ОРГАНИЗАЦИЯ
ОБЪЕДИНЕННЫХ НАЦИЙ

E

Экономический и Социальный Совет

Distr.
GENERAL

E/C.7/1996/12
29 March 1996
RUSSIAN
ORIGINAL: ENGLISH

КОМИТЕТ ПО ПРИРОДНЫМ РЕСУРСАМ
Третья сессия
6-17 мая 1996 года
Пункт 3 предварительной повестки дня*

ДЕЯТЕЛЬНОСТЬ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ В ОБЛАСТИ ВОДНЫХ РЕСУРСОВ И РЕСУРСОВ ПОЛЕЗНЫХ ИСКОПАЕМЫХ И МЕЖУЧРЕЖДЕНЧЕСКАЯ КООРДИНАЦИЯ ДЕЯТЕЛЬНОСТИ ПО ОЦЕНКЕ ПРОГРЕССА В ОБЕСПЕЧЕНИИ УСТОЙЧИВОГО РАЗВИТИЯ

Деятельность Экономической и социальной комиссии для Азии и Тихого океана в области водных ресурсов и ресурсов полезных ископаемых

Записка Генерального секретаря

В приложении ниже содержится доклад Экономической и социальной комиссии для Азии и Тихого океана (ЭСКАТО) о ее деятельности в области водных ресурсов и ресурсов полезных ископаемых и в выявлении новых и перспективных направлений использования дистанционного зондирования и получаемых с его помощью данных в водном хозяйстве и в секторе полезных ископаемых в странах Азии и Тихого океана.

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* E/C.7/1996/1.

Annex

REPORT OF THE ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC IN THE AREAS OF WATER AND MINERAL RESOURCES

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I. ACTIVITIES OF ESCAP IN THE FIELD OF WATER RESOURCES

Introduction

1. The Asian and Pacific Region, excepting the extreme north, is more densely populated and intensively calculated than elsewhere in the world, with 60 per cent of the world's population and 60 per cent of the total irrigated land. The region's share of the global water resources is about 30 per cent of the total.

2. In the last two decades there has been growing pressure on water resources with increasing demand from all sectors, in line with the population increases, agricultural expansion, industrial development, and with increasing pollution of water bodies.

3. On the other hand, the ESCAP region is widely subjected to vagaries of natural hazards, effects of which are significantly amplified due to extensive human activities at vulnerable areas. Floods are the most frequently occurring hazard in the region, with almost all of the countries experiencing frequent and severe flooding.

4. Accordingly, the work of the ESCAP secretariat in the field of water resources has been oriented towards assisting the Governments of the region in the formulation of implementation of plans and programmes for integrated water resources development and management within the context of national economic and social development plans and in the protection of water resources and aquatic ecosystems, for sustainable development. The work programme is formulated in accordance with imperatives of the Mar del Plata Action Plan, the related provisions of Agenda 21, World Conference on Natural Disaster Reduction (Plan of Action), and relevant Commission and Committee resolutions.

5. In line with the given mandates, ESCAP undertakes studies on assessment of the water resources and water uses of the member countries,

and provides assistance in formulation of activities on provision of water supplies for rural development and sustainable development, with emphasis on demand management. Activities on natural disaster reduction, particularly on flood loss prevention form an integral part of the work.

6. In implementation of its work programme in the field of water resources, ESCAP undertakes studies, organizes expert group meetings, workshops, seminars provides advisory services, prepares issue papers for the consideration of the Commission and ESCAP Committee on Environment and Sustainable Development, and maintains liaison with other United Nations and non-U.N. agencies dealing with water resources. ESCAP also publishes and disseminates quarterly bulletins of the *Water Resources Journal* and semi-annual issues of *Confluence*, as well as the widely-known *Water Resources Series* and other publications.

7. The recent activities of ESCAP undertaken in the field of water resources are summarized in the following paragraphs.

A. Integrated water resources development and management

8. An important activity undertaken recently to promote integrated water resources development and management in the region was an expert meeting on the implications of Agenda 21 for integrated water management in Asia and the Pacific held in Bangkok in September 1995.

9. The objective of the Meeting, which was jointly implemented with UNEP, was to assist the developing countries and the disadvantaged economies in transition in the Asian-Pacific region in the formulation and implementation of strategies and policies for integrated of water resources within the context of national social and economic planning efforts, which were to be consistent with the relevant provisions of Agenda 21, a programme of action for sustainable development, adopted by the United Nations Conference on Environment and Development held at Rio de Janeiro in 1992.

10. One of the activities currently under implementation by ESCAP to enhance sustainable water development and management is the establishment of water pricing policies and structures in the region. The project is being carried out in two phases: Phase I to conduct studies on the existing water pricing policies and structures in the region and Phase II to prepare appropriate water pricing policies and structures suitable to countries in the region.

11. The secretariat has prepared issue papers for consideration of the Commission and ESCAP Committee on Environment and Sustainable Development on efficient water resources management for sustainable development in the region and on flood loss mitigation through land-use planning and management. ESCAP has also provided advisory services on various aspects of integrated water resources development and management to Bangladesh, Brunei, Cambodia, China, Nepal, Philippines, Sri Lanka, Uzbekistan and Vanuatu.

B. Water resources assessment

12. The secretariat has conducted studies and published a series of monographs on the assessment of water resources and water demands by user sectors in various countries: Thailand, Japan, Myanmar (in print), China (in preparation). It has also completed a Guidebook to the Water Resources, Use and Management in Asia and the Pacific. This Guidebook is intended to provide succinct information on the water resources availability, water development structures, water use and water demand projections etc. of countries in the ESCAP region, which is expected to be useful for planners, policy makers and others concerned with water resources.

13. Workshops and training courses on water resources assessment have been organized to assist countries in their national capacity building in this field, including a workshop on computer applications in groundwater development and management organized in 1993 with the collaboration of United Nations DDSMS. Advisory services on water resources assessment were provided to Iran, Mongolia, and the Philippines.

C. Protection of water resources, water quality and aquatic ecosystems

14. ESCAP conducted a study on the current status of protection of water resources, water quality and aquatic ecosystems in the region which was endorsed at an expert group meeting in October 1994. Based on the deliberations of this expert group a publication containing guidelines on the protection of water resources as well as the experience of selected countries in this field has been prepared which will be published in the second half of 1995. The expert group made recommendations for promotion of undertaking of studies to determine the economic costs associated with water quality and quantity problems in the region, with the objective of determining the extent of freshwater crisis, and as a basis for developing a regional and a global action plan for averting a freshwater crisis in the next century.

15. In addition to the above activity, ESCAP jointly with UNESCO and Asian Institute of Technology organized a training course on assessment and reduction of groundwater contamination in 1994.

D. Drinking water supply and sanitation

16. During the 1994-1995 biennium the secretariat has implemented the training component of the World Bank/UNDP project on the rehabilitation of water utilities of Phnom Penh and Sihanoukville in Cambodia. Under this training programme a large number of national staff at various levels (from director level to technician level) have been trained in the fields of management, accounting, water resources planning and development, operation and maintenance of water utilities, water treatment and distribution etc., at various institutions abroad as well as within. Advisory services on drinking water supply were provided to Azerbaijan and Uzbekistan.

17. ESCAP is currently implementing an activity on the preparation of a guidebook on promotion of investments for water supply and sanitation projects to assist the developing countries and countries with the economies in transition in mobilizing financial resources from the private sector and financial institutions for developing infrastructure in this sector.

E. Water for sustainable urban development

18. Studies were carried out by ESCAP on the integrated approach to efficient development, management and use of urban water resources which were considered and endorsed at the regional seminar on water management in urban areas held in Bangkok in March 1993. The seminar stressed the urgent need for action at the national and international levels aimed at achieving adequate sustainable urban water supplies and the conservation and protection from pollution of water resources in urban areas. However, it was noted that although the need for properly managed urban water resources was recognized in the region, policies for sustainable development and environmentally sound management of water resources in urban areas had largely failed to materialize in many countries. A number of other workshops and seminars on urban water management were

also organized in Azerbaijan, Kazakhstan, Kyrgyzstan, Myanmar, Turkmenistan, Uzbekistan and Viet Nam between 1993 and 1995.

F. Disaster prevention and mitigation

19. During the period 1992-1995, water-related natural disaster reduction activities have been carried out by ESCAP with the aim of strengthening the disaster preparedness and mitigation capabilities of member countries through provision of technical assistance and training of key personnel in various aspects of natural hazard reduction; and for strengthening or introducing institutional frameworks for natural disaster preparedness and mitigation; promotion of regional cooperation in natural disaster reduction; and provision of substantive support to such intergovernmental institutions as the Typhoon Committee and the Panel on Tropical Cyclones. The secretariat also prepared an issue paper on natural disaster reduction for the consideration of the Commission, which accorded high priority activities in this field.

20. During the bienniums 1992-1993 and 1994-1995 ESCAP conducted seminars on comprehensive flood loss prevention and management and provided consultancy/advisory services on water-related natural disaster reduction in Nepal, Myanmar, Pakistan, Islamic Republic of Iran, Solomon Islands, Fiji, Samoa, India, Cambodia, Vanuatu and Viet Nam. The ESCAP publication *Manual and Guidelines for Comprehensive Flood Loss Prevention and Management* which was used in these seminars, have been widely distributed in the region. The Governments of China and the Republic of Korea had this publication translated into their national languages for nationwide use. A recent publication, *Natural Hazards and Natural Disaster Reduction in Asia and the Pacific*, reviewing the natural hazards affecting the region and the responses undertaken by the countries, is under reproduction. ESCAP also actively participated in the organization of the World Conference on IDNDR in 1994, and presented a review paper on natural disasters in Asia.

G. TCDC activities and other support

21. The ESCAP secretariat assisted developing countries in training their national experts in the above six areas in the water sector through its TCDC training programme. During the reporting period Cambodia, China, Iran, Kazakhstan, Kyrgyzstan, Malaysia, Myanmar, Philippines, Tajikistan, Thailand, Turkmenistan and Uzbekistan participated in the TCDC activities.

H. Coordination and liaison with other United Nations agencies

22. As regards to coordination with other United Nations agencies at the regional level, ESCAP has continued to serve as the secretariat of the Interagency Task Force on Water for Asia and the Pacific, which has recently been transformed into the RICAP (Regional Interagency Committee for Asia and the Pacific) Subcommittee on Water Resources, and hosted two sessions annually. At these sessions representatives of

agencies exchanged information and discussed how to collaborate and complement each other's work programme to enhance synergy, and eliminate duplication. As a result, most of ESCAP activities in the field of water resources were carried out in collaboration with other United Nations bodies and specialized agencies.

23. ESCAP continued to maintain its close contact and cooperation with WMO in providing substantive support to the work programmes and annual sessions of the Typhoon Committee and the Panel on Tropical Cyclones. ESCAP has continued its traditional support to the Mekong River Commission and maintained its strong relations with the IDNDR Secretariat.

24. ESCAP actively participated in the activities organized by other United Nations bodies and specialized agencies and in return received considerable support in holding of its own workshops and seminars.

II. ACTIVITIES OF ESCAP IN THE FIELD OF MINERAL RESOURCES

Introduction

25. The countries of the Asia-Pacific region has shown a great awareness for development of their mineral resources during the past decade and such activities are now recognized as a vital engine of growth for economic progress.

26. The increase in population in the region coupled with significant economic progress which will continue upto the 21st century will thus expand the supply of minerals for industry within the region.

27. Accordingly, the work of the ESCAP secretariat in the field of mineral resources has been oriented towards assisting Governments of the region in the formulation and implementation of plans and programmes for integrated mineral resources development and management within the context of national economic and social development policies that strives to achieve sustainable development.

A. Mineral resources base and its development in the region

28. Most of the countries in the region have also realized that there should be an expansion of foreign direct investment in the mineral sector as such activity entails venture capital and transfer of technology. Accordingly, the ESCAP secretariat has promoted activities in formulation of appropriate mineral development strategies conducive to foreign investment. To this end, the reorientation of national mineral policies involving legal and fiscal regimes that are attractive to the foreign investor have been vigorously pursued. The ESCAP secretariat have thus provided consultancy services for the review of mining codes and related investment regimes in Cambodia, Bhutan, Kazakhstan, Kyrgyzstan, Myanmar, Sri Lanka and Viet Nam. Such services also focussed on the process of national policy reorientation, mineral potential evaluation, formulation

of project proposals and assistance in negotiations related to mineral investment agreements. In realization of the important role the ESCAP secretariat could play in catalyzing foreign direct investment in the mineral sector, a Regional Advisor on Mineral Policy and Mineral Economics was recruited in August 1995 and continued advise in this sector is now being provided for countries requesting for such services.

B. Investment promotion in the mining sector

29. The ESCAP secretariat has also recognized the importance of promoting mineral investment at the sub-regional/regional level in response to efforts by various sub-regional groupings (growth triangles) in promoting economic growth. To achieve this objective, two mineral investment oriented projects, namely, review of mineral policies for development of the mining industry and investment promotion in selected countries of the Asia-Pacific region and training on negotiating mineral investment agreements in Asian LDC's and South Pacific island states were formulated for extra-budgetary funding from bilateral donors.

C. Environmental management of mineral resources

30. The ESCAP secretariat also focussed its activities on the assessment of geological and mineral resource potential and policy for development in Asian least developed countries and on subregional/regional assessment of important mineral commodities such as gold, base metals, industrial and non-metallic minerals and construction materials. The issues related to environmental management of mineral resources development were also pursued, and to this end, two regional studies on exploitation and use of mineral waste and confinement of waste in underground space have been carried out. The findings of these studies will be contained in a publication on mineral recovery, recycling, waste prevention and confinement for sustainable development in the Asia-Pacific region which will be released shortly.

D. Sustainable development of mineral resources

31. Sustainable development will not be achieved if key factors such as poverty alleviation and population control are not effectively addressed. To this end, sustainable mineral resource development will contribute to eradication of poverty as well as economic progress by increased exports of mineral commodities as well as downstream secondary and tertiary processing to produce finished industrial products. Accordingly, the activities related to mineral resources development by the ESCAP secretariat will catalyze sustainable development specially in the countries with reasonable endowments of minerals in the Asia Pacific region.

32. The publications of the ESCAP secretariat related to geology and mineral resources assessment as well as those containing studies on minerals trade, legal and investment regimes including environmental management continued to be in strong

demand by the world geological and mining community and such dissemination of information has also catalyzed foreign direct investment (FDI) in the mineral sector.

E. Geology in land use planning and management

33. The application of geological principles for land-use planning and environmental geology is becoming increasingly important in the Asia-Pacific region mainly due to rapidly expanding urban centres as well as increased mining activity centered around human habitations. To this end, the ESCAP secretariat is actively involved in compilation and issuance of a series of urban and environmental geology maps. Two regional expert group meetings and training activities through the implementation of a project on Environmental and Urban Geology for Sustainable Development of Fast-growing Cities were also carried out. In this regard it must be stated that the activities of the ESCAP secretariat have been highly successful in creating an awareness among urban planners as well as decision makers in the member countries on the importance of geoscientific knowledge in the urban planning process. Geohazards of both natural and man-made have also been given considerable importance in all development activities within the region and the assessment of such hazards is also within the work programme.

F. Marine affairs and marine minerals

34. The importance of marine affairs in the national planning process of the countries in the region has increased during the last two years and could be related to the entry into force of the 1982 United Nations Convention on the Law of the Sea on 16 November 1994. Moreover, Chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) held in Reo de Janeiro in 1992 has stressed the importance of the protection and sustainable development of the marine and coastal environment and its resources. Accordingly, the ESCAP secretariat has been actively involved in the study of integrated coastal zone management and practices in the Asia Pacific region and assessment of mineral and petroleum potential in the coastal and offshore areas of North-East Asia and these studies will be published shortly.

35. The ESCAP secretariat also actively pursued training activities related to legal, technical and financial aspects for removal of obsolete offshore installations and platforms on the Exclusive Economic Zone and the Continental Shelf of the Asia-Pacific region with the conduction of the third seminar in September 1995 and such activity will be pursued during 1996 where it is expected to hold a final forth seminar with extrabudgetary financial resources.

36. Ongoing and future activities related to marine affairs by the ESCAP secretariat will focus on providing necessary guidance to member states in the integration of their marine related policies with the United Nations Convention on the Law of the Sea and thus harmonizing with such international practices so as to achieve universalization.

37. The above activities have contributed to the improvement of capabilities of key mineral and marine sector institutions in assessment of the mineral potential including

offshore minerals, integrated land use planning including coastal zones, realization of the rights and obligations under universal laws and conventions such as the 1982 United Nations Convention on the Law of the Sea. Such efforts have also catalyzed the commitment of member countries in implementation of related Chapters of Agenda 21 of UNCED in order to achieve sustainable development.

G. Coordination and liaison with other United Nations agencies

38. The coordination and liaison activities with other United Nations agencies, international regional and intergovernmental organizations as well as multilateral development banks in the field of mineral resources development have been actively pursued. In this regard, the ESCAP secretariat will strive to further strengthen and promote joint mineral sector development, environmental and urban geology activities as well as those related to marine affairs with UNDP, ADB, CCOP, SOPAC, IOMAC, UNDDSMS, UNCTAD, UN/OLA-DOALS though joint execution of national UNDP projects, joint regional programming exercises, attendance at annual meetings and training sessions, presentation of keynote papers at interregional seminars, assistance in formulation of work plans, programmes and regional projects as well as regular consultations on the development of mineral resources in selected ESCAP countries.

III. NEW AND FUTURE USES TO WHICH REMOTE SENSING TECHNOLOGY AND DATA SETS CAN BE APPLIED IN THE MINERAL AND WATER RESOURCES IN THE ESCAP REGION

A. Current activities of ESCAP in the field of space technology applications (Remote Sensing/GIS) to natural resources (water/minerals) management

(a) Applications of remote sensing/GIS to natural resources (water/minerals) management

39. Coastal zone monitoring, marine ecosystem management, landuse and landcover change detection, river course monitoring, surface and groundwater resources identification, tropical cyclone studies and monsoon monitoring research were a few areas of space technology applications including remote sensing and GIS in the field of water and mineral resources for which project profiles were prepared by an Expert Group Meeting on Space Technology Applications for Sustainable Development in Asia and the Pacific that was held in Bangkok from 30 January to 3 February 1995. This was a follow-up effort for the implementation of the recommendations of the Ministerial Conference on Space Applications for Development held in Beijing in September 1994. The Ministerial Conference, through the Beijing Declaration on Space Technology Applications for Environmentally Sound and Sustainable Development launched the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP). The project profiles thus developed will be considered for implementation by ESCAP under RESAP.

40. The portfolio of project profiles thus prepared was circulated to the participating member countries at the annual session of the Intergovernmental Consultative Committee (ICC) on the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP) that was held in Dhaka, Bangladesh from 10 to 16 June 1995. In the Dhaka Meeting, a number of countries indicated their interests in participating in some of the activities proposed in the project profiles. A number of donor countries also expressed their interests in assisting in the implementation of these projects. A tentative workplan that was examined and approved at the Dhaka session of ICC included activities related to landuse planning (soil and minerals), tropical ecosystem management (natural resources management), integrated applications of remote sensing and GIS in land and water (water resource), marine and coastal resources (water, minerals and natural resources) etc.

41. In landuse planning, ESCAP organized a training course on the integrated use of GIS and remote sensing. The training was conducted by the Faculty of Geography of the Gadjah Mada University, Yogyakarta, Indonesia from 22 August to 21 October 1994. Fifteen participants from 10 member countries attended the training course. The training included basic courses in the integration of remote sensing with GIS for landuse planning as well as practical exercises and case studies using RS/GIS software available in the countries of the participants so that they would be able to start using their own equipment upon their return. The trainees, upon their return, have contributed to strengthening the organizations they belong to in their use of remote sensing/GIS for landuse planning activities. This was a TCDC training course for which the Government of Indonesia provided the fellowships and all other training expenses from its TCDC fund and matching travel expenses for trainees from the above-mentioned developing ESCAP member countries were arranged from the ESCAP/UNDP GIS/RSRP project.

42. In the Pacific, a water and land-related activity was organized at Suva, Fiji from 13 to 17 February 1995. This was a Workshop on Remote Sensing/GIS for a Land and Marine Resources and Environment Management in the Pacific. It was jointly organized by the Fiji Ministry of Lands, Mineral Resources and Energy and ESCAP and was attended by 72 participants and observers from 29 countries and organizations. The Workshop had two main objectives: the first one was to expose senior officials from South Pacific Island countries from departments utilizing remote sensing and/or GIS for land and marine resources and environment management to the new technology developments through exchange of information on the status of development and a series of lectures on the latest GIS and remote sensing applications. The second objective was to formulate a subregional action plan in remote sensing and GIS applications for development as a follow-up to the Ministerial Conference on Space Applications for Development in Asia and the Pacific held in September 1994.

43. Tropical ecosystem management covers the fields of water resources management in the tropics, as well as mineral and other natural resources management activities. Remote sensing and GIS is now being widely used in ecosystem management. The ESCAP secretariat has undertaken two activities on remote sensing and GIS applications in this field. Both these activities were funded by the National Space Development Agency (NASDA) of Japan. The activities were organized with technical support from the Remote Sensing Technology Centre (RESTEC) of Japan. The 1994 activity was held

in Bali, Indonesia from 23 to 28 August 1994 with the Indonesian Space Agency LAPAN providing host facilities. A similar seminar-cum-training activity was organized from 4 to 9 September 1995 at Subic, Philippines with the Government of the Philippines, through its National Committee on Remote Sensing, providing host facilities.

44. Both these activities targeted two groups of people involved in ecosystem management (policy level and technical level). Policy-level professionals were exposed to the integrated use of GIS and RS for the sustainable development of tropical ecosystems through the various lectures and presentations. The technical-level experts were provided hands-on training on applications of GIS/RS to ecosystem management. The proceedings of the seminar including all technical presentations and discussions as well s a report on the training and training material, will serve as a reference manual for continuing efforts in remote sensing and GIS applications for tropical ecosystem management in the ESCAP region. The seminar at Bali was attended by 65 participants from 21 countries and organizations and the training component was attended by 18 junior-level participants from 11 countries. The seminar at Subic was attended by 61 participants from 19 countries and organizations and the training activity by 15 participants from 12 countries.

(b) Coordination and liaison with other United Nations agencies

45. Among the many mandates of the Regional Space Applications Programme for Development, harmonization of the activities of the United Nations and those of non-governmental organizations in this new field of space technology applications for sustainable development is an important one. Towards the fulfilment of this mandate, ESCAP continued its association with the Asian Association of Remote Sensing (AARS), which is the largest and oldest non-governmental association of remote sensing scientists and specialists in Asia. The 1994 Asian Conference on Remote Sensing (ACRS), which was the fifteenth in the series, was held in Bangalore, India from 17 to 23 November. ACRS was jointly organized by AARS and the Department of Space, Government of India. ACRS is a unique example of government/non-government cooperation for technology transfer and information exchange. As part of ESCAP's commitment to such cooperative efforts for regional development in this new field of technology, a Regional Seminar on Integrated Applications of Remote Sensing and GIS for Land and Water Resources Management was organized as a parallel activity to ACRS at Bangalore from 16 to 19 November 1994. The seminar was participated in by 75 remote sensing and GIS specialists who enjoyed the opportunity to interact with over 300 international scientists and specialists who attended the 15th Asian Conference on Remote Sensing. The participants in the seminar were also able to attend a number of technical sessions and view the posters associated with the 15th Asian Conference on Remote Sensing. Themes of the technical and poster sessions of ACRS covered applications of remote sensing and GIS in water, mineral and natural resources.

46. ESCAP organized the first meeting of the reconstituted Intergovernmental Consultative Committee at Dhaka in June 1995. The 1995 session of ICC approved the terms of reference of ICC on RESAP which will operate under the purview of the Committee on Environment and Sustainable Development to advise as appropriate, on the implementation of RESAP. The 1995 ICC session was attended by a number of UN

agencies including UNDP, UNEP, UNESCO, UNCRD and other intergovernmental organizations including MRCS (the Mekong River Commission Secretariat).

47. The Regional Strategy identifies the need of an inter-agency forum to ensure cooperation and coordination among the UN system and donor agencies in the implementation of the recommendations of the Ministerial Conference. In pursuance of the recommendation, the ESCAP secretariat took an initiative to establish an Inter-agency Subcommittee on Space Applications for Sustainable Development in Asia and the Pacific and the first session of the Subcommittee was organized from 30 to 31 October 1995 at Bangkok. Representatives from APT, ESA, ESCAP, FAO, ITU, UNEP, UNDP, WMO, and observers from Australia, China, France, Japan, Republic of Korea, Netherlands and USA also attended the meeting. The meeting reviewed activities in relation with the implementation of the Ministerial Conference's recommendations, finalized a Terms of Reference for the Sub-committee and also discussed regional cooperation projects as well as explored ways and means for regional cooperation and collaboration in space applications for development in Asia and the Pacific.

48. In addition, staff from the ESCAP secretariat also participated in meetings organized by other agencies such as the Expert Group Meeting of the Establishment of a Permanent Committee on Geographic Information Infrastructure organized by United Nations Department of Development Support and Management Services held in Kuala Lumpur, Malaysia last July. The ESCAP secretariat was also invited as a high-level steering committee member to attend the Commencement Workshop on the Greater Mekong Subregion Cooperative Environment and Information System Programme, organized by ADB of Manila on 3-4 October 1995 in cooperation with UNEP and the Mekong River Commission.

B. New and emerging uses of remote sensing/GIS in natural resources management

Introduction

49. Remote sensing and geographic information system as well as other related spatial information technology such as satellite-based positioning systems have together become an essential tool for sustainable development planning. These new and emerging technology applications have, as a matter of fact, become an integral part of sustainable natural resources development and management programme in Asia and the Pacific.

50. After more than two decades of satellite remote sensing development, remote sensing technology has now become operational and indispensable for providing information regarding natural resources and environment for decision making. Large, complex and often bewildering remote sensing data sets are now available, offering spatial resolutions varying from 10m to 1,000 meters in various spectral bands. These data sets can be obtained by natural resource managers and planners at costs ranging from a few dollars per sq km in digital form of raw data to a few hundred dollars per sq km in the form of value-added information.

51. In recent years, the commercialization of remote sensing and involvement of private industries have further accelerated remote sensing development that have been initiated and mostly supported as governmental programmes. In the ESCAP region alone, there are 30 national remote sensing programmes/centres, 11 earth observation satellite ground receiving stations and 3 comprehensive national remote sensing satellite programmes, as well as mushroom development of the spatial information industry. It is encouraging to note that, in the next decades, there will be at least 25 land data satellites to be launched by governments or private industries, most of which are new generation satellite technologies.

(a) Major technological developments

52. Advanced space technology will in the near future contribute significantly to the new and emerging use of remote sensing and GIS technologies for natural resources management and environment monitoring. Three major technological developments are envisaged, namely: (1) high spatial resolution, (2) hyperspectral imaging and (3) imaging radar technology. Most of earth observation satellites planned for the next decade will provide data with a spatial resolution of 1-3 meters, an improvement of one order of magnitude as compared to that are available in current satellite systems. A new generation of remote sensors will overcome one of the most significant limitations of remote sensing technology — the ability to separate colours mostly wanted in the mining industry, by providing hyperspectral imaging data. In addition to 1-3 meters spatial resolution, the users may have a choice of data from few spectral bands up to 250 bands, according to the state-of-the-art technologies. Hence, geologists are extremely interested in space and airborne hyperspectral imaging sensors that have the ability to sense wavelengths beyond the long end of the visible spectrum and to make distinctions between different colours in order to identify subtle changes in rock composition. Radar technology, thanks to its cloud-penetration, whole-weather capability, has become a significant tool for acquiring information over tropical regions. Radar application potentiality in geological studies and watershed management has already been demonstrated from experimental uses of data from JERS-1, ERS-1, Seasat, Sir-A/B and the simulation of Radarsat that was recently launched.

53. Geographic information systems technology, developed independently but in parallel with remote sensing, is an enabling technology that has become another important tool for development planning. Benefitting from rapid development of computer technology and computer software engineering, the integration of remote sensing and GIS has become a reality, that will soon lead to the true operationalization of spatial information infrastructure for natural resources management and environmental monitoring in the next decade.

54. Within the next decade, as the new and emerging uses of remote sensing and GIS technologies continues to develop, information about natural resources will be increasingly integrated and access to it will continue to spread eventually reaching all levels of natural resources organizations. Organizations dealing with transboundary issues such as watershed management and forest management will be able to access global databases containing multiple data sets required for analysis and decision making. Databases built

up and commonly used by individual sectors will continue to grow larger and will be readily accessible through networks of varying spatial extents. Practical and useful applications of expert systems in connection with models built up as decision support tools to assist in the decision making and planning process, integrated with remote sensing and GIS databases, will become operational for natural resources management.

(b) Geological mapping and mineral resource assessment

55. In the field of geological mapping, remote sensing data will be used with other data layers provided through GIS databases for deriving various information. High spatial and spectral resolution data permits detailed lithologic and stratigraphic discrimination based on subtle changes in mineralogy. Thermal infrared data provide information notably for silicate and carbonate minerals and expand the capability for delineating lithologic units. Radar imagery shows variations in fold geometry that are controlled by faults in the basement rocks. Imaging spectrometers allow for detailed lithologic identification based on mineral content. For example, the distribution of the individual iron oxide and hydroxide minerals is useful for geological mapping in general and for hydrothermal alteration zonation mapping in particular. Computer image processing technology will be further developed as a major tool in geological mapping.

56. Mapping mineral resources, fossil fuels and geothermal resources is considered one of the major tasks in mineral resources management and development planning. Remote sensing data have been used in the mapping of anomalous limonite concentrations for finding hydrothermally altered rocks, identifying clays and other OH-bearing minerals, and interpreting linear structures to help characterize structure setting. Multispectral and thermal remote sensing data as well as radar images have been used together to interpret geological structure important in the accumulation of petroleum deposits, sedimentary facies affecting petroleum accumulation and possible carbonate accumulations. Future capabilities of remote sensing in mineral resources studies will involve multi-source data analysis and processing through GIS with built-in expert system in the context of mineralizing systems.

(c) Water resources assessment and management

57. In the field of water resources management and development, the unique role of geographic information systems and remote sensing technology has been increasingly recognized as evidenced by the wide use made of them. GIS, for example, allows water resources managers and specialists to store, manipulate and process hundreds of megabytes of point source data collected for watershed management and development planning. Data sources of various scales and spatial contents such as topography, soil, landuse, water resources, water quality and associated non-spatial social and economic data, can be acquired into a GIS for overlaying, modelling, manipulating and analysing to come up with various scenarios of resource utilization, preservation and development. This process involves both the time and spatial domains and would normally be difficult or even impossible to perform using traditional methodologies.

58. As spatial resolution improves to 1-3 meters and imaging radar systems become operational in the next decade, water resource assessment and management will be much improved by using the new generation satellite data. Visible and near infrared techniques will continue to be used to provide direct observation of water bodies at high spatial resolutions, including the extent of snow and ice, ice concentration and turbidity. Data beyond the visible band will be used to interpret surface features associated with surface water such as surficial geologic and geomorphologic features, vegetation and indicators of evapotranspiration. Hyperspectral thermal-infrared scanning can be used to examine ground-water discharge and diffuse shoreline seepage. Imaging radar technology will be used for real-time monitoring and other water-related disasters, particularly under the condition of heavy rains or continuous cloud covers.

59. Remote sensing and GIS technology will continue to develop rapidly and the new and emerging use of the technology to be limited only by human imagination. In order to benefit from such technology applications for sustainable development and management of natural resources, it has become of paramount importance that adequate national capacity be built up in developing nations, through technical assistance and international cooperation, as well as developing indigenous capability through enhanced education and training programmes. The United Nations, through its various organs such as ESCAP, has been assisting its members and associate members in the past two decades or more in developing remote sensing and GIS capability and will continue to provide a catalytic role in national and regional capacity building in the use of new and emerging remote sensing and GIS technologies for sustainable natural resources and environment management.
