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Implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)

Implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III): final report of the Action Team for the Development of a Comprehensive Worldwide Environmental Monitoring Strategy

Note by the Secretariat**

I. Introduction, background and justification

1. At its forty-fourth session, in 2001,[1] the Committee on the Peaceful Uses of Outer Space established action teams to implement recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).[2] The first action team was established to implement the recommendation that action be taken to develop a comprehensive worldwide strategy for environmental monitoring, which is part of the nucleus of the strategy contained in "The Space Millennium: Vienna Declaration on Space and Human Development",[3] adopted by UNISPACE III to address global challenges.

2. The first meeting of the Action Team for the Development of a Comprehensive Worldwide Environmental Monitoring Strategy was held on 1 March 2002, during

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the thirty-ninth session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space. The report of the Action Team and relevant documents were submitted to the Subcommittee.

3. At its first meeting, the Action Team examined the development of a comprehensive strategy for environmental monitoring at the national, regional and global levels, taking into account the specifics of each of the levels that were connected with each other. Whether at the national, regional or global level, environmental monitoring requires data to be collected through continuous or occasional observations. The necessary data can be provided by ground, aerial or space-based observations.

4. At present, space-based observations are an effective and reliable tool for environmental monitoring. Although their potential uses are being discovered daily, there are still many unexplored applications still to be found. Space-based monitoring requires the use of space platforms with appropriate sensors on board.

5. Managing data and setting up databases with acquired monitoring data constitute the next component of the environmental monitoring system. The availability of data for planners, decision makers, specialists and scientists on issues related to environmental monitoring is also essential.

6. Based on the recommendations of UNISPACE III, the Action Team aims to launch a worldwide strategy for environmental monitoring that would: (a) ensure the sustainable use of ecosystems; and (b) promote national, regional and global cooperation on critical environmental issues. To achieve that aim it is necessary: (a) to know what to monitor (dynamics of environmental phenomena); (b) to assess and adopt monitoring techniques; (c) to set up a convenient monitoring system or systems; (d) to establish guidelines; (e) to build capacity; (f) to enhance partnerships among relevant national, regional and international institutions; and (g) to involve non-governmental organizations and the public. It is essential to join existing efforts in order to promote greater technical cooperation, to enhance knowledge and experience exchange among countries, to develop policies to achieve sustainable environmental development and to build upon current development and national environmental action plans and rural development strategies.

II. Inventory of existing strategies at the regional and international levels

A. The background to global environmental monitoring

7. The Action Team noted the following historical milestones and background in the development of a global environmental monitoring strategy:

(a) The early 1960s:

(i) National strategies for global monitoring;

(ii) Broad international cooperation on meteorology and weather forecasting;

(b) The United Nations Conference on the Human Environment, held in Stockholm in 1972:

(i) International definition of monitoring;

(ii) Establishment of the United Nations Environment Programme (UNEP);

(c) The United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, in 1992:

(i) Agenda 21;[4]

(ii) Establishment of the Commission on Sustainable Development;

(d) UNISPACE III, held in Vienna in 1999:

Recommendations contained in the Vienna Declaration and other recommendations;

(e) The Millennium Summit of the United Nations, held in New York in 2000;

(f) the World Summit on Sustainable Development, held in Johannesburg, South Africa, in 2002.

B. Existing strategies

8. An indicative list of existing strategies on environmental monitoring identified by the Action Team is provided below:

(a) Global strategies of international entities:

(i) Organizations of the United Nations system such as UNEP, the International Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO/IOC), the Food and Agriculture Organization of the United Nations (FAO) and the World Meteorological Organization (WMO):

a. United Nations System-wide Earth-Watch;

b. Environmental Observing and Assessment Strategy (UNEP);

c. Information, Monitoring and Assessment Strategy (FAO);

d. Global Climate Observing System (GCOS), Global Terrestrial Observing System (GTOS) and Global Ocean Observing System (GOOS);

(ii) International process on sustainable development;

(iii) Integrated Global Observing Strategy (IGOS) Partnership (Committee on Earth Observation Satellites (CEOS));

(iv) Global Monitoring for Environment and Security (GMES). (European Space Agency and the European Commission);

(b) Global monitoring efforts at the national level pursued by:

(i) China, India and Japan;

(ii) The Russian Federation:

a. Russian Aviation and Space Agency (Rosaviakosmos);

b. Russian Federal Service for Hydrometeorology and Environment Monitoring (Roshydromet);

(iii) The United States of America:

a. Mission to Planet Earth of the National Aeronautics and Space Administration (NASA);

b. National Oceanic and Atmospheric Administration (NOAA);

(iv) Other regional, local or thematic programmes.

9. A brief review of existing strategies at the international and regional levels will be provided in a full report of the Action Team.

C. Conclusions

10. The full inventory of existing strategies should include:

(a) A comparative analysis, to identify common features, divergences, gaps and best practices identified in the various strategies;

(b) Definition of the key elements for purposes of policy formulation: the elements to be defined include “global”, “comprehensive”, “integrated”, and “supporting sustainable development”;

(c) Development of a strategy model, including recommendations, a review of compiled information and a preliminary implementation plan.

11. To achieve the objectives of an environmental monitoring strategy and to develop an implementation plan, needs and requirements should already be defined, taking into account the following: (a) the dynamics of the rapidly changing environmental, socio-economic and information landscape; (b) scientific and technical development; (c) shortcomings in data and information; (d) gaps in technology and instruments; and (e) increasing the number of cross-cutting issues and linkages.

12. There should also be a variety of sources and mechanisms for collaboration that provide broad experience in planning and implementation, a wide range of strategies and operational process and different approaches and multi-level studies.

III. Applications of space technology for environmental monitoring with the combined use of other ancillary techniques

A. Integration of the ground segment and ground truth

13. Data are produced by ground- and space-based monitoring networks and statistical surveys carried out by national, regional and international organizations. The use of satellite data for environmental reporting has increased, but its full

potential remains untapped. The commonly held view that space observations would make ground-based measurements redundant is seldom justified. While space observations may reduce the need for conventional in situ measurements, they do not eliminate the need for direct reporting and ground truthing.

14. The emphasis has already shifted from problems associated with obtaining or gaining information to those associated with effective use of the information and providing users with information in a user-friendly form. For various environmental systems, satellite systems of online monitoring of the Earth are the main source for developing a monitoring information base. A broad range of information obtained from various satellites in the form of images of the Earth in different spectral ranges and spatial resolutions is accumulated in many countries. The Russian Federation, in particular, has formed an enormous archive of low-, medium- and high-resolution data as well as databases of topographic and geodetic information. Nevertheless, it is predicted that, by the year 2010, meeting the requirements of different regions of the world for new maps will become the main problem for global mapping. Mapping of large territories has been carried out for many years and cartographic materials have been in need of updating for a long time. This need will increase.

15. Moreover, because of the increasing need for data of the Earth for sustainable development of the environment and available natural resources, greater attention should be paid to monitoring indicators of sustainability, including: (a) vegetation degradation (as in clearing for agriculture); (b) forest disturbance; (c) biodiversity; (d) changes in land cover; (e) estimation of agricultural crops; (f) the condition and erosion of the soil; (g) quality of inland waters and the condition of coastal wetlands; (h) the potential for landslides; drought stress on natural resources; (j) local, regional and global changes in surface temperature; and (k) disaster management. These indicators have three important features: (a) remote sensing can provide reliable measurements on a regular basis; (b) measurements can be reproduced without bias; and (c) the indicators truly reflect the characteristics of the changing environment.

B. Data quality and availability[5]

16. Lack of relevant data is a common experience. In the environmental domain, there are still serious data gaps related to, for example, pesticide application, the state of fish stocks, forest quality, groundwater and biological diversity. The quality of the existing data is of equal concern and the causes of data gaps and poor data quality are complex and diverse.

17. There are inherent challenges in working with data sets on a global scale. From the perspective of global Earth observation (GEO) as a high-level global assessment, linkages of data across scales are particularly important. Considering that, in general, only data with the same resolution, standards and date of measurement can be reliably aggregated to a regional or global level, even small discrepancies or gaps can make data sets incomplete or deficient. At the same time, even with good-quality data, aggregation and averaging may mask important spatial or temporal detail. In large-scale aggregations, features unique to smaller regions disappear. Therefore, the scale of aggregation and reporting of averages should be

carefully matched with the scale of environmental phenomena or policies and the purpose of assessment.

18. Most of the available data apply to quantitative attributes of the environment. While measuring qualitative variables is usually more difficult, it is often through qualitative change that major trends can be detected. Monitoring the quality of the ecosystem, for example, for forests or fisheries, needs to be improved.

19. Some new global or regional compendiums of environment-related data have considerably improved the global stock of data resources. Notable examples are the Dobris data compilations in Europe and the World Bank's *World Development Indicators*. In addition, a small but steadily growing number of countries have set up systematic compilations of environmental data, in part following the guidelines of the Statistics Division of the Secretariat. This is resulting in national environmental reports being issued by more countries and in the gradual improvement and harmonization of reporting to the Commission on Sustainable Development and within the framework of multilateral environmental agreements. The relatively widespread testing of the Commission’s indicator methodology by countries may well lead to demand for developing more concrete input data.

20. As regards needs for geo-referenced data in environmental assessment, there is a gradual recognition of the need to use geo-referenced data in environmental assessment and the need to have some information broken down by spatial units other than administrative units. Some important global geo-referenced data sets, such as population and landcover, have been produced in the past few years. However, this should be considered only as the beginning. Few, if any, of the new data sets seem to be routinely updated.

21. As for data access, data may be inaccessible because of copyright issues, high cost or professional or organizational competition. Although some parameters are accurately and routinely measured, the information may be classified or publicly unavailable. Difficulty of access to data on shared aquifers and surface water is an example that is seen in many parts of the world.

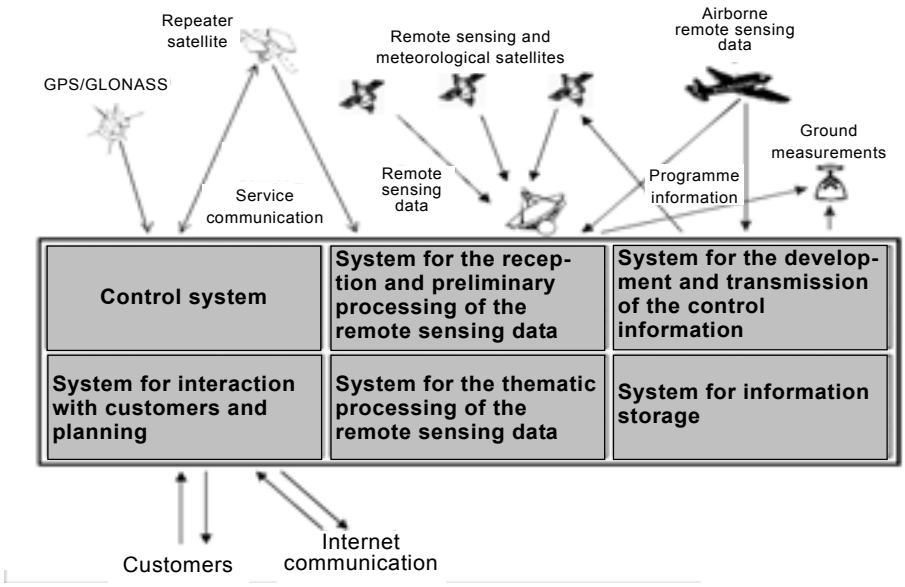
22. However, public and institutional attitudes towards access to data have changed noticeably during the past decade. With the widespread access to the Internet, the decrease in both cost and difficulty of mass data processing and the fact that there is no longer a need for cold war-style security measures, the public has become more demanding and institutions more proactive and open. This is true for a wide range of issues involving many organizations. The most symbolic event that serves as an example is the partial declassification of military satellite imagery.

23. The opening up of data holdings and data exchange leads to two potential problems for their use in broad assessments such as the *Global Environment Outlook* reports by UNEP. Firstly, access to essential data, which is currently taken for granted, may become more commercialized and therefore more difficult for multilateral organizations and other users who are conducting environment assessment. In particular, this applies to satellite data and to large integrated databases. Secondly, as data become more widely distributed and recycled, critical validation will become even more important than it is at present, making sound scientific links essential for assessments of the UNEP type.

C. Centre for obtaining, receiving and processing information

24. It is possible to avoid deficiency of information by establishing regional Earth monitoring centres utilizing modern technologies for receiving and processing satellite, aerial and in situ data. These technologies should allow for automated machine interpretation of the results of imaging, synthesis of thematic maps for complex analysis of territories, development of local or regional geographical information systems (GIS), generation of information from data and support to decision and policy-making processes. Prospective information technologies for monitoring are related to the development of such dedicated regional information systems for specific purposes. Based on those systems, it would be possible to maintain effective land and water cadastral surveys to manage resources and to carry out, for example, ecological tasks, regional land use tasks and thematic mapping tasks. A possible structure for a proposed regional centre for monitoring of the Earth is shown in the figure. A more detailed description of the geo-information centre will be presented in the full report of the Action Team.

Figure
Geo-information centre



25. The closer integration of remote sensing and GIS is increasingly becoming the dominant tendency in modern development. As a final result, it is quite possible to obtain a merger of remote sensing and GIS into a joint processing and information distribution system. In such a case, the capacity of such a joint system will be larger than the sum of the capacities of the individual systems involved. The companies working in the fields of remote sensing and GIS are becoming more and more information companies.

26. The geo-information centre presented in the figure would allow for production and maintenance of an economically and technically efficient dynamic GIS, making

it possible to conduct regular analyses of observations of the ground, adding data to a remote sensing database and updating the information system at all levels.

D. Next steps for the development of the ground segment

27. To improve data availability for environmental assessment, the *Global Environment Outlook 2000* recommends the following for immediate action:

(a) Complete analysis of information, focusing on priority environmental issues and including underlying causes as well as the impact on humans and on nature;

(b) Development of a set of objective data sets on driving forces behind environmental monitoring and pressures on the environment at the regional level, building upon work conducted by the Global Resource Information Database (GRID), the National Institute of Public Health and the Environment (RIVM) of the Netherlands and the World Resource Institute among others;

(c) Further strengthening of coordination with monitoring programmes, taking into account needs from the perspective of integrated assessment of environment and sustainability issues;

(d) Improvement in access to indicators and underlying data for collaborating centres through a dedicated Intranet platform based on the *Global Environment Outlook 2000*, the public Internet and CD-ROM;

(e) Strengthening the participatory approach and the status of data through capacity-building at regional centres for integrated environmental assessment and data validation and feedback;

(f) More stress should be placed on institutional and political aspects of observation and to the translation of data into information: a better understanding would lay the foundations for long-term improvement of the data situation.

1. From data to information: modelling and prediction

28. The results of regional efforts should be used to refine global narratives and to undertake the subsequent quantitative analyses associated with scenario narratives. Further refinement of both narratives and quantitative analyses can be achieved through an iterative process involving the core scenario team and the modelling groups.

2. Need for quantitative analytical tools

29. A few important examples from *Global Environment Outlook 3* will be provided in the full report of the Action Team.

E. Conclusion

30. The main trend in development is the integration of technology, involving the following:

(a) Acquisition of data, including from satellites and airborne remote sensing, and in situ data;

(b) The Global Positioning System (GPS) and the Global Navigation Satellite System (GLONASS);

(c) Data processing, including software and hardware;

(d) Integration of data into GIS and other information systems;

(e) Cost effectiveness and the prices of technology and services;

(f) User education and training.

31. The geo-information centre proposed above would provide a comprehensive and economically effective structure for the organization of work in receiving, processing and distributing data for environmental monitoring purposes. It would bring together modern infrastructure for receiving, processing and distributing data and deriving information. The geo-information centre would include satellite, aerial and ground-based technology for data collection and processing, GPS/GLONASS equipment, communication equipment, hardware and software for data processing and integration into GIS and other information systems. Moreover, the development of technology and the market indicates that the use of remote sensing technologies is most effective in the case of combined use of different kinds of information, database and information-processing technology.

32. The use of the geo-information centre would provide opportunities for filling the knowledge gaps in the following areas: (a) transformation of environmental data into information; (b) policy implementation; and (c) funding and finance.

33. It would also present opportunities for taking an integrated and comprehensive approach to mainstream thinking, integrated management, international coordination and technology development. This approach would provide: (a) comprehensive quantitative tools; (b) scientific and institutional technical and mathematic models; and (c) decision-support tools as the linkage between scientists or technicians and policy makers.

IV. Examples of space applications in land, water and air environments

34. The unique ability of remote sensing satellites to provide comprehensive, synoptic and multi-temporal coverage of large areas at regular intervals is an example of a space technology application for environmental monitoring. Remote sensing satellites have been and will remain an indispensable tool for continuous monitoring of dust storms, desertification, forest fires, floods, oil spills, volcanic eruptions and depletion of the ozone.

A. Air pollution and dust storms

35. Dust and smoke, or aerosols, are tiny particles caught in the air. Some occur naturally, originating from volcanoes, dust storms, forest and grassland fires, live vegetation and sea spray. Human activities, such as burning of fossil fuels and

alternation of natural surface cover, also generate aerosols. Many human-produced aerosols are small enough to be inhaled, posing a serious health hazard around industrial centres and even over hundreds of miles downwind. Thick dust or smoke plumes severely limit visibility and can make it hazardous to travel by air or road. Recent research indicates that aerosol pollution can modify cloud properties and thus reduce or prevent precipitation in the polluted region, while aerosols containing black carbon can have an impact on climate and inhibit formation of clouds.

B. Desertification monitoring

36. The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa,[6] indicates that desertification is land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Monitoring of desertification includes activities that are part of the integrated assessment and restoration of the degraded land and are aimed at: (a) assessment of current states of desertification; (b) analysis of land degradation process; (c) selection of basic indicators of desertification; (d) mapping of degraded land and other related natural resources; (e) evaluation of the impact of land use change and implemented rehabilitation measures; and (f) monitoring of desertification using space technology. Some examples of monitoring of desertification as well as the recommended methodology to monitor desertification processes using remote sensing techniques will be provided in the full report of the Action Team.

C. Forest fires

37. Detection of forest fires is made possible either by sensing the thermal or mid-infrared spectral signature of the forests during the day and the night or by detecting the light emitted by them at night. Wildfire is a natural part of the Earth's environment, caused in most cases by lightning strikes and occasionally by volcanic eruptions. Wildfires affect a million or more square kilometres (sq km) per year. People also start many fires, sometimes accidentally, but in most cases deliberately. Fire is used in agriculture to clear croplands and help return nutrients to the soil. Prescribed fires clear away dead and dying vegetation to help rejuvenate forests and reduce the risk of large, uncontrolled wildfires. Fire is also a tool people use to help clear forests for human usage. Annually, people burn between 750,000 sq km and 8.2 million sq km of forests and grasslands around the world.

D. Floods

38. Floods have been an integral part of human history ever since the start of the agricultural revolution following the first permanent settlements on the banks of the great rivers of Africa and Asia. Seasonal floods deliver valuable topsoil and nutrients to farmlands and bring life to otherwise infertile regions of the world such as the valley of the Nile. On the other hand, flash floods are responsible for more deaths than tornadoes or hurricanes. Floods are also responsible for billions of dollars in property damage every year.

E. Oil spills

39. Oil spills are caused either by break-up of tankers at sea or by illegal discharge from and clean-up of tankers. Discharge of oil is the more important of the two causes of oil spillage. Many countries have signed agreements such as the International Convention for the Prevention of Pollution from Ships and the United Nations Convention on the Law of the Sea[7] and other regional agreements that forbid dumping of waste materials in the marine environment. Earth observation data are used operationally to monitor oil spills and to enforce compliance with the agreements by using radar and thermal data provided by Radarsat, the European Space Agency (ESA) Remote Sensing Satellite (ERS-2), Satellite pour l'observation de la Terre (SPOT-5) and the Land Remote Sensing Satellite (LANDSAT)-Thematic Mapper.

F. Volcanic eruptions

40. Volcanic eruptions can be both awesome and deadly, presenting a major hazard to those who live near them for a variety of reasons. Pyroclastic eruptions can smother large areas of land with hot ash, dust and smoke within a span of minutes to hours. Red-hot rocks spewed from the mouth of a volcano can ignite fires in nearby forests and towns, while rivers of molten lava can destroy almost anything in their path as they reshape the landscape. Heavy rains or a rapidly melting snow pack at the summit can trigger lahars—masses of mud that can flow for miles, burying roads and villages. Large plumes of ash and gas ejected high into the atmosphere can influence climate, sometimes on a global scale.

G. Ozone depletion

41. The atmosphere thins as it rises above the curve of the Earth's surface. The layer of atmosphere between 10 and 50 km high, called the "limb", provides a side view of the structure of the atmosphere. Orbiting scientific instruments look at the limb to measure how the concentrations of trace gases vary with altitude and to monitor holes in the ozone. The Total Ozone Mapping Spectrometer (TOMS) instrument aboard Nimbus-7, the Global Ozone Monitoring Experiment (GOME) aboard ERS-2 and the Shuttle Ozone Limb Sounding Experiment–2 (SOLSE-2) on the Space Shuttle Columbia were used to detect such holes.

V. Guidelines for a comprehensive worldwide strategy: a model based on education, training and capacity-building

42. As a result of rapid population growth and climatic changes, environmental systems have been subjected to high pressure to meet increasing demand for food and other elements necessary for life. That pressure has resulted in many cases in degradation of the environment. Despite efforts undertaken to rationalize the use of environmental systems such as land and water resources, large areas worldwide have been degraded and are now facing many environmental problems. Both natural factors and human activities, in particular in fragile and unstable ecosystems, have

contributed to the process of environmental degradation. The result is unbalanced natural environmental systems. It is, therefore, very important to monitor and assess the degradation process at its early stages in order to take the necessary measures to combat it and rehabilitate the degraded systems.

43. In response to that situation, the international community has given high priority to environmental monitoring, as evidenced by UNISPACE III, which called for action to develop a comprehensive, worldwide, environmental monitoring strategy in the Vienna Declaration.

44. The main objective of the work plan proposed in the present report is to launch a space-based worldwide strategy for environmental monitoring, ensuring the sustainable use of ecosystems and promoting regional cooperation on critical environmental issues. More specific objectives include the following:

(a) Implementation of a preoperational system to monitor the dynamics of certain environmental phenomena in selected areas;

(b) Assessment and adaptation of relevant techniques for environmental monitoring;

(c) Provision of guidelines for effective implementation of environmental monitoring;

(d) Provision of support for capacity-building of local staff in environmental monitoring, in cooperation with concerned national institutions;

(e) Enhancement of partnerships between relevant national, regional and international institutions;

(f) Provision of support for the involvement of non-governmental organizations and the local population in environmental monitoring.

45. To achieve the above-mentioned objectives, the work plan should concentrate resources and efforts on achieving greater technical cooperation, enhancing the exchange of good practices among countries and encouraging the development of policies leading to sustainable environmental development. The work plan should build upon existing development plans, national environmental action plans and rural development strategies. A graphic representation of the work plan is provided in annex I.

A. Technical components

46. The work plan consists of four technical components. Each component consists of a set of outputs, which will be delivered through specific activities.

Technical component 1. Networking and knowledge-sharing

47. This component includes the exchange of information on best practices on environmental monitoring among countries at the regional level. In that domain, the work plan will rely on a regional consultative approach for the collection and distribution of related information. Awareness-raising and training workshops will be essential to bridge knowledge gaps between countries and will take into account the work in the area accomplished by organizations or networks.

48. Three outputs are expected:

(a) Output 1. Identification of stakeholders at the regional level

(i) Activities:

a. Compilation of an inventory of all stakeholders working on environmental monitoring at the regional level;

b. Identification and documentation of activities undertaken by countries and international institutions in the field of environmental monitoring;

c. Identification of needs and gaps as regards issues related to environmental monitoring;

(ii) Expected results:

a. Preparation of a document identifying a strategy on how to redress gaps and fulfil needs in order to develop or strengthen space-based environmental monitoring and the role of regional and international organizations and networks to meet those needs;

b. Compilation of an inventory of all stakeholders working on environmental monitoring;

(b) Output 2. Awareness-raising

(i) Activities:

a. Contribution to the organization of regional workshops in cooperation with specialized bodies and networks;

b. Organization of regional awareness-raising activities to deepen the understanding of the value of environmental monitoring;

(ii) Expected results:

a. Increased awareness among countries of the linkages between ecosystems and other sectors;

b. More case studies and lessons learned;

(c) Output 3. Knowledge-sharing

(i) Activities:

a. Upgrading of pilot projects to the regional level; encouragement of the design, implementation and repetition of pilot projects at the regional level based on lessons learned;

b. Encouragement of case studies on the development of natural resource management techniques;

c. Dissemination of guidelines and best practices among countries on the use of indigenous techniques to monitor, protect and enhance ecosystems;

(ii) Expected results:

a. Enhanced regional and international cooperation on a variety of environmental issues through the exchange of experience and best practices;

b. An increased number of partnerships and collaboration agreements among concerned institutions at the regional and international levels.

Technical component 2. Capacity-building for national and regional organizations

49. This component aims at promoting regional cooperation among countries to strengthen the institutional capacity of national and regional organizations to promote the exchange of best practices and knowledge within and among countries.

50. Three outputs are expected:

(a) Output 1. Strengthening of capacity-building of national and regional institutions

(i) Activities:

a. Strengthening the institutional and technical capacity of national and regional specialized centres to provide training in the field of environmental monitoring;

b. Technical support for relevant thematic networks;

c. Support for national and regional environmental research;

d. Strengthening the institutional relationship and linkages between early warning systems and decision makers to facilitate timely and appropriate responses to environmental problems;

(ii) Expected results:

Enhanced institutional and technical capacity of national and regional organizations and networks to conduct environmental monitoring and to provide adequate training and information in that area.

Technical component 3. Regional system for the collection and distribution of information

51. Comprehensive regional information networks on environmental monitoring need to be established in order to ensure effective dissemination of information.

52. One output is expected:

(a) Output. Regional information networks on ecosystem management and environmental monitoring

(i) Activities:

a. Upgrading of existing regional databases on environmental monitoring and management in order to create a comprehensive regional database;

b. Facilitation of linkages among regional databases in collaboration with key partners at the international level;

c. Encouragement of linkages between the national institutions and the regional database web sites and thematic networks;

d. Establishment of an international database on environmental monitoring;

(ii) Expected results:

a. Establishment of comprehensive regional information networks on environmental monitoring and ecosystem management;

b. Strengthening of information and communication linkages between networks and organizations at all levels.

Technical component 4. Space technology applications in environmental monitoring

53. This component will provide the technical skeleton of the work plan and will be based on selection of monitoring areas and series of test sites for implementation and assessment of monitoring techniques with the use of space technology.

54. Two outputs are expected:

(a) Output 1. Environmental monitoring inventory and survey

(i) Activities:

a. Survey and evaluation of methodologies used for environmental monitoring;

b. Inventory of environmental monitoring activities at the regional level;

c. Assessment of the current status of environmental monitoring at the regional level;

(ii) Expected results:

a. Identification of appropriate methods for environmental monitoring;

b. Establishment of a database on environmental monitoring activities and information;

(b) Output 2. Remote sensing applications

(i) Activities:

a. Selection of basic indicators of environmental conditions to be derived from remotely sensed data;

b. Cease studies on levels and types of environmental monitoring, including the following: (i) definition of data to be acquired (parameters and measurement protocols); (ii) data acquisition, including remotely sensed data and ground data sets; (iii) data processing and analysis using the available hardware and software; (iv) analysis of environmental degradation causes; and (v) mapping of environmental degradation trends and highlighting of hot spots;

(ii) Expected results:

a. Identification of environmental indicators that can be monitored with the use of remote sensing;

b. Production of environmental maps using remote sensing and other related space technology;

c. Identification of appropriate remote sensing techniques and other related space technology for environmental monitoring and environment degradation assessment.

B. General recommendations

55. The most effective organizational solution for the continuation of reliable integrated, comprehensive environmental monitoring is to develop an institutional mechanism, consisting of interdisciplinary activities with scientific, technical, economic, political and legal aspects, that is constantly active on a global scale in the interests of environment protection and for the benefit of all countries. This should gradually evolve towards the establishment of a united environmental monitoring system. The following key features should be taken into account in establishing the monitoring system:

(a) The system must be globally acceptable, with as many participating countries as possible, and it should be as comprehensive as possible and integrated at the horizontal and vertical levels;

(b) The system must be supported by subsystems for data collection, which should be well-structured at the national, regional and global levels and coordinated with socio-economic information systems;

(c) The system must contain effective tools for data analysis and processing to produce information and to generate knowledge accessible for officials and the general public;

(d) The system must be well-known to policy and decision makers by being able to present data and information in easily understandable format.

56. In order to create such a system, it is necessary to develop international legal documents that determine organizational and technical aspects of the system's functionality. The first step could be a resolution of the General Assembly that defines the status of the monitoring system. Further, an agreement among countries must be signed that would set forth the rights and obligations of participating countries and the organizational structure of the system. Technical issues concerning the operation of the system should also be covered. The whole set of such legal documents could be developed in stages pending the commitments to be made by participating countries at the political and legal levels and progress at the technical level.

57. The implementation of the monitoring system under the aegis of the United Nations would have the following positive features for all participants:

(a) Existence of a unique scientific database on the Earth that conforms to unified standards;

(b) Closer cooperation among countries, including cooperation in scientific data exchange to stimulate investment in data exchange;

(c) Creation of an infrastructure for information development for society;

(d) Facilitation of user access to information on global observation;

(e) Improvement in the quality of information (broader coverage and more frequent updates);

(f) Availability of different types of observation technology.

58. The monitoring system must be established and implemented in accordance with international law, including environmental law, international space law and the laws of international organizations, bearing in mind the key milestones and their results (see para. 10 above) that would provide the basis for environmental law.

59. The process of establishing the monitoring system must be gradual. Integration procedures should be accomplished taking into account existing international acquisition systems and use of Earth observation data. At the initial stages, existing monitoring facilities must be identified for integration into the monitoring system. At a later stage, the management of the system would determine what further types of observation device would be required for the effective functioning of the System and which countries should participate in what manner. Distribution of the work involved must be determined on a voluntary basis and taking into account the national interests of participating countries.

60. The objectives to be achieved for the project to develop the monitoring system could be as follows:

Year 2004

(a) Development and establishment by participating countries of legal organizational documents defining the status of the monitoring system, the rights and responsibilities of countries participating in the project, the role and functions of international authorities and conditions of access to information;

(b) February. Development of a document determining the tasks and purposes of the monitoring system and its coordination with participating countries;

(c) Inventory of existing monitoring facilities that could be provided by participating countries to meet the needs of the system;

(d) Development and coordination of standards, formats, classifiers and data-processing methods required for the system;

(e) Development of technical proposals for the system;

Year 2005

(a) Establishment of authorities to coordinate the work involved;

(b) Development, within the framework of the system, of centres for collection, processing and preparation of information for end users;

2005-2008

Integration of national observation systems;

2008-2010

Development of new technologies in order to expand the capacity of the system;

2011-2012

Upgrading of the system to become fully operational.

61. In the early stages of the establishment of the monitoring system, a strategy for integrated, comprehensive environmental monitoring could be implemented through pilot projects, which would allow local communities to take practical steps as well as to test and practice the main technological approaches and basic ideas. Two pilot projects are proposed:

(a) Remote sensing applications for monitoring of desertification (see annex II);

(b) Establishment of an institute (cycle of workshops and training activities) on the use of integrated comprehensive data for environmental monitoring (see annex III).

62. In the process of implementing the strategy for integrated, comprehensive environmental monitoring, other pilot projects suggested by relevant action teams established by the Committee on the Peaceful Uses of Outer Space to implement recommendations of UNISPACE III could also be implemented.

Notes

[1] *Official Records of the General Assembly, Fifty-sixth Session, Supplement No. 20* and corrigendum (A/56/20 and Corr. 1), paras. 50 and 55.

[2] See *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3).

[3] Ibid., chap. I, resolution 1.

[4] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992* (United Nations publication, Sales No. E.93.1.8 and corrigenda), vol. I: *Resolutions adopted by the Conference,* resolution 1, annex II.

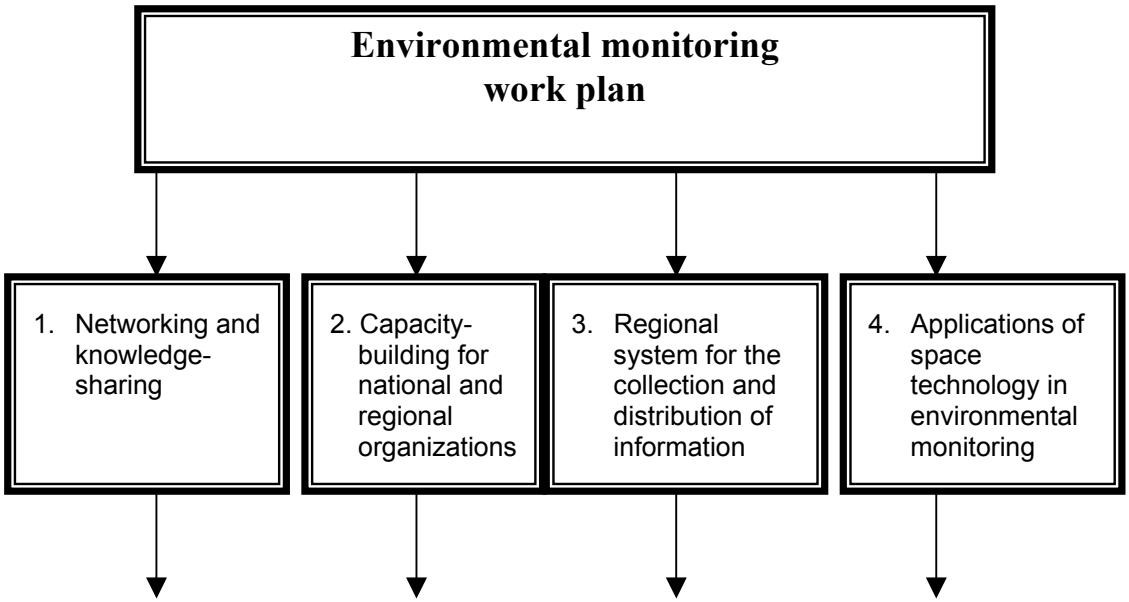
[5] See *Global Environment Outlook 2000* available at (www.unep.org/geo2000/ov-e.pdf).

[6] United Nations, *Treaty Series*, vol. 1954, No. 33480.

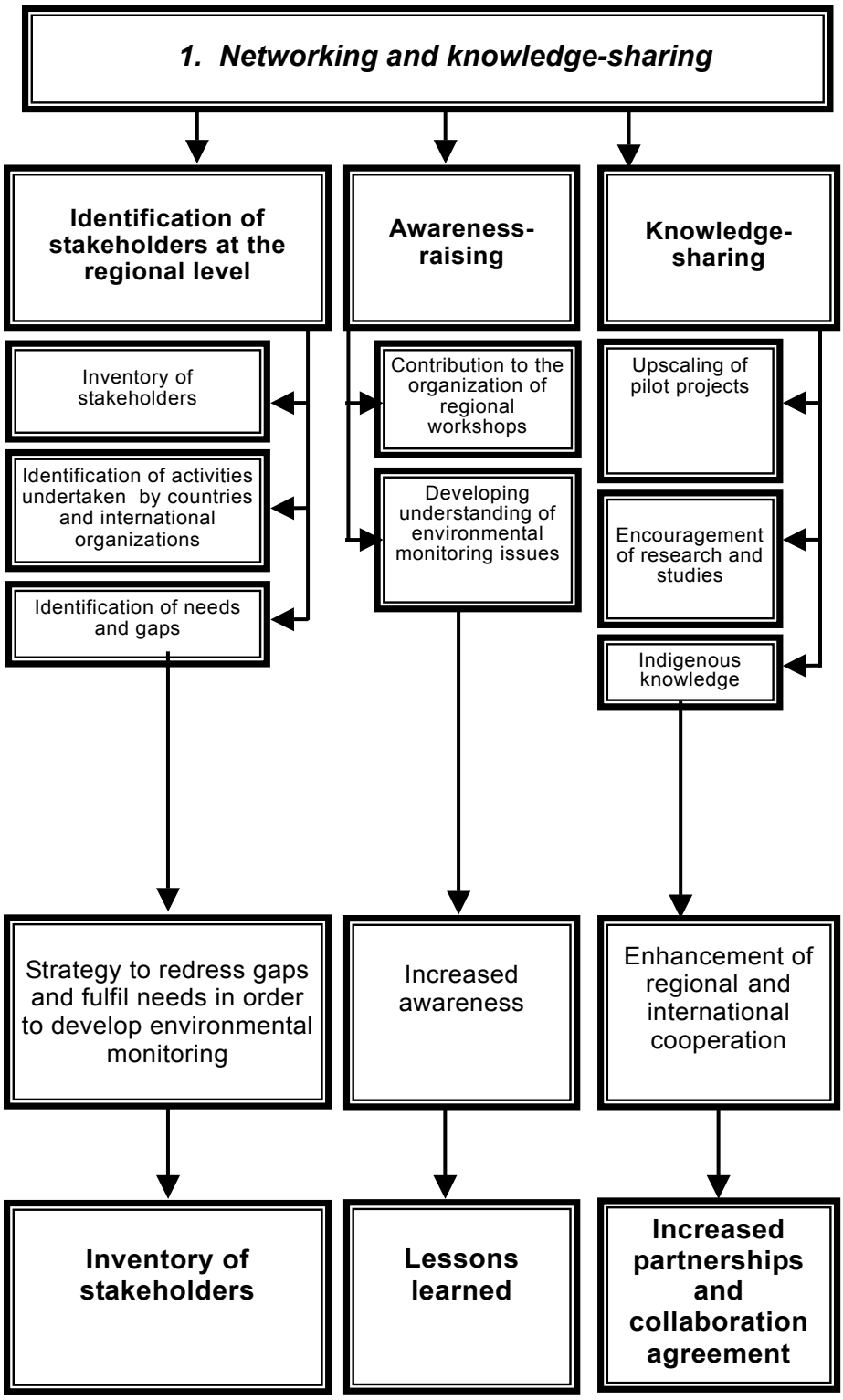
[7] United Nations, *Treaty Series*, vols. 1833-1835, No. 31363

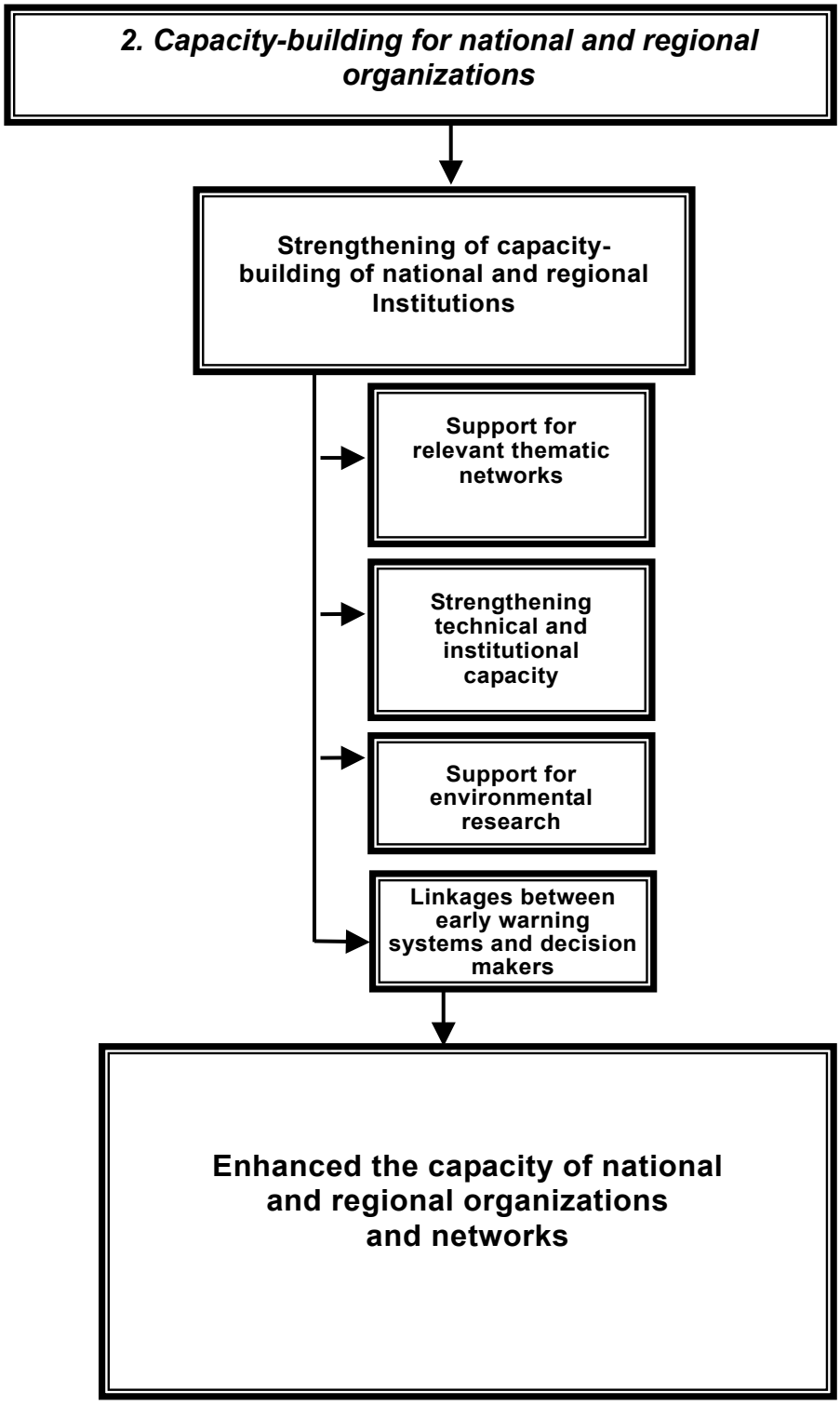
Annex I

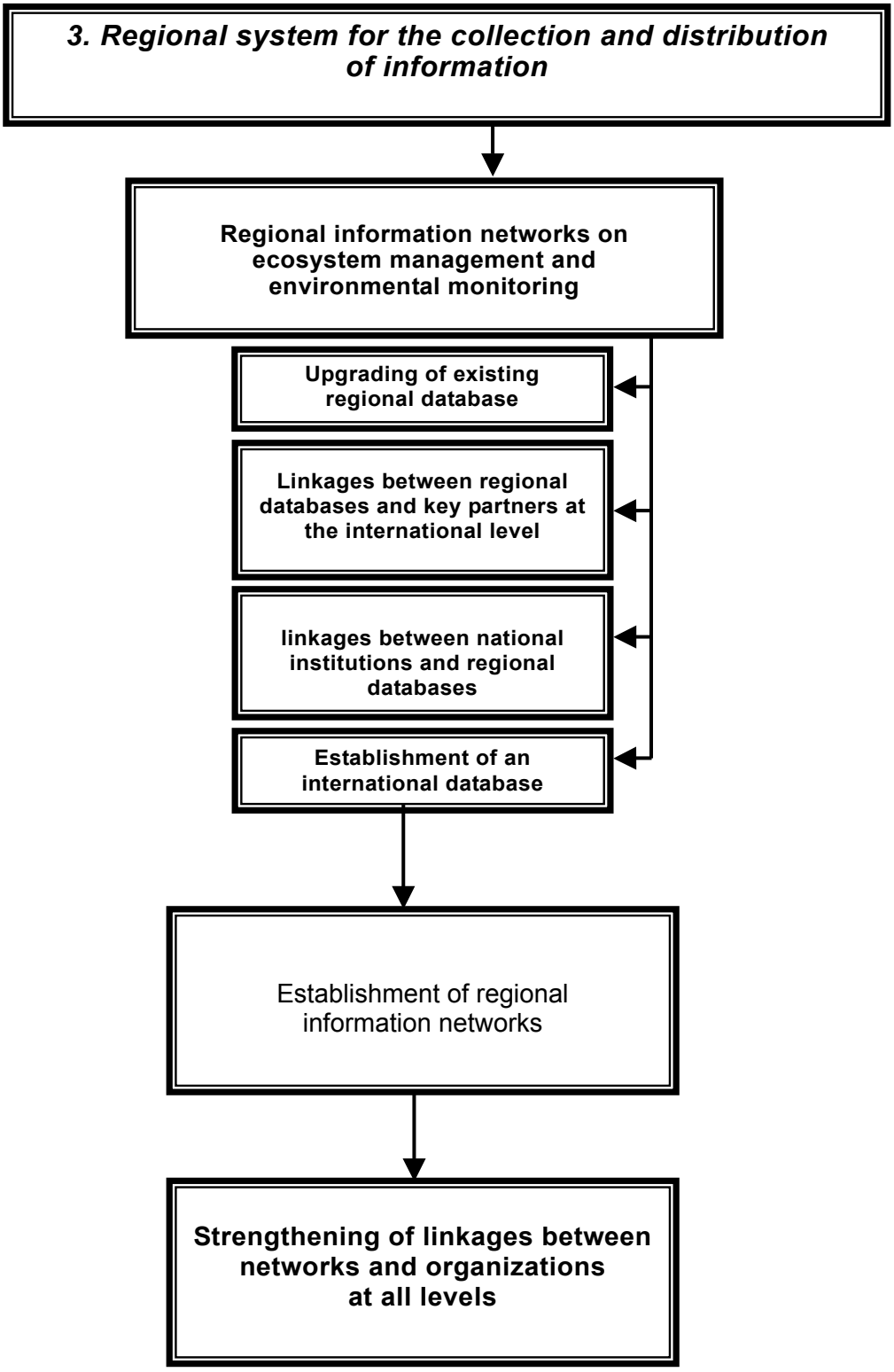
Graphic representation of the environmental monitoring work plan

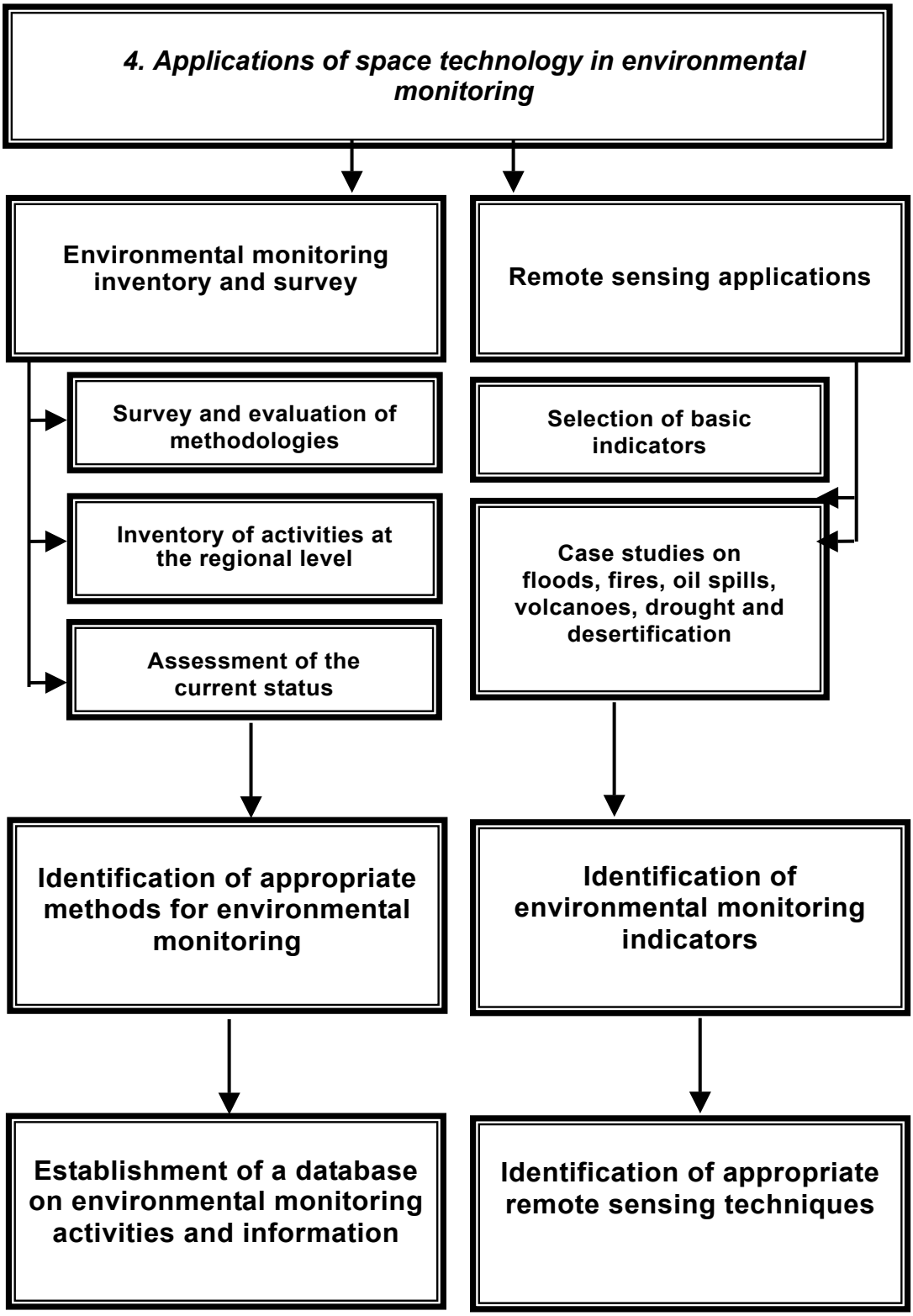


(See below)


1. Networking and knowledge-sharing
Identification of stakeholders at the regional level
Awareness-raising
Knowledge-sharing
Inventory of stakeholders
Identification of activities undertaken by countries and international organizations
Identification of needs and gaps
Contribution to the organization of regional workshops
Developing understanding of environmental monitoring issues
Upscaling of pilot projects
Encouragement of research and studies
Indigenous knowledge
Strategy to redress gaps and fulfil needs in order to develop environmental monitoring
Increased awareness
Enhancement of regional and international cooperation
Inventory of stakeholders
Lessons learned
Increased partnerships and collaboration agreement


2. Capacity-building for national and regional organizations
Strengthening of capacity-building of national and regional Institutions
Support for relevant thematic networks
Strengthening technical and institutional capacity
Support for environmental research
Linkages between early warning systems and decision makers
Enhanced the capacity of national and regional organizations and networks


3. Regional system for the collection and distribution of information
Regional information networks on ecosystem management and environmental monitoring
Upgrading of existing regional database
Linkages between regional databases and key partners at the international level
linkages between national institutions and regional databases
Establishment of an international database
Establishment of regional information networks
Strengthening of linkages between networks and organizations at all levels


4. Applications of space technology in environmental monitoring
Environmental monitoring inventory and survey
Remote sensing applications
Survey and evaluation of methodologies
Selection of basic indicators
Inventory of activities at the regional level
Case studies on floods, fires, oil spills, volcanoes, drought and desertification
Assessment of the current status
Identification of appropriate methods for environmental monitoring
Identification of environmental monitoring indicators
Establishment of a database on environmental monitoring activities and information
Identification of appropriate remote sensing techniques

Annex II

Proposed pilot project on remote sensing applications for monitoring of desertification

I. Background

1. As a result of rapid population growth, natural resources have been subjected to high pressure to meet increasing demand for food. In arid and semi-arid areas, increasing pressure has resulted in many cases in degradation of the environment. Despite efforts undertaken to rationalize the use of land and water resources, large areas of rangeland and rainfed agriculture have been degraded and are now facing problems of desertification. Both natural factors and human activities, in particular in fragile and unstable ecosystems, can contribute to the process of desertification and result in an unbalanced natural environment. It is therefore very important to monitor and assess the process at an early stage in order to take the necessary measures to combat desertification and to rehabilitate the degraded areas.

II. Objectives

2. In its articles 16 to 18, the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa,[a] calls for action to promote scientific and technical cooperation that would improve monitoring of desertification and rehabilitation techniques. In response to that call, the aims of the project proposed here would be to develop, transfer and apply remote sensing and other related space technologies to monitoring and evaluation of processes of desertification. The project has the following specific objectives:

(a) Implementation of an operational system to monitor the dynamics of desertification in selected arid and semi-arid areas;

(b) Adaptation and assessment of relevant space techniques for the monitoring of degraded areas selected as test sites;

(c) Development of guidelines for the effective implementation of monitoring of desertification at the selected sites taking into account their particular conditions;

(d) Support for capacity-building in national institutions dealing with monitoring and evaluation of desertification;

(e) Enhancement of the partnership between relevant subregional and national organizations and institutions.

II. Duration of the project

3. The duration of the project would be four years.

IV. Proposed participating organizations

4. The United Nations Educational, Scientific and Cultural Organization, the secretariat of the United Nations Convention to Combat Desertification, the United Nations Environment Programme, the Food and Agriculture Organization of the United Nations, the European Commission and concerned regional and local organizations could participate in the project.

V. Expected outputs of the project

A. Monitoring of land degradation

5. Monitoring would consist of:

(a) Selection of appropriate methods for monitoring of desertification and environmental degradation;

(b) Selection of desertification indicators that match the features of environmental degradation, based on remote sensing techniques and ground measurements;

(c) Production of land degradation maps using remote sensing and ground data and highlighting the sites to be rehabilitated;

(d) Establishment of a database on land degradation processes.

B. Capacity-building

6. Elements of capacity-building would include:

(a) Improvement of knowledge about monitoring of desertification;

(b) Transfer of successfully tested technology to concerned countries and organizations;

(c) Establishment of a database on processes of desertification to be made available to relevant institutions;

(d) Strengthening of the capacity of concerned institutions to develop and implement programmes for collection, analyses and exchange of information related to monitoring of desertification;

(e) Support for activities to increase public awareness in order to enhance understanding of the causes and effects of desertification and for the exchange of educational and information materials for awareness increase.

VI. Activities and steps for implementation

7. The following approach would be taken to implement the project:

(a) Selection of monitoring areas (about one million hectares);

(b) Selection of a series of test sites (of a few hundred hectares each) for implementation and assessment from among the most critical parts of the areas monitored.

Phase 1. Design of the project

8. The expected duration of phase 1 would be three months. Phase 1 would consist of the following activities:

(a) Assessment of the relevance of the project with regard to regional and subregional action programmes in line with the objectives of the United Nations Convention to Combat Desertification;

(b) Selection of potential monitoring areas based on the results of the above assessment;

(c) Identification of capabilities and facilities potentially available for the project in the concerned countries;

(d) Organization of a regional workshop to be attended by selected representatives, participating organizations and funding agencies in order to finalize the design of the project and to identify other partners to participate.

Phase 2. Implementation of the project

9. The expected duration of phase 2 would be 24 months. It would consist of the following activities:

(a) Assessment of the current status of desertification at the selected sites;

(b) A survey and evaluation of the methodologies used for monitoring environmental degradation and processes of desertification;

(c) Compilation of an inventory of land degradation monitoring activities;

(d) Selection of basic indicators of desertification to be derived from remote sensing data and measurements in the field, as well as processing methods to be utilized;

(e) Case studies on different levels and types of degradation.

10. The following tasks would also be performed during the implementation of the above activities:

(a) Application of the work plan prepared by the Action Team for Environmental Monitoring;

(b) Acquisition of data, including remotely sensed data and ground data sets;

(c) Data processing and analysis;

(d) Preliminary analysis of causes of land degradation and their impact;

(e) Mapping of land degradation trends and highlighting hot spots of desertification;

(f) Capacity-building aimed at strengthening the institutional and technical capacity of national and regional centres specializing in the areas studied through the following:

(i) Provision of training in monitoring and assessment of desertification;

(ii) Technical support to the relevant institutions;

(iii) Strengthening of institutional relations and linkages between existing thematic networks and early warning systems;

(iv) Strengthening of cooperation and coordination between national and subregional organizations.

Phase 3. Finalization of the project

11. The expected duration of phase 3 would be 12 months.

12. During this phase, the final maps and reports would be prepared and the databases created. A final workshop would be held to present and discuss the achievements of the project with the participating countries and the relevant international, regional and subregional organizations. The results would be disseminated through publications, electronic networks and other media.

VII. Conditions for success

13. The success of the project would require the following elements:

(a) Involvement of the local population, with special attention to the needs of women and youth, in the planning, implementation and assessment of the project;

(b) Collaboration and coordination with projects that address similar issues in the region.

VIII. Selection of areas to be monitored

14. Desertification is caused by both natural components, such as climate and land characteristics, and man-made components, such as land use and agricultural practices. This is evidenced in several parts of the arid and semi-arid regions, many parts of which have been exposed to misuse of natural resources that has led to their deterioration and to the expansion of desertification. Areas to be monitored should be selected to include areas where the following forms and aspects of desertification could be examined:

(a) Wind erosion, one of the most common environmental problems with respect to loss of the fertile surface layer;

(b) Water erosion, which leads to loss of the fertile surface layer of the soil and the transfer of large volumes of eroded soil to other sites;

(c) Loss of nutrients, which is common in irrigated areas and leads to a decrease in the production capacity of lands and their deterioration;

(d) Salinization, which is a major problem in irrigated areas or areas where the water table is raised; it makes soil unsuitable for agriculture and, after some time, leads to desertification;

(e) Aridification, which is caused by depletion of ground water resources, leading to the aggravation of desertification and aridity.

15. During the selection of areas to be monitored, the following causes of desertification should be considered:

(a) Overgrazing and disturbance of the natural balance of range plants;

(b) Cultivation of large areas of steppe and marginal lands;

(c) Irrational and inappropriate agricultural activities;

(d) Overuse of chemical fertilizers and pesticides;

(e) Misuse of land and water resources;

(f) Deforestation and conversion of forest land to agricultural land.

Notes

[a] United Nations, *Treaty Series*, vol. 1954, No. 33480.

Annex III

Proposed pilot project for the establishment of an institute on the use of integrated comprehensive data in environmental monitoring

I. Introduction

1. Environmental monitoring data can be acquired by different types of satellite as well as by airborne observations and in situ measurements. The most effective and economical method is joint, comprehensive and integrated processing and application of data and information received from different kinds of sensor and different sources.

2. It is possible to avoid deficiency of information by establishing regional centres for environmental monitoring utilizing modern information technologies for receiving, processing and presenting satellite, aerial and other data. Such technologies should provide for automatic machine interpretation of the results of imaging, synthesize thematic maps for comprehensive analysis of environment and develop local or regional geographic information systems (GIS). Prospective information technologies for monitoring are connected, inter alia, with the development of such regional GIS and, based on those technologies, it would be possible to maintain effective land and water cadastral surveys, manage resources and carry out ecological tasks, regional land use tasks and thematic mapping tasks.

II. Objectives

3. An institute on the use of integrated comprehensive data in Environmental Monitoring, with a series of workshop and training activities, would provide for:

(a) Frequent exchange of experience and opinions among experts, interested organizations and individuals involved in regional integrated centres for environmental monitoring to be established;

(b) Development of workflow charts and a schedule for establishing regional centres;

(c) Establishment of teams of international specialists for the development of regional centres and networks of centres;

(d) Promotion of all the modern information technologies necessary to support environmental monitoring.

III. Content of the workshops and training activities

4. Workshops and training activities should address the following main issues:

(a) Basics of the technologies for environmental monitoring:

(i) Space, aviation and in situ methods and technologies for environmental monitoring; data, including remote sensing data, statistical and socio-economic data; and various remote sensing applications;

(ii) Modern information technologies for receiving, processing, storing and presenting information; and system planning and interaction with users;

(iii) The architecture, as well as modern software and hardware, required for information systems for environmental information collection, processing, modelling and prediction;

(b) Geo-spatial technologies for environmental monitoring:

(i) The concept of terrain mapping using various tools and through joint processing of images from different spacecraft and other information sources; and principles of data calibration;

(ii) Remote sensing platforms and sensors; low-, medium- and high-resolution data; design features of satellites; and characteristics of different space and airborne on-board sensors;

(iii) Methods of development of photogrammetry networks; digital evaluation model (DEM) production technology; comparative characteristics of methods for rectification and ortho transformation of images, mosaics of digital images; and three-dimensional (3D)-technologies;

(iv) Methods of data interpretation; examples of thematic data processing; and working standards for data interpretation;

(v) GIS for environmental applications, their development and maintenance and future perspectives;

(c) Integrated data use for environmental monitoring:

(i) Global information and data infrastructure; available data sources from international and other organizations; resources available from web sites; Internet-based technologies; and data archiving;

(ii) Mathematical and programming methods of data processing; modelling and prediction; data mining; expert information systems; and decision support systems;

(iii) Technologies for designing information systems for specific purposes; and development of the design for a regional environmental monitoring centre.

IV. Duration of the pilot project

5. The total duration of the pilot project would be one year. Each workshop or training activity could last one week and could be prepared in two months.

V. Participants

6. Experts, scientists, decision makers and others from countries and organizations engaged or responsible for environmental monitoring in different regions would be invited to participate.

VI. Organizers

7. A leading role in implementing the project would be played by the Office for Outer Space Affairs, the World Meteorological Organization, the United Nations Environment Programme and other entities of the United Nations system. Support would be provided by concerned local or regional organizations.