Environmental Research Institute of Michigan (ERIM) the philippines, April 1978. This would be the twelfth in a series of symposia organized by ERIM, the previous II having been held in the USA. Some 800 participants were expected.

(v) UN/FAO seminar on remote sensing, with particular reference to applications in agriculture, India, probably October/November 1978. The programme would occupy three weeks, with one week spent each at Dehradun, Ahmedabad and Hyderabad.

(vi) A seminar on remote sensing with particular reference to water management and coastal problems, Bangladesh, probably in December 1978. Though initially envisaged as a national seminar, consideration was being given to its extension to include other countries in the region.

127. The meeting was further informed that in view of the strong interest expressed by the countries, the Government of Japan would be ready to examine the possibility of hosting a United Nations seminar with the emphasis on the issues of common interest, for the countries of the EBCAP region, after 1979.

128. The meeting welcomed these developments, and suggested that where arrangements were still to some extent flexible, the responsible authorities might take note of other related plans, and adjust programmes as considered appropriate.

129. A number of representatives expressed interest in training in computerized data analysis, and the representatives of India, Iran, Japan,

/Pakistan.

Pakistan, the Philippines and Thailand indicated that facilities were, or would shortly become, available in their countries for training of participants from other countries. In this connexion, reference was made to the value of visual interpretation, and the importance of trainees in digital interpretation having a strong background in visual interpretation in the disciplines of interest.

(d) Development of a system for exchange of up-to-date information in the region

130. In the course of the meeting a number of delegations referred to the need for ESCAP to provide a service for exchange of information on recent developments and plans in the field of remote sensing generally. This matter was taken up under the next item.

V. OTHER MATTERS

131. The meeting considered a proposal for the establishment of a Remote Sensing Cell in the ESCAP secretariat, which might develop into a regional Remote Sensing Agency, together with a Co-ordination Committee. The functions of these bodies would be:

(a) To collect and disseminate information on plans for satellite systems which could be expected to provide data for countries in the region; on plans for receiving stations within the region; on major developments in equipment and facilities for data processing and analysis within the region; on proposals for international workshops, seminars and training courses, and other developments likely to be of interest to member countries.

(b) To encourage co-ordination of research required for advance flood warning, crop forecasting etc. jointly from meteorological and resources satellites.

(c) To consider and encourage other regional programmes at the request of interested countries.

132. having regard to the expected difficulty in obtaining any major allocation of resources for a new activity in the secretariat, and the expectation that useful work could be done with a limited number of highly qualified staff, the meeting agreed that the role of ESCAP in the remote sensing field should be strengthened, even without such arrangements as proposed above, and in particular that ESCAP should carry out the functions outlined above together with an additional function, to take an active part in the ACC Sub-Committee on Outer Space Activities with a view to increasing the effectiveness of programmes and projects of the United Nations system in the field of remote sensing in the ESCAP region, and to provide information for other regional commissions.

133. It was envisaged that the needs of the countries in relation to training and research would be met to the maximum extent possible through the use of institutions and programmes within the region.

134. It was noted that the dissemination of information on the subject of remote sensing was not an easy task and that it had been found in Europe that this task had been facilitated to some extent by having one office nominated in each country as the national centre for collection and dissemination within the country.

VI. ADOPTION OF THE REPORT

135. The meeting adopted its report on 13 June.

LAUNCH DATE: Mid-1978
Expected lifetime: One year

ORBIT: Polar, near circular
Altitude; 800 km
Inclination: 108°
Coverage: 72° South to 72° North

SENSORS:

Active	Frequency/ Wavelength	Resolution	Swath width/ FOV	Repeat Coverage
Radar altimeter	13.9GHz	1.6-12 km	10 km	Less than 6 months
Synthetic aperture radar (SAR) imaging	21.5cm	25m	100km swath	1-14 days (direct readout)
Radar scatterometer (wind field)	13.9 or 14.595GHz	50km	Two 500km swaths	36 hours
Passive				
Visible scanner	0.5-0.9um	10km	1500km	36 hours
Infrared scanner	10.5-12.5um	5km		
Scanning multi-spectral micro-wave radiometer	4.55, 2.81, 1.67, 1.36, 0.81cm	25-125km	650km	36 hours

DESCRIPTION: Spacecraft bus attached to sensor module

Weight: 1800kg

GROUND STATIONS: Fairbanks, AK, Goldstone, CA, Rosman, NC, in US; Pouch Cove, NF, Canada; Madrid, Spain; Orroral, Australia

PURPOSE:
Ocean condition monitoring and forecasting.
Radar imaging of coastal zones;
Detecting wave height, wind speed.
Wind and wave direction.
Ocean temperature and survade topography.

EROS visual aids, 2606, 2607, 2586

Annex-2

HCMM (Heat Capacity Mapping Mission)

LAUNCH DATE : 1978

Expected lifetime: One Year

ORBIT: Circular, sun-synchronous, crossing Equater at 2:00 p.m.

Altitude: 600 km
Cycle: 1½ to 3½ days
Repeat coverage for thermal inertia measurements every 8 days

SENSOR:

	Wavelength (micro m)	Resolution (m)	Swath width (km)
Heat Capacity Mapping Radiometer (2 channels)	0.5-1.1 10.5-12.5	500 x 500 at nadir	700

No tape recorder

DESCRIPTION: Scanner-adapted Nimbus 5 Surface Composition Mapping Radiometer (SCMR)

Weight: 130 kg
Diameter: 76 cm
Height: 118 cm (solar paddles extend to 2.9 m)

PURPOSE:

Measure reflected solar energy.
Determine heat capacity of rock types.
Collect temperature data.
Monitor soil moisture, thermal effluents, plant canopy temperature, snow cover.

GROUND STATIONS: Fairbanks, AK, Goldstone, CA, Rosman, NC, in US; Pouch Cove, NF, in Canada; Madrid, Spain; and Orroral, Australia.

EROS visual aid: 2570.