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REPORT ON THE UNITED NATIONS/INTERNATIONAL ASTRONAUTICAL FEDERATION WORKSHOP ON SPACE TECHNOLOGY AS A COST-EFFECTIVE TOOL TO IMPROVE INFRASTRUCTURES IN DEVELOPING COUNTRIES

(Turin, Italy, 2-5 October 1997)

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INTRODUCTION

A. Background and objectives

1. The General Assembly, in its resolution 37/90 of 10 December 1982, decided that, in accordance with the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space,[1] the United Nations Programme on Space Applications should assist the developing countries in establishing an autonomous technological base for the development and use of space technology by promoting the growth of indigenous capabilities. The Committee on the Peaceful Uses of Outer Space at its thirty-ninth session took note of the activities of the United Nations Programme on Space Applications for 1997, recommended by the Scientific and Technical Subcommittee at its thirty-fourth session.[2] Subsequently, the General Assembly, in its resolution 51/123 of 13 December 1996, endorsed the activities of the Programme for 1997.

2. The present report contains a summary of the United Nations/International Astronautical Federation Workshop on Space Technology as a Cost-effective Tool to Improve Infrastructures in Developing Countries. The Workshop was organized as part of the 1997 activities of the Office for Outer Space Affairs of the United Nations Secretariat under the United Nations Programme on Space Applications. The Workshop was the seventh in a series organized by the United Nations, and was held at Turin, in conjunction with the forty-eighth Congress of the International Astronautical Federation (IAF). Previous symposia and workshops in the series had been held in Austria, Canada, China, Israel, Norway and the United States of America.

3. The objectives of the Workshop were to assist developing countries in establishing and strengthening national capabilities in space technologies and applications, to provide developing countries with a general plan for establishing cost-effective industrial and institutional enterprises in selected fields of space science and technology, to explore the possibility of an increased scientific and technical cooperation between industrialized and developing countries, as well as between the developing countries themselves; and to explore the possibility of cooperative ventures involving space industry and developing countries. The Workshop was intended to provide a forum for interaction with representatives of the space industry, thereby helping the participants to gain a greater understanding of the needs and requirements that should be met if ventures were to be successful. The observations of participants and the conclusions reached by the Workshop would also provide inputs and ideas to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, which will be held at Vienna from 19 to 30 July 1999.

4. The sponsors of the Workshop were able to provide participants from developing countries with the opportunity to attend the technical sessions associated with the forty-eighth Congress of IAF, which began immediately after the Workshop. That had become one of the objectives of the series of workshops, as it allowed participants from developing countries to present papers and hold discussions with their colleagues in one of the more important international space events.

5. This report, covering the background and the objectives of the Workshop, as well as the presentations and discussions, and the observations made and conclusions reached by the participants, has been prepared for consideration by the Committee on the Peaceful Uses of Outer Space at its forty-first session and by its Scientific and Technical Subcommittee at its thirty-fifth session. The participants will report to the appropriate authorities in their own countries. The proceedings of the Workshop, including a detailed address list of all participants, will be made available through the Office for Outer Space Affairs in due time.

B. Programme of the Workshop

6. During the course of the Workshop, successful examples for the use of space technology applications were presented. The aim was to demonstrate how developing countries could benefit from space technology for economic and social development. The Workshop was structured around six sessions, in which 23 papers were presented. There was a vigorous exchange of information, comments, questions, recommendations and suggestions. In addition, the brief presentations by participants from developing countries provided an insight into the status of space technology applications in their countries. Afternoon sessions concluded with panel discussions, followed by an open exchange of views.

7. National and transnational space projects and programmes were discussed, and possibilities were suggested for increased scientific and technical cooperation between industrialized and developing countries, as well as among the developing countries themselves.

C. Participants

8. The United Nations invited developing countries to nominate candidates for participation in the Workshop. Selected participants were required to have university degrees in remote sensing, communications, engineering, physics, biological or medical sciences or other fields related to the themes of the Workshop. In addition, participants were selected on the basis of their working experience in programmes, projects or enterprises in which space technology is or could be used. The participation of policy makers at a decision-making level from both national and international entities was specifically encouraged.

9. Funds allocated by the United Nations, IAF, the European Commission, the European Space Agency (ESA) and the Government of Italy for the organization of the Workshop were used to cover international air travel and per diem expenses of 30 participants from developing countries. Registration fees for the Congress and room and board expenses for participants from developing countries were also covered by the sponsors of the Workshop.

10. The Workshop was attended by more than 120 participants, including funded participants from Azerbaijan, Bangladesh, Benin, Brazil, Burkina Faso, China, Ethiopia, India, Indonesia, Iran, Jordan, Malaysia, Nicaragua, Nigeria, Pakistan, Sri Lanka, St. Lucia, Sudan, the United Republic of Tanzania, Uzbekistan, Venezuela and Zimbabwe.

11. Lectures were delivered by representatives of the Office for Outer Space Affairs, the World Meteorological Organization (WMO), the European Commission, ESA, the Austrian Space Agency, the Chinese Academy of Space Technology, the French National Centre for Space Studies, the German Aerospace Research Establishment, the Indian Space Research Organization, the Italian Space Agency, the National Aerospace Laboratory of the Netherlands, the National Space Development Administration of Japan, the Space and Upper Atmosphere Research Commission of Pakistan (SUPARCO) and the International Space University.

12. Presentations by space industry and commercial ventures were given by representatives of CLS-ARGOS (France), Earth Observation Satellite Company (EOSAT) (United States), ORBCOMM (United States), ORBIMAGE (United States), SPACEHAB (United States) and Surrey Satellite Technology Ltd. (United Kingdom of Great Britain and Northern Ireland).

I. PRESENTATIONS AND DISCUSSIONS

13. Opening statements were made by the Head of the Italian Space Agency, a member of the Indian Space Commission and Honorary Chairman of the Committee for Liaison with International Organizations and Developing Nations of IAF, the representative of ESA, the President of IAF and the Director of the Office for Outer Space Affairs, as well as by representatives of the City of Turin and the International Training Centre of the International Labour Organization (ILO).

14. The cost-effectiveness of space technology applications as an alternative for developing countries was illustrated by the representative of the Chinese Academy of Space Technology in his keynote address on space technology applications, the cost-effective alternative for developing countries. Major examples of successful space technology applications in China included satellite-telecommunications, tele-education and Earth observation projects covering meteorological forecasting, natural disaster mitigation and resources management. One of the biggest challenges for China, which had a land area of 96 million square kilometres and a coastal area of 3 million square kilometres, was the unbalanced development and underdeveloped infrastructure, especially in its rural regions. Space technology applications provided a low-cost and high-benefit solution for many of those problems, improving the economic, social and cultural development of the country. In the near future, China would have an enormous market potential for satellite direct television broadcasting, satellite mobile communication and satellite direct radio broadcasting. China had also started to use retrievable space platforms for rice and wheat breeding experiments in the micro-gravity environment of space. Farmers benefited through a higher yield from the new crop seeds.

15. The representative of the Italian Space Agency, speaking on space technology for infrastructure improvement in developing countries, stressed that space data needed to be integrated with other collateral data to provide useful information for infrastructural development and management that could be directly interpreted by policy makers and decision makers.

A. Enhancing the cost-effectiveness of space technology applications

16. ESA had analysed and quantified the direct benefits of some of its major programmes, including the METEOSAT satellites, the Ariane launcher and the European Communication Satellite (ECS). In addition to the direct benefits, indirect effects needed to be considered. A study had revealed that for every currency unit invested by ESA, more than three currency units were generated in indirect economic activities. Further indirect benefits to be considered were of a technological, commercial, organizational and educational nature. It was, however, rather difficult to quantify benefits before the programmes had been implemented. The commercial success of the Ariane and ECS programmes had not originally been foreseen. It was, however, becoming easier to predict the cost of space projects as more and more sophisticated cost-analysis tools were being developed. Those in turn could be very useful for trading options, benchmarking proposals or giving realistic estimates of the resources needed by a project.

17. With the growing demand for resources, due, for example, to increasing population pressure, it was necessary to improve methods for resource management without adversely affecting the environment. The means for achieving that balance was known as sustainable development. Space technology applications could provide significant support for the sustainable development of a country. The representative of the National Remote Sensing Agency of India gave a brief account of the Indian space programme, followed by a detailed description of example applications, using remote sensing data and Geographical Information Systems (GIS) in an integrated approach to the identification of land use alternatives for sustainable land and water management in a selected watershed of the Ahmednager district of Maharastra. Using space technology, the generation of local action-plan maps cost half as much as it did using conventional methods (2.43 rupees per hectare as against 5.10 rupees per hectare (36 rupees equalling approximately 1 United States dollar ($)). Cost was calculated using data obtained between 1993 and 1994 from extensive studies covering large areas and representing different terrains.

18. The European Commission, as the largest buyer of remote sensing data in Europe, was an important player in the operationalization of Earth observation programmes. As part of its activities, the European Commission was also offering education and training programmes for developing countries. Courses in remote sensing were offered for two weeks in the year by the Joint Research Centre, in collaboration with International Centre for Agronomic Studies, Spain, or on a case-by-case basis in the frame of projects financed under the following programmes: Tropical Ecosystem Environment Observations by Satellite (TREES), Fire in Global Resource and Environmental Monitoring (FIRE), Satellite Assessment of Rice in Indonesia (SARI), South East Asia Rice Radar Investigation (SEARRI), Ecosystem of Forest in Central Africa (ECOFAC) and others.

B. Space technology: a cost-effective tool for developing countries

19. The broad range of benefits that space technology applications could provide to developing countries was evident in the presentation on the review of follow-up activities of previous United Nations/International Astronautical Federation workshops. For the review, the Office for Outer Space Affairs had contacted 152 former participants in United Nations/International Astronautical Federation workshops and asked them to provide information on their follow-up activities. The former participants had also expressed their views on the usefulness of the workshops. Among other things, the respondents indicated that the workshops provided an excellent opportunity for a general exchange of information on space technology applications and for networking with colleagues from other countries.

20. Environmental monitoring had long been recognized as an important application of space technology, with its ability to provide the holistic view necessary for effectively tackling and solving problems. Examples were given by the participant representing SUPARCO, Pakistan, in his presentation on the role of space technology in creating environmental awareness. Satellite data were frequently being used for the monitoring of river course changes, mapping of floods and areas affected by salinization, prospecting for oil field studies and measuring the ozone depletion in the atmosphere. It was often forgotten that low-resolution data provided the most cost-effective approach for such large-area studies.

C. Operationalization of remote sensing applications

21. The representative of the Remote Sensing Exploitation Department of ESA presented an overview of the remote sensing data market. He outlined the main steps involved in making remote sensing applications operational: research, demonstration, pre-operations and operations. Only a few systems, mostly those providing meteorological data, were currently operational. That situation was expected to change soon with the advent of commercial remote sensing satellites. Some applications, including applications in research, geology, environment, agriculture, mineral prospecting, and oil-spill detection, were already mature, while others, like applications covering GIS simulations, insurance, shipping and engineering, were developing at different rates.

22. The current market value of remote sensing data was $200 million a year for data providers and some $300 million to $500 million a year for value-added companies, with an expected annual increase rate of 15-20 per cent. Remote sensing data per se had little commercial value. It was rather the information that the data could provide, and the resulting services, that would determine the commercial impact of the remote sensing market.

23. When considering the cost-effectiveness of space image data, a direct comparison with aerial photography revealed that surveying with remote sensing data was cheaper when the surveyed area was larger than 20 square kilometres. Earth observation from satellites would for the first time come into direct competition with aerial photography early in 1998, when the first civilian remote sensing satellites providing a similar spatial resolution would be launched.

24. An example of a future operational Earth observation system was the VEGETATION payload, which would be launched with the SPOT-4 satellite. The payload had been developed jointly by France, Belgium, Italy, Sweden

and the European Commission, and would tentatively be launched in March 1998. It would deliver measurements with a medium spatial resolution of one kilometre, specifically tailored to land-surface monitoring parameters, with an approximately once-daily revisiting frequency on a global basis. The system would complement the existing spatial high-resolution capabilities of the SPOT satellite series, providing simultaneous spectral measurements in the visible and short-wave infrared domain of the electromagnetic spectrum. Applications in agriculture, forestry and environmental monitoring were being prepared. Further information on the VEGETATION payload was available at <http://www-vegetation.cst.cnes.fr:8050/>.

25. The coastal environment functioned as a buffer zone and interface between land and the open oceans and required heavily integrated coastal zone management to achieve sustainable development. The coastal zone comprised 18 per cent of the global surface, housing approximately 60 per cent of the human population and accounting for 90 per cent of the world's fish catch. The Marine Environment Unit in the Space Applications Institute of the Joint Research Centre of the European Commission used space technology to monitor toxic algae blooms in the Baltic and to give early warning of the "white tide" in the Northern Adriatic sea. A number of Ocean Colour Sensors were used or were being developed for oceanographic studies (for example, the Global Imager (GLI) and the polarization and directionality of the Earth's reflectances sensor (POLDER) on ADEOS II, the Sea Wide-Field Sensor (SeaWiFS) on OrbView-2, the Moderate Resolution Imaging Spectroradiometer (MODIS) on EOS AM-1 and EOS PM-1, the Medium Resolution Imaging Spectrometer (MERIS) on ENVISAT 1) and high-resolution sensors were used for coastal change studies (for example, the Advanced Visible and Near Infrared Radiometer (AVNIR) on ALOS, the Thematic Mapper (TM) on Landsat 5, the High Resolution Visible (HRV) on SPOT 1 and SPOT 2, the Modular Optoelectronic Multispectral Scanner (MOMS) on Priroda (MIR Space Station)). Earth observation of coastal regions were still in a pre-operational stage, key constraints being the lack of continuously operational Ocean Colour Sensors, lack of appropriate algorithms with local and timely calibration, low frequency of measurements, difficult access to data, unfriendly integration scheme with other data sources and poor information dissemination. Those problems were being tackled by several institutions with a view to creating a system to integrate multiple data sources and to assimilate data over time to improve the information on coastal regions.

26. The Director of the Andhra Pradesh State Remote Sensing Application Centre in India demonstrated the potential of remote sensing data and GIS for the management of natural resources at the village level. Mapping of geomorphology, lithology, geology, structure and lineaments, land use and land cover, soils, slopes, surface water bodies, drainage and watersheds, transportation networks, settlement locations and village boundaries had been completed on a 1:50,000 scale, using both remote sensing and conventional data. The acquired information had resulted in specific local recommendations for the rainwater harvesting structure, soil moisture conservation and fodder and fuel wood development.

D. Benefits of international cooperation in space activities

27. The representative of the National Aerospace Laboratory of the Netherlands presented the Forest Assessment and Monitoring Environment (FAME) concept for a worldwide operational forest monitoring system. Studies by the Food and Agriculture Organization of the United Nations (FAO) had revealed several impediments to the operational use of remote sensing satellites and GIS for sustainable forest management. They included political and financial factors and also functional and performance requirements. The FAME concept was intended to overcome those limitations, enabling the forest manager to acquire information on forest changes directly where it was needed, in the office of the forest manager. Information on the latest FAME developments could be requested from <fame@itc.nl>.

28. Remote sensing cooperation activities in the Asia and the Pacific region of the National Space Development Agency (NASDA) of Japan were discussed by a representative of its Office of Earth Observation. NASDA had launched several Earth observation satellites, including the Marine Observation Satellites MOS-1 and MOS-1b, the Japanese Earth Resources Satellite JERS-1, the Advanced Earth Observing Satellite ADEOS (no longer functional), the Tropical Rainfall Measuring Mission TRMM, and several geostationary meteorological satellites. ADEOS-II

and the Advanced Land Observing Satellite ALOS were currently at the development stage. Bilateral cooperation projects with countries in the Asia and the Pacific region included direct data reception of JERS-1 in Australia, Canada, China, Indonesia, the Republic of Korea, Thailand and the United States. Pilot projects for practical data use had been established with Thailand, including data analysis cooperation in the Global Energy and Water Cycle Experiment (GEWEX). Several multilateral cooperation projects had been started and others were under consideration.

29. The representative of the Scientific and Industrial Research and Development Centre of Zimbabwe discussed his country's experiences with space systems for disaster warning in Southern Africa. While remote sensing applications for mining and forestry had already been established, the problem of drought mitigation was still not being properly dealt with. He also discussed the influence of the 1997 El Niño phenomenon, which had caused drought in certain parts of Zimbabwe, and the need to use space technology to mitigate the effects of such disasters.

30. The Director of the World Weather Watch programme of WMO made a presentation on the topic "Meteorology in the year 2000: the impact of remote sensing". General improvements in space-based meteorology beyond 2000 would include better detection of natural hazards, increased use of applications, improved timeliness and accuracy of forecasts and warnings and enhanced capabilities to distribute meteorological information among nations and to the public. That would lead to improved aviation and marine and maritime safety and efficiency, agricultural productivity, forest and range management, weather forecasting for the public, environmental quality and understanding of the climatology and climate variability.

E. Presentations by representatives of the space industry

31. Surrey Satellite Technology Ltd. was well known for its development of a series of small satellites (100-500 kg class) that could provide developing countries with affordable access to space. Technology transfer programmes had taken place with Chile, Malaysia, the Republic of Korea, Pakistan, Portugal, Singapore, South Africa and Thailand. The objectives of the programmes were to train engineers to be the nucleus of an indigenous space industry, to launch a first national microsatellite and demonstrate its applications and to establish national space facilities and capabilities. The technology transfer programmes covered microsatellites and ground stations and involved both academic and skill training. Current studies for future projects included a microsatellite constellation for disaster monitoring from space and a low Earth equatorial orbit constellation of telecommunications satellites, as well as a possible scientific lunar mission that would require international cooperation.

32. Argos was a global satellite-based location and data collection system that had been operational since 1978; it was dedicated to studying and protecting the environment. Currently, two polar-orbiting National Oceanic and Atmospheric Administration (NOAA) satellites were used to receive and retransmit signals for various applications, including the monitoring of fishing vessels, wildlife studies, oceanography, volcanology, hydrology, glaciology and meteorology. The time from acquisition to delivery of data could be as little as 20 minutes. Thousands of water, land and airborne transmitters weighing under 1 kg and as little as 25 g were currently in operation. An enhanced Argos-2 payload would be launched on-board NOAA-K in early 1998 and on the future NOAA Polar Orbiting Environmental Satellite System (POESS). In 1999, an Argos-2 instrument, with downlink messaging capability, would be put into orbit with ADEOS-II and later Argos-3 would be launched with the European METOP-1 satellite.

33. ORBCOMM was the world's first commercial low-Earth orbit (LEO) mobile satellite system providing global two-way narrow-band data communication. The first two satellites were in orbit and the full constellation of 28 satellites would be in service in 1998. The technology was based on low-cost LEO satellites and low-cost subscriber equipment, providing a cost-effective solution for applications, including data monitoring, tracking of transportation and heavy equipment, environmental data collection and messaging.

34. ORBIMAGE had successfully launched the OrbView-1 and OrbView-2 satellites. OrbView-1 was the world's first privately operated weather satellite, mainly providing scientific and environmental data with a low spatial

resolution of 10 kilometres and a high temporal resolution for disaster detection capability. OrbView-2 was an operational satellite providing daily colour images of the world with 1.1 kilometres spatial resolution. Its major commercial applications included coastal zone and environmental monitoring, marine navigation, offshore oil and gas operation, natural disaster mitigation and coastal and deep ocean fishing. OrbView-3 would provide 1 and 2 metre resolution in panchromatic mode, 4 metre resolution in multispectral mode, and 8 metre resolution in hyperspectral mode (280 bands) imaging, and would complement the capabilities of the existing satellites.

35. Space Imaging EOSAT had integrated the world's largest constellation of satellites and aerial mapping sources, including the Landsat satellites, the Indian Remote Sensing (IRS) satellites, the Canadian RADARSAT satellite, the Japanese Earth Resources Satellite (JERS-1) and the ESA ERS-1 and ERS-2 satellites. Imagery with 1 metre high-resolution in panchromatic mode and 4 metre resolution in multispectral mode would be provided by IKONOS 1, to be launched early in 1998.

36. The President of the Association tunisienne de la communication emphasized in his presentation on education at a distance the benefits of using space technology for distance education. Merging the capabilities of telecommunications satellites with the interactivity provided by the Internet offered new prospects for tele-education applications, which would be particularly important in providing those services to regions with an underdeveloped infrastructure.

F. Space spin-offs and future applications

37. The International Space University (ISU) was a non-profit educational institution specializing in multidisciplinary advanced space study programmes. One of the two projects developed during the 1997 ISU summer session programme at Houston, Texas, focused on technology transfer. Specific coverage was given to methods for improving the transfer of technologies between the space and non-space sectors. The executive summary and the full report could be ordered from <publications@isu.isunet.edu>.

38. The Institute of Aerospace Medicine of the German Aerospace Research Establishment was conducting a number of telemedicine projects. Argonauta was a project to set up regional health-care networks in Argentina and Chile with links to German and Italian medical centres using mobile equipment and satellite technology. The remaining challenge, however, was to integrate developing countries into the Global Information Society.

39. With the imminent start of construction of the International Space Station in 1998, human spaceflight had become the prime domain for international cooperation in space. Although most developing countries had rightly set their top priorities in the fields of telecommunications and remote sensing applications, a few developing countries were considering or had already taken first steps to participate in human spaceflight missions. Once a country had decided to fly payloads on human-tended platforms, the challenge was to find adequate flight opportunities. SPACEHAB provided commercial beginning-to-end services for private and governmental customers. Possible applications of interest to developing countries included microgravity and life science research, chemical and biological processing and material research.

II. OBSERVATIONS AND CONCLUSION

40. Considering that the cost-effectiveness of space technology applications had been demonstrated in several application domains for improving infrastructures, the participants observed that specific and focused cooperative efforts should be made by international organizations and by national entities to promote the use of appropriate technologies. That would reduce the risk that the lack of national resources in developing countries would lead to a discriminatory situation in which space technology could not be used to help the development of those countries.

41. To trigger long-term sustainable development and to support the building of indigenous capacities in developing countries, international cooperation had to materialize in the form of:

(a) The effective transfer of know-how to developing countries through education, on-the-job training, opportunities to attend meetings, networking capabilities and access to information;

(b) Coordinated and targeted funding of application projects of high relevance to developing countries, based on a committed partnership by the developing countries in terms of human, technical and financial resources;

(c) The provision of business opportunities for local industry through joint ventures with companies from more developed countries.

42. International organizations were urged to play a key role in ensuring that the above measures were implemented as quickly and as widely as possible, while Governments of developing countries were urged to consider the use of space technology as a cost-effective tool to improve infrastructures and consequently to commit human and financial resources to implementing its use in the country.

43. The creation of an international advisory body on space technology was urged, whose main task would be to act as a reference contact entity for institutions in developing countries that were willing to improve the national use of space technology. That body should, among other things:

(a) Ensure the availability of simple but effective executive brochures on the cost-benefit results that could be expected from application projects;

(b) Provide developing countries with dedicated, integrated and easy-to-access information on results achieved through the use of space technology, sources of specific information, and opportunities to attend events and meetings;

(c) Help institutions from developing countries to define their specific needs for cost-benefit analyses of using space technology in local application activities;

(d) Advise institutions from developing countries on how to prepare space technology application projects to attract international cooperation and funding opportunities.

44. Participants also reiterated many problems that had already surfaced during the discussions in previous workshops, in particular the following:

(a) There were already a number of applications, for example forestry, land use and land cover, geology and agriculture monitoring, that were close to operational maturity. Availability, the standardization of data sets and in many cases also the affordability of space technology were, however, matters of great concern, especially for the developing countries that would benefit most from those applications;

(b) Among key issues preventing the use of space technology in developing countries were the lack of training opportunities, the low number of skilled personnel and a weak or non-existent basic support infrastructure. The needs of developing countries should therefore be defined, bearing in mind their existing resources;

(c) There was an urgent need to make decision makers more aware of the capabilities of space technology applications and their utility in developing infrastructure and of the cooperative effort programmes already in existence which were designed to achieve sustainable development.

45. The participants concluded that the use of space technology for the mapping of natural resources had proved to be cost-effective, especially with regard to improving infrastructural facilities in some developing countries. The lack of national resources should not therefore be considered as an insurmountable barrier for the use of space

technology in solving problems, as the resulting benefits would outweigh the initial burden of investing in space technology for monitoring natural resources and improving infrastructural facilities.

Notes

[1]See *Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 9-21 August 1982* (A/CONF.101/10 and Corr.1 and 2), part one, sect. III.F, para. 430.

[2]*Official Records of the General Assembly, Fifty-first Session, Supplement No. 20* (A/51/20), sect. II.B, para. 39.