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ENVIRONMENT AND SUSTAINABLE DEVELOPMENT: INTERNATIONAL
DECADE FOR NATURAL DISASTER REDUCTION

Early-warning capacities of the United Nations system
with regard to natural disasters

Report of the Secretary-General

SUMMARY

    The present report is submitted pursuant to General Assembly resolution
49/22 B of 20 December 1994 and contains information about the early-warning
capacities within the United Nations system with regard to natural and similar
disasters which have an adverse impact on the environment. The use of
telecommunications in support of early warning is described in accordance with
Economic and Social Council resolution 1995/47 A of 27 July 1990.

    The report reviews the current early-warning activities of organizations
in the United Nations system and proposes improvements and ways in which they
may be coordinated more effectively. Consideration is given to the roles of
technology and telecommunications in the warning process. Conclusions and
proposals are made for a process that can lead to the appropriate transfer of
technology, in particular to developing countries, and for means of
contributing to improved coordination of early warning internationally.

CONTENTS

CONTENTS (continued)

I. INTRODUCTION

A. The value of early warning

1.   The timely and effective warning of possible disaster is a self-evident
objective, universally pursued by Governments and organizations in determining
disaster-reduction strategies. It is critical for individuals in local
communities organizing practical measures to protect their own lives and
property. Advances in science and technology have expanded the possibilities of
anticipating the effects of many, but still not all, of the hazards which
threaten nearly every country in some way.

2.   As countries incorporate disaster-reduction policies into their national
social and economic development plans, establish effective preparedness measures
and improve their response capacities, the value of timely and effective
warnings in averting losses and protecting resources becomes apparent. Many
sectors of a society need to contribute to these efforts. When they are able to
focus their attention on mutual collaboration for effective early warnings, the
results can be impressive.

3.   In 1991, government officials of Andhra Pradesh, India, were able to
implement a previously planned programme to evacuate 600,000 people from the
path of an approaching cyclone within 40 hours. This was possible because the
results of meteorological forecasts and warnings were communicated through a
combination of advanced and traditional channels to people conversant with the
preparedness plan from earlier community exercises. Fatalities numbered less
than one tenth of the more than 10,000 people who perished in a similar cyclone
13 years before. At that time in the same location, neither warning,
communications nor local response capacities were as well established.

4.   Another example of successful early warning occurred prior to the volcanic
eruption of Mt. Pinatubo in the Philippines in 1991. The results of
sophisticated scientific monitoring techniques were translated rapidly into a
common public understanding through simple means directly to the vulnerable
communities. When these warnings were coupled with the timely implementation of
previously organized preparedness activities, more than 350,000 people were
spared personal physical harm from the largest explosive volcanic eruption of
the twentieth century.

5.   While not all hazards offer the same possibility of prediction or
forewarning, national Governments none the less bear the sovereign
responsibility to the best of their abilities to protect their citizens from
disasters. In this respect, Governments in their policies, and local
communities by their actions, display varying degrees of awareness, commitment
and ability in adopting successful disaster-reduction strategies.

6.   Organizations of the United Nations system have shown long-standing
commitments to early-warning programmes. In some cases, programmes have
provided an institutional base or framework for the identification and reporting
of specific hazards at international or regional levels. In others, they have
been instrumental in encouraging common standards or procedures which assist in

the collection, interpretation or dissemination of data. Their activities
frequently transfer technology among specialists or between national
authorities. Other programmes focus on technical assistance and training for
capacity-building in developing countries.

7.   For all the recent scientific and organizational progress made in the
conceptualizing, establishment and operation of early-warning systems, both
within and beyond the United Nations system, early warning is still inadequate
for most of the world's population. The technical ability to foresee and
interpret most hazards is no longer as limited as it once was. Modern
communications technologies provide more access to information, more quickly. A
major challenge remains to ensure that this knowledge can be accessible to,
understood by and acted upon by local communities and the people most directly
affected by threatened disasters.

B.   International interest in early warning

8.   Since the proclamation of the International Decade for Natural Disaster
Reduction by the General Assembly in its resolution 44/236 of 22 December 1989,
the International Framework of Action for the International Decade for Natural
Disaster Reduction, contained in the annex to the resolution, has provided a
wider context for concerted international action to involve technical resources
and improved coordination in critical areas of natural disaster reduction.
Timely and effective warnings are a basis for creating the culture of prevention
necessary for a safer world in the twenty-first century.

9.   During the Conference on Disaster Communications held in May 1991 at
Tampere, Finland, the unequal access of countries to communications technology
for effective early warning was identified. While many of the recommendations
of the Conference addressed communication requirements for emergency response,
one recommendation in particular encouraged the establishment of mechanisms for
international cooperation in the use of terrestrial and satellite communications
technologies in the prediction, monitoring and early warning of disasters. 1/

10.   By building on the increasing awareness of disaster prevention among
countries encouraged by the International Decade, the World Conference on
Natural Disaster Reduction, held at Yokohama, Japan, from 23 to 27 May 1994,
succeeded in providing renewed emphasis and focus to achieve the goals of the
Decade. One of these goals, formulated in the founding resolution of the Decade
(resolution 44/236), is to provide by the year 2000 ready access for all
countries to global, regional, national and local warning systems and the
possibility of broad dissemination of warnings.

11.   In specific terms, the findings of the Yokohama Conference's Technical
Committee on Warning Systems, organized jointly by the World Meteorological
Organization (WMO) and the United Nations Educational Scientific and Cultural
Organization (UNESCO), provide expert guidance for future applications of
existing knowledge. 2/

12.   The primary outcome of the Conference, the Yokohama Strategy for a Safer
World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation,

containing the Principles, the Strategy and Plan of Action, 3/ supplemented by the Yokohama Message 4/ and the recommendations and reports of the Main Committee and Technical Committees of the Conference, 5/ constitute a basis for concerted international efforts encouraged by the United Nations to improve early warning of disasters.

13. The Yokohama Strategy and Plan of Action underscore the importance of strengthening capacities at local, national, regional and international levels to warn of the possibility of disaster from natural phenomena or environmentally destructive occurrences. A principle of the Strategy notes that early warnings and their effective dissemination by telecommunications, broadcast services and other means are key factors to successful disaster prevention and preparedness. The Strategy itself emphasizes, inter alia, the necessity for improved risk assessments, broader monitoring and the communication of forecasts and warnings.

14. These forward-looking outputs of the Conference were considered by the General Assembly during its forty-ninth session and endorsed in its resolution 49/22 A of 2 December 1994. The General Assembly recognized the specific value of early warning and effective dissemination as key factors to successful disaster prevention and preparedness in all countries, but especially for developing countries.

15. In the context of the International Decade for Natural Disaster Reduction, the General Assembly also adopted resolution 49/22 B of 20 December 1994, in which it requested the Secretary-General to report to it at its fiftieth session on early-warning capacities within the United Nations system. The Assembly also invited proposals on how those capacities might be improved and better coordinated in order to provide for an adequate response to natural disasters and similar disasters with an adverse impact on the environment.

16. In addition, and by taking account of chapter 34 of Agenda 21 6/ as well as the Principles of the Yokohama Strategy for a Safer World, proposals were invited on the transfer of technologies related to early warning, particularly to developing countries. Recommendations were also requested on the capacity of the United Nations system to coordinate information about natural and similar disasters, and how this information could be passed effectively to national, regional and sectoral early-warning capacities.

17. Subsequently the Economic and Social Council, during its substantive session of 1995, adopted resolution 1995/47 A of 27 July 1995, in which it recognized the importance of reliable and hazard-resistant telecommunications for disaster reduction, in particular in support of early warning at all operational levels. The Council also invited proposals from the Secretary-General for further improvements in the field of disaster-related telecommunications and further invited him to ensure close cooperation between the International Framework of Action for the International Decade for Natural Disaster Reduction, the Department of Humanitarian Affairs of the United Nations Secretariat and the International Telecommunication Union (ITU).

18. As the world takes a serious look at development requirements into the next century, as well as the means by which resources can best be utilized within the United Nations system, early-warning strategies provide one of the keys for

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coordinated efforts to protect development accomplishments. Improved early-warning practices can link the abilities and resources of the United Nations system with the interests of all countries in protecting human resources and physical assets. At the same time, national capacities for disaster reduction can be created within those communities most exposed to natural hazard.

II. THE DISASTER CONTEXT OF EARLY WARNING

A. The purpose of early warning

19. Early warning is a deceptively simple notion. It can be understood narrowly as the means by which a potential danger is detected or forecast and an alert issued. However, this leaves unspecified the responsibilities for the dissemination of warnings and the response which is necessary to avoid potential harm or loss.

20. Warnings represent an added value and function. There are three abilities which constitute the basis of early warning. The first, largely a technical ability, is to identify a potential risk, or the likelihood of occurrence, of a hazardous phenomenon which threatens a vulnerable population. The second ability is that of identifying accurately the vulnerability of a population to whom a warning needs to be directed. The third ability, which requires considerable social and cultural awareness, is the communication of information to specific recipients about the threat in sufficient time and with a sufficient clarity so that they take action to avert negative consequences.

21. This highlights four components of the warning process:

    (a) Assessment of the vulnerability of potentially affected people;

    (b) Detection, interpretation and forecasting of hazards;

    (c) Formulation and dissemination of warning messages to specific targeted recipients;

    (d) The perception of and reaction to warnings by the intended recipients.

22. For the warning to be successful, these actions need to be taken in sufficient time in order to save lives, property and livelihoods that would otherwise be lost to disasters. Depending on the nature of the hazard, the location of vulnerable people and assets, and designated responsibilities for action, elements of warning systems may be organized and implemented at local, national, regional or international levels.

23. The early-warning process has to be interpreted in this broad context in order to address the General Assembly's concern for improvements in warnings.

B. Effectiveness of early warning

24. Warning systems are only as good as their weakest link. They can, and
frequently do, fail in both developing and developed countries for any of four
primary reasons. There can be a failure of forecasting, demonstrated by an
inability to understand a hazard or a failure to locate it properly, in time or
space. There also may be an ignorance of prevailing conditions of vulnerability
determined by physical, social, or economic inadequacies. A third possibility
can be a failure to communicate the threat accurately or in sufficient time.
Finally, there can be a failure by the recipients of a warning to understand it,
to believe it or to take suitable action.

25. The capacity of a Government or a community to respond to a warning can
also be constrained by a range of practical as well as conceptual limitations.
Adequate human, material and technical resources are needed to establish and
operate early-warning systems properly. This raises choices as to whether to
apply often scarce resources to meet other competing priorities within a
society, or to provide protection for assets over a longer period of time
against something which may only occur in the unspecified future, or perhaps not
at all.

26. The functions of early warning are accomplished by various professional or
specialized groups in a society. They include the scientific community,
government officials, communications authorities, broadcast media, disaster-
management agencies and often the military. Each of these groups has its own
organizational structure and methods of operation. The nature of their regular
responsibilities does not necessarily bring them together to address issues of
early warnings.

27. If a narrow approach to warning is taken by an agency or organization,
limited to its own area of competence and with less regard to the utilization of
its output by others, the reliability and utility of the entire system is
diminished. Therefore, each phase of the warning process must be accomplished
effectively, accurately and in a timely manner with a full understanding of the
relationship to the other parts of the process. A basic indicator of success
for early warning is the demonstrated capacity for joint action among the
various contributors.

C. Disasters, vulnerability and risk

28. Disasters happen when a natural phenomenon or unplanned occurrence of great
force strikes a population that is vulnerable to its effects. During the latter
half of the twentieth century, the results of scientific endeavours have
provided a much better understanding about the natural forces which shape
hazards and determine their behaviour. Major advances have been made in the
capacity to anticipate potentially destructive natural phenomena and in the use
of communication media to channel this knowledge to the people concerned.

29. At the same time, rapid population growth has increased social and economic
pressures on the natural environment in many countries. Natural features which
previously provided protection from hazards have been uprooted or altered. The

growing tendency of people to live on marginal or fragile landscapes or in conditions of urban poverty has increased their vulnerability to hazards. Despite the best efforts, only modest gains have been registered in the equitable distribution of the benefits of national development in many countries. These issues, along with other unfavourable social and economic factors have combined to increase the number of people who are exposed to risk - and are therefore at risk - from natural and similar disasters.

D. Hazards

30. With the exception of earthquakes, it has become technically possible to anticipate the occurrence of most disasters arising from natural hazards, although the time of forewarning and the range of appropriate responses to the risk varies with the individual hazard. With regard to human-induced hazards, which could have an adverse impact on the environment, greater complexity and our still evolving knowledge make their identification and forewarning more demanding.

31. In considering the early warning of natural disasters and similar disasters with an adverse impact on the environment, as stipulated in General Assembly resolution 49/22 B, the present report does not include disasters arising from extreme social, ethnic or political disparities or conflict situations which may induce large population displacements. Other slowly evolving factors which may constitute forms of long-term environmental modification and potential future hazards, such as global warming and rising sealevels, are also beyond the scope of early-warning concerns covered by the report.

32. The following categories reflect the types of hazards reviewed in the present report and addressed by early-warning capacities within the United Nations:

     (a) Meteorological and hydrological hazards, including floods, droughts, all types of storms, cyclones/typhoons/hurricanes, weather and climate extremes;

     (b) Geophysical hazards, including earthquakes, landslides, volcanic activity, mudflows, tsunamis;

     (c) Environmental hazards, including erosion, drought, desertification, wildfire, infestation;

     (d) Technological hazards, including accidental nuclear, chemical or industrial release, structural or infrastructural systems failure.

33. While the above categorization is of assistance for a review of existing warning systems, it should be noted that one type of disaster can trigger others, as in the case of an earthquake resulting in flooding, urban fire or technological emergencies. The users of warning systems need to be aware of the possibility for multiple hazards and their compound effects.

III. TECHNICAL PRACTICES AND EARLY WARNING

A. Technology and warning practices

34. New technologies can provide better understanding about hazards and can lead to improved accuracy in forecasting. The wider availability of information collection, storage, retrieval and dissemination by electronic means has facilitated the exchange of information among technical specialists and provided increased preparatory lead times. None the less, both industrialized and developing countries still need to arrange effective regulatory, institutional and agreed professional procedures for the useful application of those technologies that are available. The challenge in applying technology to disaster reduction is less a matter of its availability or suitability, than a need to understand it, the associated costs and the working relationships among intended users.

35. As the costs of innovations are reduced and the operational requirements of technology become simplified, advanced technical applications will become more widespread in early warning. With the acquisition of additional technical skills and the spread of personal computers, disaster managers at local community levels can access user-oriented technologies such as decision-support systems that can evaluate different scenarios for populations and property at risk. As access to more information increases, however, information management will become a major factor.

36. With the rapid advance of technology, it is necessary to recall who the primary recipients of early warnings are and the conditions in which many of them live. In many prevailing social and economic conditions, traditional systems provide the primary services and means for early warning. They can become more effective if actively promoted and refined for this purpose, especially if they relate to traditional disaster-reduction knowledge accumulated within local communities.

37. In contrast to the introduction of costly and sophisticated innovations, the improvement or partial updating of existing capacities may be more cost-effective. In order to ensure an equitable development of early-warning capacities world wide, there is a need to recognize both the relative values of traditional systems and the benefits of more sophisticated technologies. It is equally important to ensure that each type can be adapted, and that they can interact, when appropriate.

B. Communications and early warning

38. There are essentially three types of communications systems involved in the early-warning process. The first focuses on the detection of the hazard and the assessment of any risk which it may pose. The communications component is the telemetry associated with the relay of data and information from observing technologies to scientists or other specialists of the phenomenon. These systems are generally dedicated to the particular applications of the discipline concerned and managed by its scientific establishment.

39. The second level of communication links the technical community familiar with the hazard to the body of officials, politicians, government agencies or other organizations which are responsible for determining the relevance of hazard data to populations at risk. In order for them to carry out this responsibility of informing about an imminent threat and mobilizing appropriate preparedness and response measures, communications among the primary actors are essential. These actors may include civil-defence authorities, selected ministries, technical agencies and possibly military authorities. In this area, communications systems are frequently dedicated for the purpose and managed independently of regular public or communications services.

40. The third, and ultimately most critical stage of communications relates to conveying warnings and information to the public and local communities. Some elements of these networks may be managed by privately owned or commercial broadcasting entities, while others are operated by local or national authorities. The utility of these networks varies widely from country to country and even within countries.

41. Some advanced communications systems can transmit data to an automated facility, from which they are re-transmitted to the public without any additional human action. They can also activate automatic procedures in order to halt critical systems through electronic means. It is important that these technological possibilities provide the information that is relevant to a specific audience. This is an important human element requiring insight and understanding of local political, cultural and social situations.

42. The communications necessary for effective warnings are those which are in place and operational prior to the onset of a hazard. While there is a need for basic operational reliability, many established and routine forms of communication can be utilized effectively for early warning if there is an official recognition of their utility and organizational planning to do so. National telephone systems and existing radio networks of national agencies can be effective instruments for this purpose. This point is easily confused with other, quite different requirements for emergency communications necessary in the subsequent rescue and relief phases of disaster management, after the disaster has occurred and when previously existing means of communication may have become inoperable.

43. Satellite and other technologically advanced communications systems have proved their worth in disaster detection, analysis and preparedness, as well as response, but it is nevertheless important to relate these systems to the terrestrial systems, which are still the most characteristic means of communication within many developing countries. The ability of many people to provide for their own protection will continue to depend on local and familiar means of communication.

44. Many villages throughout the world will continue to use radio broadcasts, telephones, church bells, gongs, gunshots, sirens, loudspeakers, flags, marketplace public notices, instructions given by the mayor and other routine forms to convey local warnings. Ultimately, the added value of technology lies in its effective marriage with existing forms of communication to enhance the

accessibility and to increase the understanding of warnings by a greater number of people.

C. Technological opportunities

45. Relevant technological applications for improved warnings can best be considered by relating them to the primary functions of warning systems (see paras. 20-21 above). As the respective needs differ, so do the opportunities for possible transfer of technology.

46. Satellites, through their continuous coverage of the globe, provide essential information that can lead to effective detection and interpretation of many hazards. The ability of meteorological satellites to monitor the atmosphere continuously and to communicate varied types of data easily have made them a mainstay in the identification and analysis of meteorological and hydrological conditions. With their well-developed technology and relative simplicity in reporting, the use of satellites for transmission of data is one way of reducing costs while greatly enhancing the efficiency of in-country communications for early warning, once the expensive capital costs are met. The utility of their products is evident, for example, in the photographs of cloud cover which appear regularly in newspapers and other forms of media throughout much of the world.

47. Airborne and satellite remote-sensing techniques such as aerial photography, imaging radar and multi-spectral scanning represent other tools which can improve hazard detection and analysis. They can be used to observe, map and monitor features and phenomena on the earth's surface. Data can be provided or changes measured for estimating rainfall or observing possible indicators of drought or infestation. Experimental work continues to expand satellite observation for flood forecasting and identification of possible landslide warnings and in contributing to experimental efforts of earthquake prediction and possible volcanic activity.

48. Sophisticated analytical remote-sensing tools have been married to simplified graphical representations that are able to provide packaged information for particular locations or purposes. When linked with personal-computer technology and the possibility of electronic communications, the information becomes highly portable and widely accessible. While vast amounts of information can be generated, compilers or packaged information can tailor the amount of data or the complexity of its presentation to match the requirements and skills of end-users.

49. As the judgements and decision processes of experts and large amounts of scientific information can be compiled in computerized decision support systems and disseminated at minimal cost, there is an expanding opportunity to translate specialist knowledge into forms suitable for local applications. The development of CD-ROM technology in connection with personal-computer applications can bridge technical information gaps economically in many countries. Expert systems can be used to provide guidance for decision-making by disaster managers or in guiding an appropriate response for specific types of warnings.

50. The combination of remote-sensing data with global positioning and geographic information systems (GIS) can provide a powerful means for more precise interpretation of data if a sufficient level of expertise and technical resources is available. The technology can relate important community facilities graphically to areas of potential hazards to facilitate the preparation of the risk maps which are essential for planning effective preparedness and response measures. These technologies can also be applied to provide a more refined analysis of terrain factors to identify potential mountain hazards.

51. As the forecasting of natural hazards relies on the analysis of mathematical models and verifiable environmental conditions, any opportunity for new or additional information to update and develop these references further is important. The availability of more precise data generated by any advanced technology contributes to potential gains in warning accuracy through improved interpretive skills. Applications of space technology, especially, have provided a dramatic increase in the possibility of monitoring and improving understanding about the relationships between the earth's physical, chemical and biological interactions in the atmosphere, oceans and land areas.

52. A regional remote-sensing project in support of the early-warning and food security system for the 11 countries of the Southern Africa Development Community (SADC) provides an example of how technical assistance can support regional and national warning capabilities. Started in 1988, the project has established an operational information system able to process satellite and space technology data into information products disseminated among SADC countries over electronic mail links. GIS applications are used to support regional and national early-warning systems. The use of electronic mail and an inexpensive combination of hardware and software allows individual country agencies to access information materials throughout the region.

53. The project has been able to apply modern applications of technology, but without losing a human dimension in creating a sustainable basis for the programme. All of the technical support and necessary backstopping is to be met from within the shared capacities of the SADC countries.

IV. UNITED NATIONS SYSTEM INVOLVEMENT IN EARLY WARNING

54. Within the United Nations system there are numerous activities which contribute to different aspects of the early-warning process. A review of the purposes, primary actors and perceived strengths or relative weaknesses of various programmes is contained in a technical information paper prepared by the secretariat of the International Decade for Natural Disaster Reduction. The summary given here indicates the breadth and diversity of the commitment of the United Nations to early warning.

A. Early warning for meteorological and hydrological hazards

55. Early-warning systems can have a marked effect on reducing fatalities associated with meteorological and hydrological disasters. In the 30 years

between 1900 and 1929, hurricanes killed more than 10,000 people in the United States of America. In the period from 1947 to 1975, fewer than 2,000 died despite similar occurrences of the hazard. By 1992, as one of the most powerful storms to hit the North American coastline, hurricane Andrew caused more than $20 billion in damages but caused only 23 deaths, in a striking testimony of the effectiveness of early-warning systems.

56. In spite of larger and more concentrated populations living in areas of risk, these accomplishments have been made possible by means of faster transmission of more data, improved forecasting, the composition of better warnings and effective communication of information to the public. Most importantly, the warning process is integrated into organized emergency planning and effective community response programmes.

57. A consistent global approach within the United Nations system has yielded beneficial returns on investments in meteorological and hydrological warning activities. The World Weather Watch (WWW), coordinated by the World Meteorological Organization (WMO), is a telling example of global cooperation in the collection, analysis and distribution of vital weather information and forecasts. Standardized communication systems, protocols for the presentation of observed data and processed information and a common terminology, all developed under the auspices of WMO, have been the keys to universal acceptance and usefulness.

58. The coordinated efforts of national systems comprise the three main components of the World Weather Watch system. The Global Observing System observes and measures meteorological conditions by air, land, sea, and space, providing data and information needed by a country for its own weather services on a daily basis, in addition to forecasting severe events. The associated Global Data Processing System consists of a network of global and regional data-processing centres which produce daily weather analysis, forecasts and guidance for weather advisories. These are disseminated world wide by the third component, the Global Telecommunications System. The experience gained over 30 years demonstrates the utility of free and unrestricted exchange of information through a dedicated global means of communication linked to individual national technical agencies.

59. The Twelfth World Congress of WMO provided additional emphasis for the organizations' role in fostering inter-agency coordination related to early warning. Member countries encouraged WMO to provide the benefit of its specialist knowledge, information and operational structures related to meteorology and hydrology in support of United Nations humanitarian and relief efforts before, during and after natural disasters and other forms of crisis. This important organizational initiative underlined the types of effort which can foster greater synergies among specialized agencies for common benefit.

60. WMO has established coordination mechanisms to provide comprehensive coverage and early-warning capability for tropical cyclones through the regionally coordinated actions of the Tropical Cyclone Programme. Activities are accomplished in association with national meteorological services located in the six affected regional ocean basins of the world and in the Asia and the

Pacific region, with the additional collaboration of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

61. The WMO programme assists member countries in upgrading their national forecast and warning services for tropical cyclones and related hazards through regionally coordinated systems. An important part of the strategy is the encouragement of country authorities to establish national disaster prevention and preparedness measures and the promotion of effective community responses to warnings. In recognition of the vital role of national meteorological services in providing warnings of severe weather events to the community, WMO's Public Weather Services Programme includes specific projects directed at strengthening the capacities of national meteorological services and in raising the awareness and level of public understanding about the services provided.

62. The Hydrology and Water Resources Programme of WMO is a world-wide network of flood forecasting systems consisting of data collection and transmission systems linked in real time to national and basin-wide forecasting centres. As with WWW, the systems are operated by national agencies of the countries concerned, working within a common agreed framework of functions and reporting standards. Warnings are disseminated within the relevant basin area by the technical facilities concerned.

63. The current development of the World Hydrological Cycle Observing System by WMO, with the support of the World Bank and others, will help to coordinate bilateral and multilateral contributions at both international and regional levels to further the coordination and technical consistency of water resource systems in the developing countries within the Hydrology and Water Resources Programme.

64. The African Centre for Meteorological Applications to Development and the Drought Monitoring Programme in Eastern and Southern Africa are other examples of regional programmes initiated by WMO to develop hazard-monitoring capabilities linked to longer-term national development objectives within a geographical area. Through ongoing assessment activities and the production of medium-term forecasts appropriate to climatological and drought hazards, these programmes demonstrate the potential social and economic significance of technical cooperation motivated by early-warning initiatives.

B. Early warning for geophysical hazards

65. Given the nature of the phenomena, the opportunities for accurate prediction and warnings of geophysical hazardous events are limited and earthquake prediction is not yet possible. Advances in scientific research have improved the interpretation of critical stages in preliminary volcanic activity, although that alone does not prevent disasters, as was tragically demonstrated in 1985 by the Nevada del Ruiz volcanic mudslide in Colombia. There can be a brief warning period prior to the effects of a local tsunami, or several hours' notice provided for ocean-wide warnings of tsunami events. In either case, warnings are useful only to the extent that response mechanisms can act at short notice.

66. There is no global, comprehensive identification or warning structure within the United Nations system for geophysical hazards. There is, however, the hazard-specific Pacific Tsunami Warning System organized by the Intergovernmental Oceanographic Commission (IOC) of UNESCO. From the Pacific Tsunami Warning Centre in Hawaii, the programme monitors seismic and tidal reporting stations spread among 26 participating countries to detect and locate earthquakes in the Pacific region which may generate tsunamis.

67. Warning and information bulletins are issued rapidly through the WMO Global Telecommunications System and in conjunction with the telecommunications network of the international aeronautical systems. A variety of local visual and auditory warning signals then alert populations in potentially affected areas. Public education and awareness activities have proved to be essential in the countries concerned, and information guides are prepared to support education, operations and field studies of the specific hazard.

68. While there is no comprehensive international programme for the early warning of geophysical hazards, there are some internationally acknowledged technical facilities or national agencies which collect, analyse and disseminate information regarding global seismic and volcanic events. The Global Volcanism Network of the Smithsonian Institution in the United States, the National Earthquake Information Centre of the United States Geological Survey and the International Seismological Centre in the United Kingdom of Great Britain and Northern Ireland are three such examples which provide information world wide. While these and other agencies monitor and document seismic events, and UNESCO is active in supporting activities in geophysical activities, there remains an unmet need for the global consolidation of geophysical disaster awareness, reduction and support to national capacity-building, as is evident with other types of hazards.

C. Early warning for environmental hazards

69. Droughts develop from a complex interaction of factors, including land use, water management practices, weather and many aspects of human activity. Agricultural production and other relationships between economic or social requirements of a society and the environment can be affected by disruptive factors such as pests, erosion, pollution or severe weather conditions which occur over long or short periods of time. Because of this complexity and uncertainties about human actions, early warnings about environmental hazards must be sensitive to many variables. The monitoring of potential hazard indicators, the formulation of warnings and the identification of appropriate response mechanisms for environmental hazards all require a broad range of organizational involvement and a variety of professional abilities.

70. The Global Information and Early Warning System on Food and Agriculture (GIEWS) operated by the Food and Agriculture Organization of the United Nations (FAO) is a comprehensive international warning system for crop and food supply conditions. It monitors the international crop and food supply/demand conditions and the factors likely to affect them. It identifies countries and regions where food shortages may become imminent and maintains continuous assessments of possible emergency food needs, maintaining close liaison with the

World Food Programme (WFP) in the process. Satellite data are used extensively to monitor crop conditions.

71. FAO receives monthly reports of demand requirements and cropping conditions from FAO member countries; this is augmented by additional information obtained from other United Nations organizations such as WFP, WMO, the World Health Organization (WHO), the Office of the United Nations High Commissioner for Refugees (UNHCR), the United Nations Development Programme (UNDP) and the Department of Humanitarian Affairs of the United Nations Secretariat, special joint assessment missions, and from other contributors outside the United Nations. The programme disseminates forecasts and reports ongoing assessments to Governments, international organizations, scientific and private institutions and others world wide. Special country alerts are issued in cases of the rapid deterioration of a country's food security situation.

72. FAO also supports regional initiatives that monitor additional threats to food supplies. The FAO Desert Locust Information Service monitors, analyses and disseminates information about the locust situation in affected countries, in conjunction with associated weather and vegetation conditions. Use is made of satellite remote sensing, GIS and analytical models of locust behaviour to provide forecasts and early-warning information. The FAO Emergency Prevention Systems for Transboundary Animal and Plant Diseases for Desert Locust Component is another regional programme which alerts and supports response activities for this particular hazard. By focusing on capacity-building, it acts to reduce the risk of locust plagues through long-term management and research activities in the affected countries.

73. A comprehensive environmental monitoring programme has been initiated by the United Nations Environment Programme (UNEP). The United Nations System-wide Earthwatch Programme is proceeding to coordinate, harmonize and integrate the observation, assessment and reporting activities related to environmental and socio-economic information throughout the United Nations system. The objective is to provide a consolidated basis for decision-making about sustainable development and to warn countries and the development assistance community of emergency problems requiring concerted and timely international action.

74. Regional or intergovernmental authorities provide additional emphasis for specific warning requirements. The Intergovernmental Authority on Drought and Development, composed of countries in north-eastern Africa, manages a regional Early Warning and Food Information System. The programme monitors crop and livestock production and marketing through systematic data collection and analysis. Efforts are focused on the development and application of early-warning methodologies and improved communications suited to the area, in addition to local staff training and the distribution of information.

75. Other similar programmes are the Regional and National Early Warning System conducted by the countries of the Southern Africa Development Community and the AGHRYMET Programme of the Inter-State Committee on Drought Control in the Sahel. Support is provided by United Nations specialized agencies to each of these programmes, in which satellite observation and electronic communications systems are employed along with conventional national and regional telecommunications

systems for the interpretation and dissemination of early-warning information for participating countries.

D.   Early warning for technological hazards

76.   In addition to providing emergency warnings of an imminent technological threat to the environment, as in a chemical or nuclear release, the systematic analysis of information, often involving a multidisciplinary range of specialists, is an important component of early warning for technological hazards. In contrast with known natural hazards with evident effects and likely seasons or location of occurrence, technological or chemical hazards having an adverse effect on the environment may exist in the midst of communities which are unaware of the threat which they represent.

77.   There is a special need for early warnings of technological hazards to be able to alert, but also to identify, evaluate and inform about sources of potential risks. As there can be causal relationships between natural and technological disasters, there is a growing concern that multiple hazard risks are emerging more rapidly than the knowledge base to anticipate appropriate means of prevention or response.

78.   In the area of nuclear and radiation hazards, the International Atomic Energy Agency (IAEA) oversees an international framework organized to minimize the environmental, health and economic consequences of a nuclear accident. The 1986 IAEA Convention on Early Notification of a Nuclear Accident is the primary instrument to ensure the timely and adequate notification to authorities of countries that might be affected by a nuclear accident. It is a matter of some interest that the Convention, now ratified by 75 countries with 68 additional signatory countries which have not yet ratified it, was negotiated immediately after the Chernobyl reactor accident.

79.   IAEA requires that accident notifications refer to standardized data to create a common information structure. Requirements were outlined in a 1992 guidance document and IAEA provides a standard basis of reference with the International Nuclear Event Scale, which allows a common understanding of nuclear events among the technical community involved, the media and the public. As it is used to describe the magnitude of an event and also to inform the public promptly and consistently of various aspects pertaining to safety, it could serve as a model for the development of global nomenclature and advisory standards for other types of hazards and comprehensive warning systems.

80.   IAEA collaborates with other international organizations in an exemplary model of coordination which is based on the reliability and technical abilities of its partners. The coordinating mechanism is the Inter-agency Committee for the Response to Nuclear Accidents, which is chaired by IAEA. WMO plays an important supporting role, as it provides IAEA with 24-hour backup support to prepare projections of atmospheric conditions essential for accurate warnings. WMO's Global Telecommunications System is also utilized by IAEA for the dissemination of warnings. WHO participates with a concern for medical and health-related issues, as well as maintaining special arrangements to provide public-health support in response to a request from a national ministry of

health. FAO is concerned with food distribution and consumption issues
following an event, while UNEP contributes environmental and natural resources
information and support. IMO provides technical information in relation to
nuclear pollution at sea. The Department of Humanitarian Affairs of the United
Nations Secretariat assists in the dissemination of information about the event
internationally.

81. In a broader context, WMO has an environmental Emergency Response
Activities programme to facilitate the international exchange of data and
information following the dispersion of nuclear or other forms of environmental
pollution. As a component of WMO's World Weather Watch system, the ERA
programme has global objectives to develop and improve the capabilities of
member countries to respond effectively to human-induced environmental
emergencies. WMO coordinates its ERA involvement with that of other
international agencies and regional organizations to ensure programme
effectiveness in responding to early warnings.

82. The UNEP programme dedicated to the Awareness and Preparedness for
Emergencies at the Local Level (APELL) has been instrumental in translating the
broad need for warnings into a process for developing awareness of potential
technological hazards and providing effective community collaboration for
responding to industrial accidents. The involvement of industry and government
officials in addressing warning and disaster preparedness interests of local
communities has been influential in translating the awareness of a threat into
practical, collaborative accomplishments. The Cameo hazardous materials
directory promoted by APELL provides a useful example for local application of
decision support systems technology.

83. The United Nations Economic Commission for Europe (ECE) has been
instrumental in promoting early-warning capacities for industrial accidents
through the Convention on the Transboundary Effects of Industrial Accidents.
The 1992 Convention aims to strengthen national capacities and international
cooperation in the prevention, preparedness and response to industrial accidents
capable of causing transboundary effects through the promotion of mutual
assistance, research and development, the exchange of information and the
development of safety management technologies. An industrial accident
notification system has been devised, including the designation of emergency
notification contacts in the signatory countries. Two industrial accident
coordinating centres have been established to enhance national capacity-
building, with special emphasis on the needs and priorities of countries in
transition.

84. A joint UNEP/Department of Humanitarian Affairs (United Nations)
Environment Unit was established and located in the Department's Relief
Coordination Branch in 1994 to enhance international capacities to respond to
environmental aspects of disasters for countries whose ability to cope has been
overwhelmed. The Unit provides international notification of specific
emergencies, brokerage of required services between affected and donor
countries, an information clearing-house, impact and response assessments, and
facilitates the provision of emergency assistance.

85. The Environment Unit is developing interface procedures with relevant
United Nations agencies and other organizations to strengthen regional and
international procedures relating to notification and response to environmental
emergencies. The joint involvement of UNEP and the Department of Humanitarian
Affairs in this area was expanded in 1995 with the creation of an international
Advisory Group on Environmental Emergencies, composed of experts and national
focal points from around the world. The Group meets annually to review the work
of the joint Unit and to act as a forum for sharing international experience
relating to technological aspects of environmental emergencies.

E. Review of telecommunication activities

86. The International Telecommunication Union (ITU) is the world-wide
organization through which Governments and the private commercial sector
coordinate the establishment and operations of telecommunications networks and
services. It is responsible for the regulation, standardization, coordination
and development of international telecommunications and works for the
harmonization of national policies. As the custodian of the international radio
frequency spectrum, ITU has a critical role in fostering collaboration and
operational standards among all bodies involved in early-warning systems.

87. The opportunities for improved early warnings provided by traditional
telecommunications services and emerging modern technologies are considerable.
The increasing flexibility demonstrated by systems in both private and public
domains provide various types of interface with early-warning requirements at
the international, country or local level.

88. ITU has been instrumental, working together with the Department of
Humanitarian Affairs and specialized agencies of the United Nations engaged in
emergency operations to obtain an international convention on disaster
communications. While most of these efforts have concentrated on facilitating
the use of telecommunications resources for disaster response activities in
acute emergencies, ITU has also noted the important role of telecommunications
in disaster mitigation. Resolution No. 7 of the ITU First World
Telecommunication Development Conference in 1994 extended that awareness
specifically to include early warnings.

F. Review of supporting activities and capacity-building

89. Virtually all of the early-warning systems described and the related
activities of United Nations organizations contribute to the capacity-building
of national or sectoral technical abilities. Early-warning practices can only
exist to the extent that they are based on the developed skills and abilities of
people related through structured organizational relationships. The programmes
described and the respective United Nations agencies associated with them have
each contributed training, the transfer of technology, research abilities or
technical expertise to national counterpart and technical organizations. In
addition, there are other organizations or individual programme activities in
the United Nations system which play additional supporting roles for the early
warning of natural and similar disasters.

90. WHO has a long-established commitment to preventive strategies based on the early detection of potential hazards and community awareness, incorporated in the ongoing public-health programmes of member countries. The organization has initiated an Epidemiological Information System that regularly issues bulletins and alerts relating to significant epidemiological problems. WHO's International Programme on Chemical Safety is conducted in close association with UNEP's APELL programme to provide technical advice to affected communities and also maintains comprehensive toxicological information and databases essential for early warning through a global network of collaborating centres.

91. The translation of early-warning information on slowly evolving disasters such as drought into effective response depends on the accurate assessment of the relative and changing vulnerability of the population within the affected area. For this purpose, computer programmes and equipment are becoming more accessible to quantify and map this vulnerability. WFP has taken advantage of advances in geo-referenced database management and in 1994 established a Vulnerability and Mapping Unit within its overall organizational Disaster Mitigation Strategy. WFP's disaster-mitigation activities are carried out in close collaboration with programmes of other cooperating partners, non-governmental organizations (NGOs) and Governments. In this respect, WFP's activities have placed a special emphasis on building sustainable vulnerability-mapping systems which encourage full government ownership. This has resulted in the development by several African countries of national vulnerability assessment and mapping committees or similar analysis systems integrated into national planning and development efforts.

92. UNEP's Global Resources Information Database (UNEP/GRID), located within UNEP's Environment Assessment Division, provides geo-referenced data to support environmental assessment within UNEP, among other United Nations agencies, and for national partners and clients. UNEP/GRID's Global Information System on Natural Hazards is a specific activity being implemented in conjunction with the Department of Humanitarian Affairs and the secretariat of the International Decade for Natural Disaster Reduction. This interpretive and display technology based on global data sets and GIS technology provides reference documentation to specialists and decision makers involved in hazard and risk assessment.

93. Other programmes within the United Nations system contribute, either directly or indirectly, to early-warning capacity development. These activities include, by way of example, GIS training and networking conducted by the United Nations Institute for Training and Research (UNITAR) in the drought-prone areas of Africa. Similarly, the United Nations Programme on Space Applications is active in promoting an increased understanding and use of space technology for the improvement of early warning for natural disasters, particularly in developing countries.

94. Under its mandate to coordinate international humanitarian assistance, the Department of Humanitarian Affairs of the United Nations Secretariat is an important user and disseminator of information regarding the early identification and warning of possible disasters for the international response community. The Relief Coordination Branch maintains an Operations Centre which screens incoming information from technical institutions and national services for the early indication of potential emergencies. The branch reports and

facilitates the exchange of information for international response, including the implementation of standby arrangements for immediate technical or material assistance. Similarly, the Department's Complex Emergencies Division has the mandated responsibility of facilitating the exchange of information and coordinating the international response pertaining to drought conditions.

95. The development of the ReliefWeb global information system under the Department's auspices is a major initiative to identify and then provide access to consolidated information pertinent to early warning. HazardNet, the Emergency Preparedness Information Exchange (EPIX) and similar electronic information networks under development represent future possibilities of specialized information to support coordinated access to background information.

96. The Disaster Mitigation Branch, working in association with the secretariat of the International Decade in the Disaster Reduction Division of the Department of Humanitarian Affairs, is particularly suited to facilitate the broader international collaboration and programme attention necessary to strengthen regional and national capacities related to early-warning effectiveness. The Disaster Management Training Programme, supported jointly by UNDP and the Department of Humanitarian Affairs, also has demonstrated a capacity to initiate official and institutional strategies designed to improve hazard awareness, preparedness and response capabilities in more than 50 countries.

V. THE BASIS FOR INTERNATIONAL COORDINATION IN EARLY WARNING

97. A review of early-warning programmes within the United Nations system shows that there are gaps and insufficiencies in covering the hazards that have been cited in the present report. Coordinated efforts are required to harmonize existing programmes at international and regional levels to support the development and strengthening of national capabilities. The challenge before the United Nations, and the present opportunity to be decisively exploited, is to provide the leadership and the commitment to proceed with measures which can create an agreed international basis for the coordination and collective benefit of improved, comprehensive early-warning systems.

A. Role of the United Nations

98. The General Assembly, in its resolution 46/182 of 19 December 1991, on strengthening of the coordination of humanitarian emergency assistance of the United Nations, provides an explicit basis for the Organization to intensify its efforts for the systematic pooling, analysis and dissemination of early-warning information on natural and technological hazards. The Assembly specifies that the capacity of disaster-prone countries to receive, use and disseminate early-warning information should be strengthened and urges the international community to assist those countries in the establishment or enhancement of national early-warning systems. To do this, the United Nations must draw upon the full range of its existing early-warning knowledge, organizational experience and resources in a methodical way.

99. Policies and procedures are needed to link these requirements with the abilities of Governments, specialized institutions, intergovernmental and non-governmental organizations through a collective approach to forge a coherent and global framework for early warning.

100. The aim is functional coherence among the different specialist abilities which contribute to early warning. Equally, there is a need for systematic procedures to be agreed for related communications at all levels. The experiences of both WMO and IAEA demonstrate that a sustained and broadly based effort, drawing on the distributed technical abilities of various institutions and national collaborators, is critical for the successful coordination of international warning systems.

101. To pursue this process there is, first of all, the need for a collective United Nations approach to define a doctrine which reflects the true cross-sectoral, multidisciplinary, and inter-agency nature of comprehensive global early-warning activities. The experience and requirements of countries affected by natural and similar hazards, and particularly those of developing countries, need to guide the development or integration of services provided by technical agencies and international organizations.

102. This process can be furthered by designating an authority or mechanism to provide comprehensive oversight to early warning for natural and similar disasters within the United Nations system. Above all, there is a need to encourage more interaction between headquarters for the agreement of common early-warning objectives and the consideration of synergies among their respective programmes. The same process needs to be encouraged between bilateral or multilateral aid organizations so that technical-assistance planning and implementation can contribute to collaboration between agencies and with national counterpart organizations.

103. Possible mechanisms are already in place. The International Decade for Natural Disaster Reduction provides the basis of an international framework for concerted collaboration, guided by an explicit strategy in the Yokohama Strategy and Plan of Action. The Department of Humanitarian Affairs is able to guide and relate national policy initiatives and to link warnings with coordinated response capacities. Scientific and technical specialists are accessible through UNESCO, the United Nations Children's Fund (UNICEF), FAO, WHO, WMO, UNEP, IAEA and ITU, among other organizations. Support for national developmental planning efforts, management capacity-building and operational abilities is available through UNDP, the Department of Humanitarian Affairs, UNITAR, the United Nations Department for Development Support and Management Services and others. Practical steps are needed to consolidate these capacities on the basis of common agreement to focus the resources of individual organizations for collective purposes, while retaining the benefit of specialist experience in the implementation of responsibilities.

104. At the country level, the resident coordinator system provides a coordinating mechanism to encourage a policy emphasis for early warning when this is in the national interest. In this respect, the Country Strategy Note (CSN) is a useful instrument for disaster-prone developing countries to identify early-warning requirements in a national disaster-reduction strategy.

Coordinated by UNDP, but representing the interests of government and specialized agencies alike, the CSN can serve as a frame of reference for the joint preparation and coordinated proposal of early-warning requirements that are fully integrated into a country's national development priorities.

105. The United Nations Disaster Management Team (UNDMT) concept is another instrument that can be utilized within countries to improve the coordination among the organizations of the United Nations system represented within a country, in association with key government counterpart departments. Motivated by the Disaster Management Training Programme, UNDMT provides a structure for the coordinated planning and local assignment of functional responsibilities related to preparedness measures and ongoing capacity-building. It is also a mechanism which could be used after a disaster to work with national authorities to focus on early-warning aspects to define lessons learned and to prepare corresponding technical assistance proposals.

106. UNDP has a major role to play at the country level through its multisectoral advisory and funding role for development activities. UNDP can provide a sustained development programme environment for early-warning policy motivation and can support capacity-building in areas such as improved information management, training activities and preparedness operations planning. The UNDP resident representative is normally the United Nations resident coordinator. As such, he/she leads the coordinated approach of the United Nations system at the field level in all aspects of disaster management, including early warning. These functions are executed through the Disaster Management Team (UNDMT), in close cooperation with the Department of Humanitarian Affairs, and under the guidance of the Emergency Relief Coordinator/Under-Secretary-General for Humanitarian Affairs.

B.   International agents for development

107. International coordination in early warning can be initiated, facilitated and supported by the United Nations system, but it requires the active support and involvement of other elements of the international development community.

108. Additional opportunities need to be found to encourage the contributions of the scientific and technical community to the decision-making process of technical and development assistance. Technical institutions and other forms of professional interest groups have a valuable role to play, particularly at the regional level, in articulating commonly held concerns or requirements of countries that are exposed to similar types of hazards or share common geographical or cultural attributes.

109. Decisions taken by individual donors in support of specific preferred programme sectors or single-country emphasis can result in a fragmentation of early-warning interests and initiatives. Urgent bilateral actions related to developing emergencies or inspired by a recent singular event can introduce inappropriate or unsustainable technologies. These actions can also contribute to a misrepresentation of an agency's ability or role within a larger national context of responsibilities.

110. Countries which depend on the use of international or regional early warnings have an obligation themselves to contribute the benefit of their experiences candidly to the international community. Their ability to do so depends partially on the rigorous application of their own critical assessments and evaluations about their capabilities, as well as requirements for improvements. Ex post facto assessments of early warning should be conducted following any emergency event and the observations used to revise existing procedures or operational relationships. These assessments, when made jointly with the participation of technical agencies, international organizations or donor representatives, should contribute to a collective process of evaluation leading to improvements in early warning.

111. The cumulative value of these efforts for improving international coordination of early warning can be realized through concerted efforts to modify existing policy. Member countries articulating common concerns in governing councils of United Nations agencies or regional economic and development associations can develop a consensus in guiding joint efforts for early-warning commitments.

112. Other forms of regional or political organization also provide opportunities to enhance coordination. One example is the Council of Europe's Open Partial Agreement on the Prevention of, Protection against and Organization of Relief in Major Natural and Technological Disasters. This Agreement, signed in 1987 and currently being updated, groups the interests of 20 States, 4 international organizations and 1 non-governmental organization in activities of common interest. These include compulsory contributions by member States for a European Warning System, composed of a network of 12 specialized European technical centres which implement training, information and research programmes that enhance early-warning capacities in the countries concerned.

113. Collaborative agreements, resolutions or other forms of joint acceptance of common interests, principles of operation, standards or shared resources are basic to encouraging a broader involvement of organizations in coordinating early-warning practices. The most effective early-warning systems pertaining to specific types of hazards are founded upon some type of basic agreement among participants.

VI. BUILDING CAPACITY FOR EARLY WARNING: ISSUES, GAPS, NEEDS

114. A review of early-warning activities of United Nations organizations reveals gaps and requirements for future improvements in effectiveness and coordination of early warning. Priority issues relate to improving the coordination of early warning within the United Nations system and supporting activities for national capacity-building in a larger developmental framework, as summarized below.

115. As both of the above subjects are crucial for the mobilization of concerted efforts within the International Framework of Action for the International Decade for Natural Disaster Reduction and the achievement of strategic Decade targets, a technical information paper has been prepared by the Decade secretariat to provide more elaboration. The paper provides direction for a

process in which coordinated early-warning activities during the next four years can contribute to the concluding event for the Decade. In this way, the process can contribute to the possibility of achieving an international consensus leading to established procedures for comprehensive and coordinated early warning as a basis for future disaster reduction in the twenty-first century.

A.   Perceptions of early-warning problems

116. There is a lack of understanding about the social and organizational nature of early warnings. The process can be made more effective by the sustained application of tools and techniques appropriate for the required functions. The primary criterion for improvement has to be one of increased comprehension by the intended receivers of information. A critical priority for improved early warning relates to working relationships, leading to planned actions in an increasing number of local communities.

117. The access to and exchange of technical experience and abilities - commonly referred to as the transfer of technology - are important contributions to improving early-warning systems. Their usefulness is dependent upon the extent that the operators and users of the systems can sustain the technical abilities and costs of operation. It is necessary to scale technology to the specific levels of individual early-warning functions, recognizing the need to relate different technologies to each other, if their potential is to be fully achieved.

118. Warning systems need to be established and supported throughout normal times. Early warnings are associated with emergency conditions, but their usefulness is determined by the extent to which they are installed and active beforehand. Effective warning systems need to be involved with ongoing activities to maintain procedures and to develop a routine competence with effective inter-organizational relationships. They need continuous material and political support. Means are necessary to incorporate early-warning abilities into other activities which contribute to national development efforts.

119. Organizations associated with early warning need to encourage collaborators to focus on the fundamental objective of their efforts: to enable timely, coherent and effective response by officials and the public to a warning. There is often the need for political will to respond to the evidence of early warning, especially the very early signs, when there may be more immediate priorities facing a Government. For this reason, early-warning functions need to be linked to risk assessment and preparedness programmes within a coherent disaster-management strategy. To further this relationship, there is a need for continued research and development of the technical aspects of early-warning systems for explicit user-determined needs and applications.

B.   Translating hazard identification into effective response

120. Early-warning activities span a range of professional disciplines, and each of them can have a very different perception about early warning. The interdisciplinary and multisectoral implications of early warnings have been

thus far inadequately addressed. There is a critical need to develop a broader common understanding among all the people involved in the warning process. This includes bridging gaps between scientists, communication technicians, media professionals, political decision makers, and other departmental or community officials responsible for implementing disaster-management functions.

121. There is an essential need to translate technical matters into a common understanding for the public. There is equally the need to improve the channels by which technical and scientific knowledge about disaster reduction can influence the political decision-making process. Whether the critical information conveyed by a warning is technical or administrative in nature, there is a need for increased dialogue between the producers and intended users of the information, in a language understandable by all, if it is to have any impact.

122. Efforts made towards formulating warnings need to be distinguished from those made towards their utilization. The collection and monitoring of hazard data differs from its subsequent interpretation, forecasting and presentation. The former activities may be enhanced by sophisticated techniques. The other functions may benefit from a more simplified approach to implementation. The tools and technologies suited to each of the tasks must be scaled to meet the needs and the abilities of the people involved.

123. Technological innovations for early warning need to be assessed to ensure that they provide added value, rather than additional costs, to early warning. Advanced technologies can have significant recurrent costs attributable to maintenance and their rapid evolution. There is a need for continuous training, and there are costs associated with ensuring the continued engagement of experienced technical staff. Both requirements are critical for the sustainability of a warning system.

C. International abilities and national experience

124. Effective warning systems require freely available data and reliable access for all collaborators. Exemplary warning systems encourage data exchange and seek to facilitate its utility by establishing commonly accepted standards, procedures, assessment criteria, etc. International agreement on operational standards and nomenclature for early warning can contribute to improved understanding and common benefit at all levels of activity.

125. There is a need to draw more attention to the differing international and national perspectives regarding what warning systems can do, technically, and what they need to do, practically. The better understanding of purpose, and a clear determination of users and their needs, can contribute to the design of more effective and sustainable warning systems. Advanced technology can create the opportunity for countries to identify and tailor systems to their own requirements or to devise related low-cost applications which can provide added value.

126. Export of these modified technologies can similarly benefit other developing countries. Through increased opportunities for multidisciplinary

dialogue among national partners and technical agencies, there is additional scope for international best practices to address countries' primary needs. There is an equal opportunity for individual countries to contribute their experience to the body of international understanding for improved early-warning capacities.

127. Early-warning systems require continuous human resources development and the documentation of experience. In addition to technical education, systems management training is essential for the improved effectiveness and better coordination of early-warning processes. Education is also needed to develop a broader understanding of the relationship between early warning and other aspects of disaster management. Efforts must be made to encourage the sharing of knowledge among developing countries and to document the experience of disaster-affected countries. More applied research regarding the effectiveness of early-warning measures needs to be conducted in primary disaster-affected developing countries by nationals of the country concerned.

D. Disseminating the message; communicating early warnings

128. International communication standards, best practices and coordinated efforts can contribute significant uniformity for common benefits to early warning. As in the case of communications related to emergency response, those used in the context of early warning can benefit from prior international agreement on privileged access, revised tariffs, designated responsibilities and coordinated functions.

129. The important function of communicating at the different levels of early-warning activity needs to be scaled appropriately to address the resources and skills available, and the requirements to be met. Both the needs and the limitations of users have to be translated into the application of the most suitable combination of traditional communications systems and modern technologies.

130. The different user tariffs applicable to various communications systems and the attributes of official, publicly owned and operated, as well as private commercial systems need to be evaluated more thoroughly in response to the particular needs of specific warning systems. The economics and feasibility of technical sustainability in the rapidly developing sector of communications needs to be matched against practical requirements evident in the different functions of information exchange in early-warning programmes.

131. There is a need to evaluate the opportunities provided by upgrading or including existing forms of familiar means of communication in the warning process as an extension of preparedness measures associated with early warning. Media relations, public radio and television broadcasting, telephone systems, amateur radio operators, which are often identified primarily with emergency response activities, can be effective in expanding the coverage of early warning.

E. Coordination of international and national capabilities

132. Improved global early-warning coordination is dependent on two strategies.
Early-warning practices and systems need to become more effectively linked to
the organizations and activities responsible for responding to the warning at
the national and local levels. Improved early-warning coordination will be
determined by a sustained commitment to capacity-building and the explicit
involvement of the subject in development endeavour. A short-term, primarily
relief-based perception of early warning could lead to fragmented efforts and
emphasis on one sector or aspect at the expense of another.

133. The United Nations system offers the institutional base for guiding
international efforts to formulate an early-warning doctrine. Such a frame of
reference and body of thought, with clearly defined objectives, operating
principles, and priority actions, is needed if the development of common
practices, standards and collective efforts of parties involved is to be
encouraged.

134. Equally, an operational agreement would be required among Governments,
agencies, programme sectors and the development assistance community for such a
commitment to be sustained. The process of building improved coordination needs
to be based firmly on a systematic basis of ex post facto assessments of early-
warning effectiveness of all future disasters, grounded in affected countries'
experiences and based on lessons which have been learned by them.

135. Successful mobilization of resources at the international level and the
resulting funding opportunities for programme activities relating to early
warning would also create an incentive for better early-warning coordination.
Commitments need to be sustained and consolidated to advance the development of
capacities over time. Greater efficiency can be achieved by an understanding of
the purpose of early warning, its mutually supporting functions and the
resources required for its accomplishment.

VII. CONCLUDING OBSERVATIONS

136. The following conclusions and proposals are submitted for consideration
with respect to the improvement of early-warning capabilities, better
international coordination in their use and more effective and beneficial
exchange of knowledge and technology:

     (a) Within the existing International Framework of Action for the
International Decade for Natural Disaster Reduction, there is a need for an
informal mechanism to develop international doctrine and operational standards
for improved and better coordinated global early-warning analysis, forecasting
and dissemination. Such a mechanism should comprise representation from
Governments, United Nations agencies and organizations, scientific and technical
communities and other professional disciplines engaged in the early-warning
process. The mechanism, an open-ended interdisciplinary and inter-agency
working process, would provide a collective operating framework to direct a
credible and effective application of early warning within disaster management

at all levels, in particular in support of local communities at risk from natural and similar disasters;

(b) National Governments of all countries are encouraged to undertake a systematic assessment of the extent to which current international, regional and national warning systems adequately address their own requirements to provide ready access to warnings for all citizens, and particularly those living in local communities most exposed to hazards. The assessment should be conducted with the full support of the organizations of the United Nations system, technical institutions and the international development community. The results of these assessments should contribute field-based experience to the international working group on early warning;

(c) Countries are encouraged to designate a national body or responsible agency as the focus for the coordination of early warnings based on an all-hazards approach. An acknowledged national authority can contribute to ensuring linkages with international efforts to streamline and coordinate priority activities and capacity-building. There is a need to strengthen links between local communities and centralized systems at national, regional and international levels to capitalize better on local variables and perceptions. At the same time a coherent national approach to disaster awareness, preparedness, management, response and reduction can be advanced;

(d) It is proposed that the mechanism referred to in subparagraph (a) above submit its recommendations to the General Assembly at its fifty-second session, outlining a comprehensive and streamlined operational framework for improved and better coordinated early-warning capacities world wide as well as propose international principles and operational modalities for United Nations organizations, national Governments, technical institutions and all professional interests concerned with early warning;

(e) The implementation of these proposals for the improvement of the early-warning capacities of the United Nations system with regard to natural disasters and similar disasters with an adverse impact on the environment should be duly considered in the preparatory process of the closing event for the International Decade for Natural Disaster Reduction foreseen for 1999. This will provide an opportunity to take stock of concerted international efforts to improve early warning and to ensure their full integration in the strategy for natural disaster reduction beyond the year 2000.

Notes

1/ Tampere Declaration, adopted by the Tampere Conference on Disaster Communications, Tampere, Finland, May 1991, paras. 13-14.

2/ See the report of the World Conference on Natural Disaster Reduction (Yokohama, 23-27 May 1994) (A/CONF.172/9), chap. V.

3/ Ibid., chap. I, resolution 1, annex I.

4/ Ibid., annex II.

    5/   Ibid., chaps. IV and V.

    6/   Report of the United Nations Conference on Environment and
Development, Rio de Janeiro, 3-14 June 1992 (A/CONF.151/26/Rev.1 (Vol. I and
Vol. I/Corr.1, Vol. II, Vol. III and Vol. III/Corr.1)) (United Nations
publication, Sales No. E.93.I.8 and corrigenda), vol. I: Resolutions Adopted by
the Conference, resolution 1, annex II.