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EARLY WARNING SYSTEMS

Existing experience of early warning systems and specialized institutions acting in this field

Note by the secretariat

1. By its decision 12/COP.2 on the work programme of the Committee on Science and Technology (CST), the Conference of the Parties (COP) decided that the priority issue to be addressed in depth by the CST at its third session would be early warning systems in the broadest sense.

2. By the same decision, the COP invited Parties to submit contributions in writing, not exceeding 10 pages, to the Convention secretariat no later than 30 June 1999, referring to the priority issues to be addressed at the third session of the Committee, reporting on already existing experience of early warning systems as well as on specialized institutions acting in this field to facilitate the preparation of the third session.

3. The Convention secretariat received written contributions on early warning systems from six Parties, namely, Canada, France, Italy, Mali, Saudi Arabia and Switzerland. Observations, suggestions and recommendations are included in these contributions, which are attached as annexes I to VI, respectively.

Annex I

CONTRIBUTION OF CANADA

CANADIAN EXPERIENCE AND CAPACITY IN DROUGHT EARLY WARNING AND RELATED GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING TECHNOLOGIES

prepared by:
The Desertification Convention Office,
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(CIDA)

May 1999

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CANADIAN EXPERIENCE AND CAPACITY IN DROUGHT EARLY WARNING AND RELATED GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING TECHNOLOGIES

INTRODUCTION

The following is a survey of Canadian capability in the area of geographic information system (GIS) and remote sensing, generally, with focus on applications in the area of early warning and drought preparedness initiatives and capacity-building, specifically.

The complexity of environmental issues such as drought early warning and preparedness demands the collection, analysis and presentation of massive quantities of data, and the mathematical modelling of multifarious processes, usually over time. Geomatics technologies are ideally suited to this area. The geographic positioning system (GPS), for example, offers an excellent tool to monitor society's impact on the environment. It can be used to track the movement of everything from icebergs and polar bears to groundcover vegetation and the expansion and retraction of desert margins. In addition, it offers exciting opportunities in the area of weather forecasting. Remote sensing technologies and geographic information systems, which are ideally suited for handling such data sets, and many other geomatics technologies are regularly being employed in many environmental applications. Canada's environmental and geomatics capacity is very highly regarded around the world.

The International Food Policy Research Institute recently prepared a paper on "Food Policy Research - Emerging Issues and Trends" (1999) in which it identified risk management and coping strategies as a critically important emerging issue. It suggested that "increasing climatic fluctuations are likely to introduce new risks and uncertainties" and though "new or improved tools such as better climatic forecasting and the availability of data from geographic information systems are becoming available", the "application of these opportunities is lagging and appropriate private and public institutions have not been developed".

It is hoped that, by sharing information about Canadian capacity in this field, new partnerships can be formed to foster the necessary capacity in private and public institutions in developing countries affected by desertification. Working together, Canadians can help developing countries establish advance warning systems, be better prepared for drought and over the long term, better able to combat desertification.

SECTION 1 - CANADIAN DOMESTIC CAPACITY

The variability and extremes of weather in Canada result in a variety of risks (frost, hail, excessive rainfall, wind and drought) which challenge the sustainable land management of Canada's agricultural land base. Within its government, private and research sectors, Canada has had to develop the technological and human resource capability to be aware of, prepare for, and address these concerns.

A. GOVERNMENT

1. **Prairie Farm Rehabilitation Administration** (Agriculture & Agri-Food Canada) (PFRA/AAFC)

The *Prairie Farm Rehabilitation Act* establishes a mandate "...*to secure the rehabilitation of the drought and soil drifting areas in the Provinces of Manitoba, Saskatchewan and Alberta, and to develop and promote within those areas, systems of farm practice, tree culture, water supply, land utilization and land settlement that will afford greater economic security.*" Visit the web site at http://aceis.agr.ca/pfra/.

PFRA's history of mitigation of the potential impacts of drought and desertification includes promoting the sustainable use of agricultural resources by providing information and technical advice, and designing and delivering resource conservation and development programmes. More significant initiatives in this area include:

i. Drought monitoring

Prairie Drought Monitoring Network

PFRA works with other federal and provincial agencies to monitor the status of low-probability but severe widespread drought in the prairies.

Ad Hoc Drought Committee

PFRA works with other agencies, encouraging the development of long-range climate forecasts for the prairies, and monitoring existing forecasts as indicators of potential conditions. Drought-watch web site: (http://aceis.agr.ca/pfra/drought.htm)

PFRA uses information from a variety of sources to generate precipitation maps on an ongoing (bi-weekly) basis, as well as monthly temperature maps, pasture condition assessments and soil moisture information.

Climate change

PFRA is collaborating with other agencies on climate adaptation and public outreach activities, and has sponsored a workshop for potential educators on climate change issues and how to get information to the public.

The investigation of opportunities for reduction of atmospheric greenhouse gas emissions and carbon sequestration are two main areas where PFRA is active: PFRA participates in an integrated economic production modelling study designed to correlate the impacts of various agricultural practices on the production of greenhouse gas emissions. PFRA has initiated a shelterbelt biomass project to determine the amount of biomass and carbon fixed in prairie shelterbelts and to accurately quantify them. Various tree species have been analysed for their biomass

volume and carbon sequestering potential. The potential for carbon sequestration in soils is also being investigated.

PFRA is involved in the identification of agricultural residues, in excess of soil conservation requirements, available for industrial uses (i.e. strawboard technology) which have potential as a long-term carbon sink.

ii. Water conservation and development

Rural water development programme

PFRA provides technical and financial assistance for water development and distribution projects that lessen the adverse effects of drought, and alleviate water-related constraints to rural economic growth. Projects are designed to withstand droughts, address water quality concerns and multiple diverse interests. Major activity areas include:

(a) Development of water supplies and infrastructure that supports on-farm diversification, value-added processing and a high quality of life;

(b) Promoting best management practices that enhance water supplies;

(c) Improving water use efficiency;

(d) Investigations of innovative water treatment technologies such as biological and well rehabilitation processes;

(e) Treatment of contaminated water through means such as constructed wetlands or effluent irrigation;

(f) Conducting water development studies in regions of greatest need.

iii. Preventative and preparatory water systems

Irrigation has permitted intensification, diversification and economic security of many dry regions across the prairies.

South-west irrigation projects

PFRA has constructed a network of dams, diversion structures and water distribution infrastructure for irrigation projects in this drought-prone region. The projects provide farmers with irrigable hay-land, and help assure stabilized forage supplies to maintain a livestock population in the region. The storage reservoirs also provide a secure supply of water for many farms and several communities.

Technical development centres

PFRA works with provincial and industry partners, with a focus on development and demonstration of technology supporting environmentally sustainable irrigated production. Specific initiatives include evaluation of agronomic factors which result in more efficient water use, water conservation methodologies, reclamation of saline soils, and the sustainability of effluent irrigation.

iv. Other preparatory systems and drought responses

Shelterbelt centre

PFRA provides tree and shrub seedlings to prairie landowners for farm, field, wildlife and agroforestry plantings. Technical assistance is provided to show how tree plantings can support sustainable agriculture by improving soil moisture, and reducing soil erosion and energy requirements. Programmes are designed for selection and improvement of drought-hardy tree species suitable for the prairie climate.

Community pasture programme

PFRA manages 87 community pastures on 905,000 hectares of land across the prairies. Most of the pastures were developed in the late 1930s in response to drought. Cultivated marginal lands severely eroded, or at risk of erosion, under annual crop production were consolidated and protected from erosion by establishing permanent cover. These fragile lands are managed to sustain long-term cattle production.

Technical assistance

PFRA provides technical advice to help farmers adapt to a number of adverse conditions and implement soil conservation practices and other land management initiatives that support agricultural sustainability.

- Farmers use the information to adopt management systems such as contour farming, conservation tillage, grassed waterways, cover crops and strip cropping, that reduce the risk of erosion (especially critical in drought periods);

- Information on residue cover is used to target advice on soil conservation and also to help identify areas at risk to erosion, e.g.. in drought events.

Water resource management

- PFRA participates in an inter-departmental committee on water working to develop a new federal fresh water strategy;

- PFRA is represented on the surface water, groundwater and hydrology committees of the Prairie Provinces Water Board;

- PFRA staff are part of a multi-disciplinary group working with other provincial and federal agencies to assess water and agricultural issues across Canada.

Permanent cover programme

In an effort to stabilize landscapes susceptible to erosion, PFRA initiated a programme to convert land from cultivation to permanent cover. Conversions were under long-term contracts, which PFRA continues to monitor.

Tax deferral programme

If drought is severe over widespread areas and producers are forced to sell cattle, PFRA designates areas eligible for deferral of income tax from drought-induced sales of breeding livestock.

2. Natural Resources Canada

Natural Resources Canada (NRCan) is the federal government department specializing in energy, minerals and metals, forests and earth sciences. The mandate of NRCan is to look at natural resource issues that are important to Canadians from both a national and international perspective, using expertise in science and policy. Focus is on leading-edge science and technology to assist Canadians in using their country's resources wisely, reduce costs, protect the environment and create new products and services.

i. Geomatics Canada

Geomatics Canada is part of the Earth Science Sector of Natural Resources Canada. Geomatics Canada represents the principal presence of the government in matters relating to surveying, mapping and remote sensing. Activities include: establishing and maintaining spatial reference systems and satellite tracking stations; regulating and managing property surveys on federal land; maintaining the United States-Canada boundary; acquiring and maintaining topographical maps and geographical information on the Canadian landmass; publication of maps, aeronautical charts, aerial photos, etc.; as well as receiving, processing, archiving and disseminating data from remote sensing satellites. In addition, Geomatics Canada provides technical assistance to operational users of remote sensing for resource management and environmental monitoring, including support to Canadian industry active in international markets where Canada has a reputation as a world leader in the field of geomatics. For more information visit http://www.geocan.nrcan.gc.ca.

Geomatics Canada comprises various divisions and centres. Of particular relevance to this survey are the activities of the Canada Centre for Remote Sensing and the Canadian Earth Observation Network.

ii. Canada Centre for Remote Sensing (CCRS)

The Canada Centre for Remote Sensing coordinates a national programme in remote sensing, in cooperation with other agencies of the Government of Canada, provincial governments, industry and Canadian universities. Established in 1971, CCRS is

responsible for the reception, processing, archiving and dissemination of remotely sensed data for Canada and, in conjunction with private industry, for the development of technology and applications for remote sensing. For more information on CCRS, visit http://www.ccrs.nrcan.gc.ca.

The Centre is internationally recognized as a centre of excellence in the use of earth-observation data. Of particular relevance to this survey is the work of its Environmental Monitoring Section (EMS), which is mandated to:

(a) Derive and apply biophysical and geophysical environmental parameters from remote sensing data over land at various spatial scales, from national to local;

(b) Develop and demonstrate procedures for using remote sensing data in detecting, identifying and quantifying environmental change and in the modelling of environmental processes and change at the landscape to national spatial scales, and at seasonal and interannual timescales.

(c) Contribute to the definition and development of technology and systems for using remote sensing data in regional and continental applications.

iii. Canadian Earth Observation Network (CEONet)

The CCRS is also in the process of developing the Canadian Earth Observation Network, which will provide users (both national and international) with real-time access to remote sensing satellite and other spatial databases, both of land and ocean, through the Internet. For more information, visit their web site at http://ceonet.ccrs.nrcan.gc.ca.

3. Environment Canada

Clearly of relevance to this survey is the Canadian meteorological and atmospheric monitoring and prediction capability, which is centred at Environment Canada (http://www.ec.gc.ca). This capacity is located in various divisions and centres. Of particular relevance to this survey are the activities of the following.

i. Weather Office

The Weather Office (http://www.weatheroffice.com) gives Canadians the tools they need to make sound decisions in a changing environment by offering regional and local weather information and improving Environment Canada's ability to predict long-term environmental conditions. This branch researches atmospheric issues, including weather and climate change. Weather warnings as well as local and regional weather forecasts are just one example of the information available from this branch. Often, the research conducted here provides the basis for others' sustainable development activities. Many industries such as the forestry and agriculture industries take advantage of Environment Canada's climate research. Information is distributed to the general public as requested including industry, community groups, scientists and others.

ii. Atmospheric Environment Service

The Atmospheric Environment Service (AES) is Canada's source for meteorological information as well as a source of research and advice on climate, atmospheric science, air quality, ice, water quantity and other environmental issues (http://www1.tor.ec.gc.ca/index_e.cfm). It comprises various directorates and divisions, including the following with specific relevance to this survey.

Atmospheric Monitoring and Water Survey

This directorate provides national leadership for Atmospheric Environment Service activities in atmospheric and water monitoring, archiving and data management. Through national standards and strategic planning, it works with the regions to supply the fundamental observations for weather and environmental prediction. This directorate is composed of the following groups: Monitoring and Technology Strategies; National RADAR Project; Operational Support; Data Standards and Quality Management; Hydrology; Climate and Water Archives; Climate and Water Applications and Services.
(http://www1.tor.ec.gc.ca/cd/aesorg/Atmospheric_Monitoring_and_Water_Survey_e.cfm).

Atmospheric Environment Prediction

This directorate provides leadership for all prediction activities of the Atmospheric Environment Service and is responsible for numerical weather prediction, national informatics and telecommunications. This directorate includes four branches: National Prediction Programs and three others that form the Canadian Meteorological Centre - Informatics, Operations and Development.
(http://www1.tor.ec.gc.ca/cd/aesorg/Atmospheric_Environment_Prediction_e.cfm).

The National Prediction Programs branch leads and coordinates prediction programmes among regional and central components. It also develops common approaches and promotes collaboration in the areas of production and dissemination systems and programmes.

The Canadian Meteorological Centre provides forecast guidance to national and regional prediction centres and centralized computing and telecommunications services. It operates and maintains the supercomputer facility in Dorval, Quebec and various telecommuncations networks. It is responsible for the national and international environmental emergency response service.

iii. Ecological science centres

In addition, Environment Canada is funding a programme which will support the creation of ecological science centres in partnership with the scientific, academic and industrial community as well as with some participation of local or regional public groups. Partnerships are also being facilitated on the global level through linkages to such programmes as the International Tundra Experiment and the

International Global Change Programme, and in the global network on ecological research and monitoring.

The goal of this programme is to establish a long-term "state of the environment" monitoring and assessment capability to study resources at risk, ecosystem response and the impacts of major disruptions to ecosystems. To meet this goal, ecological science centres are being established. The purpose of the centres is to facilitate interdisciplinary research on ecosystems in conjunction with long-term monitoring and to provide a scientific basis for interpretation and assessment of ecosystem change. This initiative will greatly improve the quality of environmental decision making by providing the information needed both for anticipating problems and for shaping effective preventive responses to them. The objective of the ecological science centres is threefold: to improve our knowledge of ecosystem processes and functions; to determine the underlying causes and ecological consequences of environmental change; and **to provide an early warning system for environmental change**.

B. PRIVATE SECTOR

According to a comprehensive list generated by a web site search engine (Canadian Geomatics http://www.ualberta.ca/schatz/company/ab.htm), there are more than 250 companies across Canada which deal with GIS and remote sensing. At least 36 indicate that their interest is specifically in areas relevant to this survey such as: environmental data mapping, earth science observation and analysis, geotechnical and geophysical land and natural resource management (inventory), agricultural applications, hydrological applications, forest management, and 3-D terrain mapping. One firm, Logiciels et Applications Scientifiques Inc., located in Laval, Quebec, has developed grassland GIS software.

While the majority of these companies likely focus on domestic applications, many also have experience in international implementation. For a comprehensive review of Canadian private sector capacity in the area of geomatics visit the site of Geomatics Industry Association in Canada (GIAC) (http://www.giac.ca/), which is the national business association dedicated to serving the geomatics industry in Canada. GIAC encompasses the entire range of geomatics disciplines. Membership includes almost 100 of Canada's leading geomatics service and technology firms, and approximately 80 per cent of the active exporters in this sector.

SECTION 2 - INTERNATIONAL

A. GOVERNMENT

1. Canadian International Development Agency (CIDA)

The Canadian International Development Agency (CIDA) (http://www.acdi-cida.qc.ca) is the lead player in delivering Canada's official development assistance (ODA). The cornerstone of Canadian development assistance is to support sustainable

development in order to reduce poverty and to contribute to a more secure, equitable and prosperous world.

Development is an enormous global effort. It is a complex, long-term process that involves all of the world's people, and governments and organizations at all levels. Canada, like other industrialized countries, provides development assistance in the form of goods, services, the transfer of knowledge and skills, and financial contributions. Working with partners in the private and public sectors in Canada, and in developing countries and with international organizations and agencies, it supports foreign aid projects in more than 100 of the poorest countries in the world.

The objective is to work with developing countries and countries in transition to develop the tools to eventually meet their own needs. To do this, Canadian ODA is concentrated on six priority areas: basic human needs; women in development; infrastructure services; human rights, democracy, good governance; private-sector development; and the environment.

Canada has supported the negotiation and implementation of the United Nations Convention to Combat Desertification and is actively programming in the spirit of this global initiative. Programming is undertaken through three main channels: bilateral (government to government); multilateral; and through Canadian and international civil society organizations (Canadian Partnerships Branch).

Generally, CIDA early warning and drought preparedness related programming takes the form of either:

(a) Bilateral technical support for meteorological, atmospheric research and scientific bodies (including technology transfer and capacity-building for use of technology such as GIS and remotely sensed information, etc.); and/or

(b) Institutional strengthening and community/grassroots initiatives focused on community preparedness, mitigation and coping strategies.

For a more comprehensive overview of CIDA projects currently under way, see annex A.

2. Prairie Farm Rehabilitation Administration

In addition to its domestic mandate, the Prairie Farm Rehabilitation Administration (PFRA) is active in providing project design, management and implementation of projects in Africa and China. Specifically, PFRA has been active in the design of the Water Harvest and Institutional Strengthening Project in Ethiopia, is the executing agency of a water management project in Egypt, is the International Chair of the Sustainable Agricultural Working Group in China and is currently developing some proposals for dryland management projects in China for CIDA or third party donors for consideration. In addition, a number of PFRA staff have extensive

experience in project management and technical assistance in a number of regions throughout the world on both short-term and long-term assignments.

Overall, PFRA has extensive expertise in hydrology, geohydrology, irrigation management and research, soil degradation and conservation, climate change and long-term climate forecasting, soil database interpretation, GIS/GPS applications in the above areas, and agroforestry.

B. PRIVATE SECTOR

1. Assistance for Canadian exporters of geomatics products and services

The Federal Government of Canada provides assistance to the Canadian geomatics industry in identifying, pursuing and executing major international contracts in geomatics, consisting of surveying, mapping, cadastral programmes, remote sensing and geographic information systems. Specific services include market intelligence, market access, facilitation and trade promotion, and strategic brokering. The current focus of the programme is on Asia, Latin America, the Middle East, and countries of the former Soviet Union. For more information, visit the Internet site at http://www.geocan.NRCan.gc.ca.

C. ACADEMIC AND RESEARCH INSTITUTIONS

1. International Development Research Center

The International Development Research Center (IDRC) (http://www.idrc.ca) is a public corporation created by the Canadian Government to help communities in the developing world find solutions to social, economic and environmental problems through research. IDRC connects people, institutions, and ideas to ensure that the results of the research it supports and the knowledge that research generates, are shared equitably among all its partners, North and South.

Programme initiatives are the Centre's primary programming unit for funding research in developing countries. Managed by multidisciplinary teams, they are working networks that link Southern and Northern researchers to address specific research problems and set a research agenda. By linking all the parties involved in the research process, IDRC hopes to add to the likelihood of success. Because of their multidisciplinary focus, programme initiatives will often address issues that fall under several themes. Programme initiatives with early warning drought preparedness aspects include: community-based natural resource management; communities and the information society; people land and water; and the water demand management research network.

For a comprehensive list of IDRC projects currently under way in this area consult annex B.

2. GlobeSAR 2

GlobeSAR 2 is a three-year, applications development and technology transfer project being led by the Canada Centre for Remote Sensing (CCRS). The programme is designed to develop radar expertise in 11 Latin American countries. The project's university programme builds cooperation by supporting joint research and application development projects between South American and Canadian universities. Co-funded by CIDA and IDRC, the project will be supporting 90 initiatives in: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Honduras, Panama, Peru, Uruguay and Venezuela by 2000.

Connected with the GlobeSAR 2 project, and of relevance to this survey, are staff at: the University of Guelph (Land Resource Science) (rprotz@lrs.uoguelph.ca) who are researching synthetic aperture radar (SAR) for agroecosystem monitoring, specifically soil moisture, soil salinity, tillage practices and crop yields; the University of Manitoba (Geography) (dbarber@mail.ms.umanitoba.ca) SAR applications in hydrology, land cover and disaster management; Université du Québec (INRS - eau) (monique_bernier@inrs-eau.uquebec.ca) integration of SAR data in hydrological modelling, and soil moisture monitoring. For more information on this programme see http://dweb.ccrs.nrcan.gc.ca/ccrs/db/glbsar

GlobeSAR 2 approved North-South university projects related to early warning and drought preparedness

- Argentina soil surface moisture mapping using SAR images and distributed hydrological models
- Evaluation of land degradation in semi-arid inter-mountain valleys in Argentina with RADARSAT and GIS
- Integration of SAR and optical wavelength earth observation data for drought assessment in north-east Brazil

3. Other university partnerships

Carleton University's Cartographic Research Centre is involved with CIDA in the digital mapping / GIS pilot project (see annex A).

Université de Sherbrooke, Centre d'applications et de recherche en télédétection, Sherbrooke, Quebec is working with IDRC on the environmental evolution of sub-Sahelian Senegal project (see annex B).

Université Laval, Quebec is working with IDRC on a project entitled "Système d'aide à la planification des aménagements CES à l'aide d'indicateurs biophysiques et socio-économiques", as well as a project on the GIS applied to the management of pastoral activity in the Algerian steppe (see annex B).

Association des universités partiellement ou entièrement de langue française, Montreal, Quebec is working with IDRC on the environmental evolution of sub-Sahelian Senegal project (see annex B).

University of Manitoba, Department of Anthropology is working with IDRC on the disaster management research network in Brazil (see annex B), which focuses on drought preparedness and mitigation.

University of Guelph is involved in the IDRC participatory land and water management in dryland agropastoral areas project in Egypt (see annex B).

SECTION 3 - CONTACT POINTS

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Annex A

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY PROJECTS CURRENTLY UNDER WAY RELATED TO DROUGHT EARLY WARNING SYSTEMS AND DROUGHT PREPAREDNESS

TYPE 1: Technical support for meteorological, atmospheric research and scientific bodies (including technology transfer and capacity-building for use of technology such as GIS and remotely sensed information).

RADARSAT data evaluation project. This project will introduce active remote sensing technologies using SPOT, LANDSAT and radar satellite data. It will develop, evaluate, demonstrate and train Indonesians in RADARSAT applications in environmental analysis. In partnership with the Canada Center for Remote Sensing.

Latin American RADARSAT. All countries in South America rely on their natural resource base for economic development, and information is essential to manage these resources. This is a project which involves the transfer of Canadian radar remote sensing technologies for the purpose of protecting the environment through improved natural resource monitoring, management and planning capacity in the region. In partnership with the Canada Center for Remote Sensing and RADARSAT International.

Digital mapping / GIS pilot project. The pilot project will enhance the electronic mapping and the GIS capability of Latin American countries using Internet technologies. These geospatial methods will be used for the analysis of environmental and socio-economic information and address the priority of environmental and natural resource management and decision-making. In partnership with Geomatics Canada and the Cartographic Research Centre of Carleton University.

Environmental information systems. The aim of this project is to assist the Government of Egypt Environmental Affairs Agency to formulate and implement timely and appropriate environmental policies, projects and programmes through the provision of reliable environmental information in the area of water resources and land management.

Ryazan digital mapping. Natural Resources Canada will modernize the existing Russian capability in surveying and mapping and produce a topographic database, a cartographic database and a model GIS cadastral database. At project completion, the skills and tools necessary to complete digital mapping for the entire oblast will be in place. Experts from the Russian Federal Service of Geodesy and Cartography will disseminate results to other oblasts.

TYPE 2: Institutional strengthening and community and grass-roots initiatives focused on community preparedness, mitigation and coping strategies.

Aménagement de terroirs, zone de Nippes. The project will contribute to the amelioration of environmental conditions in this region of Haiti through the protection and rehabilitation of the physical landscape, including the conservation, promotion and introduction of agroforestry models of production and the management of micro-hydrographic basins.

Community drought mitigation project. The purpose of this project is to reduce community vulnerability to food insecurity in drought-prone areas of southern Africa through the identification and support of community-based projects. This project is targeted at lessening the effects of drought at the community level through emergency preparedness and the promotion of environmentally sound technologies and agricultural practices.

Disaster mitigation - Ethiopia phase I and phase II. The purpose is to increase the food security in vulnerable households by improving the capacity of the Government of Ethiopia to prepare for and mitigate future food-related crises. Emphasis is on better detection of food shortages, and an early response to assist the poorest. Canada will provide: policy familiarization, training and support, early warning systems and analysis, training in data collection and computer systems.

Water harvesting and institutional strengthening - Tigray phase II. The project's goal is improved food security in drought-prone areas of eastern Tigray. It will assist in developing regional government and community capacity to decide on and implement water development schemes based on local natural resource potential and the resources of each community with usufructuary rights to water and land throughout the catchment. In partnership with the Prairie Farm Rehabilitation Agency.

Eritrea capacity-building. This project is designed to increase food security of people in Eritrea by building the institutional capacity of the Government of Eritrea to establish and operate an emergency food reserve and an early warning system for food insecurity.

Annex B

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE PROJECTS CURRENTLY UNDER WAY RELATED TO DROUGHT EARLY WARNING SYSTEMS AND DROUGHT PREPAREDNESS

Environmental Evolution of sub-Sahelian Senegal. north Senegal has been subject in recent decades to periods of acute drought alternating with periods of relatively ample rainfall. Extrapolating from climatological data, scientists predict a serious drought between 2005 and 2015, with an advance of Sahelian (pre-desert) conditions as far as the Gambia. To help development agents prepare for this crisis, the project will develop and perfect a tool (GIS) for diagnosing and predicting the interactions between environment and development. The project will propose territorial strategies for adapting to the predicted drought.

Use of RADARSAT for natural resource management - Costa Rica, Honduras, Nicaragua, Panama. This project involves developing expertise in radar remote sensing in four countries for use in natural resource and environmental management, specifically, in: agriculture, forestry, coastal zones, volcanic activity, hydrology, slope stability, soil moisture, land cover and land use.

Framework for the development of national environmental information systems. The aim is to provide governments and other actors with a framework to guide the development, implementation and maintenance of national environmental information systems.

Agricultural policy analysis. This is a collaborative project with the United States Agency for International Development to establish the eastern and central African programme on agricultural policy analysis. Its objectives are to strengthen the capacity of national agricultural research systems. The programme will foster agricultural policy formulation based on sound research and analysis of the sector's potential and constraints.

Feasibility study for the development of sustainable agricultural information resource centers in South Africa. A prefeasibility study undertaken by CAB International indicated the need for agricultural information and the potential role of information and communication technologies in the effective delivery of information in this sector in the region. This project supports further research and modelling for setting up information resource centres.

National desertification audit. As part of its commitments under the UNCCD, South Africa has undertaken to develop a national action plan. This plan will incorporate a national audit on the status of desertification, including a collection of baseline data.

Global Network for Disaster Management. The International Federation of Red Cross and Red Crescent Societies assists in disaster management, preparedness and prevention wherever and whenever needed. This project assists in the following: improving speed and effectiveness of communications and information exchange in support of disaster preparedness programmes, developing capacity of the national societies to collect and access relevant disaster-related information, developing disaster management support applications, participating in global disaster information exchange.

Disaster management research network. This project is the research component of a five-year programme to develop a core of specialists, training curricula and research modules to respond to local, regional and national natural disasters in Brazil. Initially it will address the north-east's recurrent problem of drought management through: planning strategies, extension support, disaster preparedness and mitigation, monitoring recurrent drought, coping programmes.

Participatory communication in support of community actions for combating desertification in the Sale. The most important factor in the fight to combat desertification and drought is the participation of local populations to field action and decision making. Communication is the tool to facilitate such participation. Communications strategies supporting and reinforcing community participation to combat desertification must be developed and tested.

SAGATELLE Phase II "Système d'aide à la planification des aménagements CES à l'aide d'indicateurs biophysiques et socio-économiques. Tunisia GIS; remote sensing; economic and social indicators; soil conservation; water conservation.

Water demand management network. In the Middle East and North Africa the limitation of water resources, and the economic and environmental costs involved in tapping the few remaining water resources, make it imperative that the conventional supply-oriented approach be replaced with a demand management approach. This project will establish and promote a research network to advance this effort. The activities of the network will influence policy-makers' awareness of water demand management options, thereby increasing the likelihood of a more efficient, sustainable and equitable management of limited water resources.

Rainwater catchment, phase II. Because of the costs involved in supplying Tanzanians with clean safe water, the Government has emphasized, in its water policy, that rainwater harvesting should be promoted. This phase II project will promote community awareness and training in the construction, use and maintenance of rainwater catchment systems resulting in their dissemination throughout the United Republic of Tanzania.

Managing the water demand. The water deficit problem is a vital concern for most countries in North Africa and the Middle East. The objective of this project is to design a comprehensive strategy for managing the water demand in Tunisia in order to avoid rationing.

Participatory land and water management in dryland agropastoral areas: north-west coast of Egypt, phase II. This project will integrate aspects of land evaluation, watershed planning and management, farming systems analysis, and indigenous knowledge. It will take into consideration biophysical and socio-economic information to identify needs and constraints and develop practical solutions. The methodology will include remote sensing, modelling and GIS, with the goal of developing and applying a functional area planning tool to support participatory natural resource management and agricultural development in this semi-arid, agro-pastoral area.

Network for research on software tools for land management (HUMUS Network). Management of land resources is a critical issue. The development of software to support land management requires broad interdisciplinary collaboration and exchange of information. This project will support the creation and operation of an Internet-based network of interested individuals and institutions.

Traditional water management in Africa. Water scarcity in the arid and semi-arid regions of Africa poses a grave threat to the well being of rural people. The conventional approach has been to emphasize Northern technologies over indigenous forms of water management, without considering the potential benefit of the latter, which have evolved with the local environment and are specifically adapted to local conditions. This project will address this oversight by supporting an in-depth study of the efficacy of traditional methods of water management.

Local strategies for water supply and conservation management. In many parts of the world water scarcity is becoming endemic. Demand management or conservation options are increasing attractive but seldom used. This project will define the extent to which locally managed water supply and end-use conservation options, including surface and ground water, can serve as responses to water scarcity; and support the development of local capacity to manage water as an alternative to large-scale centralized, supply-oriented options in India and Nepal.

GIS applied to the management of pastoral activity in the Algerian steppe. The ecological equilibrium of the steppe has been compromised by a combination of anthropological and climatic factors. Working with other Algerian institutions, the project will demonstrate the potential of utilizing remote sensing for rapid and efficient characterization of the environment and its evolution; and the application of GIS to the management of the steppe and the formulation of action.

For more information on these and other IDRC projects, visit the web site at http://www.idrc.ca.

Annex II

CONTRIBUTION OF FRANCE

I. INTRODUCTION

The French contribution sets out various considerations relating to the topic of early warning. It draws on a body of knowledge and ongoing programmes with French participation relating to mechanisms of desertification and early warning.

II. FOOD SECURITY WARNING SYSTEM

Very little work has been done on warning systems for desertification. Doubt has even been expressed as to whether the principle of early warning has any value when applied to desertification. However, a substantial number of early warning systems for food security are currently in operation throughout the world, especially in Africa and in the Mediterranean basin.

Analysis of the principal ongoing programmes shows that they are based in the first place on observatories, or more precisely observation networks which measure grain production. A crisis situation is defined in terms of a shortfall in actual production compared with production expected or required. Actual production depends on climatic and phytosanitary conditions, crop pests, cropping practices, and so on. On the basis of the percentage losses in relative production (i.e. production as a proportion of average levels over preceding years), the gravity of the situation can be quantified: losses of 10 per cent are enough to trigger an alert, 30 per cent a state of emergency.

Here we will deal with two other components of a warning system: the concept of indicators and thresholds, and the triggering of an alert (a state of emergency) as the step which initiates policy action.

Indicators are defined by OECD as a value calculated from a set of parameters which supplies information on a phenomenon or on the state of that phenomenon. The indicator is designed for a certain purpose and a specific group of users. It reflects a given situation and can help in decision making in that context. It can be either a quantitative benchmark or a qualitative description.

The choice of thresholds for each indicator is equally important. These thresholds are often dictated by other types of indicator, but sometimes they form an intrinsic part of the definition of the indicator (for example, in the case of a needs/resources ratio, which must remain less than 1). The various thresholds selected must reflect the increasing seriousness of the situation. They generally feature in international warning systems for food security ("Early Warning Systems") as follows:

. Warning or alert, marking the progress of the phenomenon and the need to curb it;

. Alarm, meaning that restoring the previous situation will be a lengthy and/or expensive process;

. Emergency, the final stage before the situation becomes irreversible.

Lastly, the warning is pointless unless it serves as a trigger for action. This requirement raises questions in terms of coordination and institutional interconnection among scientists (who are often responsible for data collection and processing), politicians (who take decisions on action to be pursued), and the departments entrusted with implementation. This interconnection is relatively easy in terms of food security, as machinery for food aid is long-established and operational.

III. SHOULD A WARNING SYSTEM BE DESIGNED FOR DESERTIFICATION?

Analysis of food security warning systems gives rise to a number of hypotheses as to the components of a warning system.

The timescale of the desertification warning system is essentially determined by the speed with which the desertification processes under study evolve. They occur over the medium and long term. Data organized around indicators and thresholds are vital. The question that arises relates to information systems constructed on the basis of the challenges involved in efforts to combat desertification. What criteria should be used, what indicators? Defining these indicators and criteria must first take account of the phenomenon of desertification and the way in which it is perceived.

The United Nations Convention to Combat Desertification defined the concept in 1992 as "land degradation in arid, semi-arid and dry subhumid areas resulting from various factors, including climatic variations and human activities". More recently, it stipulated that the term "desertification" does not refer to the expansion of existing deserts. Processes of desertification occur because the ecosystems of dry regions are extremely vulnerable to inappropriate use and over-exploitation. Poverty, political instability, deforestation, overgrazing or poor irrigation techniques can all reduce soil fertility.

Land degradation is the result of natural processes prompted or catalysed by man. It takes the form of a deterioration in plant cover, soils and water resources. Through physical, chemical or hydrological processes, it culminates in destruction of the biological potential of land or its capacity to carry the populations living on it. The state of desertification at any given moment simultaneously generates an "impact" on (or consequence for) human society and nature itself (through the remaining resources). Conversely, man and the environment exert "pressure" (or causes) on the area which is subjected to desertification.

The challenge facing information systems is therefore to integrate both socio-economic and physical factors. This poses a real difficulty, especially for socio-economic phenomena. They relate to human behaviour (a plurality of participants, the concept of conflict, etc.) and are more difficult to schematize and simulate (even using empirical models). This difficulty is all the more real in that these issues have generally been addressed by ecologists rather than specialists in the human sciences. Finally, the relevant data are

much more difficult to collect (particularly in developing countries, where institutional machinery and collection networks are lacking), to quantify, and, above all, to spatialize.

Aids to decision.making form the second element in a warning system. Even if an information system is available which satisfactorily simulates the problem of desertification (taking an integrated view of its biophysical and socio-economic components), simulating their interactions is essential to decision.making by the users of the system. This simulation also makes it possible to reduce the "gap" between the outputs of the various programmes and the range of options facing the decision makers. By virtue of the precautionary principle (minimization of risk), decision makers (political or administrative) often choose to take no action rather than the wrong action. If they could foresee the consequences of their decisions for the state of desertification and hence for society (since the system may be regarded as being a closed one), all those involved, and particularly the natural environment, would gain.

The issue of aids to decision making additionally poses the problem of institutions and the conditions for hosting the desertification warning systems. In what machinery, within which institutions can they best play their role?

Drawing up a balance sheet of achievements in desertification research projects will make it easier to pinpoint the action to be pursued.

IV. DESERTIFICATION RESEARCH PROJECTS

Many research projects are currently being carried out on the issue of desertification. Most of them focus on the regions of the Mediterranean basin. They may be described as a set of exercises for the modelling of multidisciplinary processes using observation data as inputs and providing a variety of outputs ultimately intended to furnish advice to stem the phenomenon of desertification.

The common approach followed in these research projects involves the following:

(a) Observation of the causes and effects of desertification. This involves monitoring the dynamics of soils and plant cover. Organizing the collection of data on the ground is crucial for the accomplishment of this stage;

(b) Research on the mechanisms of the desertification process. Understanding them generally involves modelling of biophysical and socio-economic systems;

(c) A transfer of knowledge and skills. This stage involves extending the previous results to other affected areas, generating local skills, etc.

All these projects display similarities in:

(a) The definition of the study sites affected by desertification. A number of study zones experiencing some clearly circumscribed desertification processes are selected. For each site, a database encompasses the climatic data, the vegetation, the pedology, etc. In this way the study is limited to a representative area, and the analytical methods can be transferred to other sites. These are DeMon's "ecoregions" or ROSELT's "agro-ecological" zones; 1/

(b) The method of data collection. It is standardized as between sites for purposes of reporting on the processes identified;

(c) The techniques used for reporting on the evolution of landscapes over time. For example, for processing of remote sensing images, the projects use techniques of spectral mixing analysis from DeMon or "Linear Spectral Mixing Modeling" from Medalus;

(d) Modelling of the processes of desertification (essentially processes of wind and water erosion), modelling of growth in plant cover;

(e) Simulations and forecasts. This stage is made up of a set of forecasts (extrapolated from the simulations) which should make it possible to supply advice for purposes of development assistance, or for management;

(f) The integrating role of geographical information systems (GIS). All these research projects endeavour to incorporate these successive stages into a global system, generally taking the form of one (or several) GIS (ROSELT's Environmental Information System or MEDALUS's MEDRUSH). 2/ The GIS serves simultaneously as a database, a framework within which the modelling exercises are merged and a catalogue of statistical and cartographic products. Each research centre adapts the study to its sites and its areas of expertise (see the list of universities in MEDALUS, for example);

(g) Lastly, the formulation of management advice appropriate to the users and the problems encountered. Note that this stage is generally bypassed.

To sum up, these research projects observe, model, sometimes forecast and advise. However, several aspects of the warning system are lacking:

(a) Monitoring is not continuous (except for ROSELT). One observation is carried out on the environment at a given moment or over a short period. These are research projects, and hence have no direct operational objectives;

(b) None gives any alert. They do use indicators of different levels of complexity, but none of them applies a critical threshold which reflects a state with consequences of a seriousness estimated in advance. As we have said, these degrees of seriousness must be defined in terms of advisory or reactive capability. This requires in particular alerts which are reliable, are supplied well in advance, etc.;

1/ ROSELT: Réseau d'observatoires pour le suivi de l'environnement à long terme (Long-term ecological monitoring observatories network).

2/ MEDALUS: Mediterranean Desertification and Land Use.

(c) The overall approach to the environment, in terms of its natural (biophysical) and man-made (socio-economic) aspects, is clearly inadequate;

(d) Measurements of the impacts of decisions (simulations) are not addressed.

V. AVENUES OF WORK?

A method?

The development of warning systems for desertification can be considered in the perspective of an effort to make desertification research projects more operational and more effective.

A first point might relate to actions to be undertaken in the light of the requirements of a warning system. This would involve a number of successive choices:

(a) The agro-ecological zone proposed for study. The main requirement is that it should be homogeneous from the viewpoint of the ecological and man-made phenomena it contains;

(b) The desertification problem, i.e. the identification of the process or processes involved in the selected area;

(c) The spatial scales, which depend as much on the desertification phenomena as on the decision makers who will finance the project;

(d) The timescales of the processes involved (given that man-made processes are more rapid than natural processes where desertification is concerned);

(e) The indicators describing the pressures on the state of the environment at a given moment and the responses (both natural and man-made) to changes in it;

(f) The data to be acquired and the collection networks for monitoring these two types of indicator;

(g) Modelling of the processes which will make it possible to understand and forecast the values of the indicators;

(h) The principle of the warning and the tolerance thresholds to apply to the indicators of "state", dictated by the consequences of desertification (on the basis of the indicators of "pressure" and "response");

(i) The type of simulation of decision making (reflected in the "response" indicators) which will feed back onto the indicators of "pressure" and "state", which are needed for the warning;

(j) The overall system to be instituted to gather together all these stages (institutional organization, computerization, etc.) and its simultaneous evaluation.

Annex III

CONTRIBUTION OF ITALY

I. EXISTING EXPERIENCE IN EARLY WARNING SYSTEMS

Since the early 80s, in order to increase food security in the arid zone of the African continent, Italian cooperation has been sustaining the development of early warning systems (EWS).

Since the beginning, priority was given to those systems able to produce immediate operational outputs, thus enabling the development of applications appropriate to the technological level of the national services and providing, at the same time, a more accurate overview of food security conditions.

The positive results obtained in recent years were possible thanks to the ability to adapt to the technological evolution that has been taking place since the mid-1980s, even though priority was reserved to the decision-makers' needs.

Among the most significant experiences particularly worth mentioning, are the projects carried out in the framework of the Agrhymet Programme in the Sahel area since 1985:

(a) *Assistance to the National Meteorology Departments* in Niger, subsequently extended also to Burkina Faso and Mali, aimed at strengthening the operational capabilities by the utilization of agro-meteorological models;

(b) The *ZAR3/ project*, aimed at developing the appropriate methodology for the identification of risk areas through both meteorological data and a statistical analysis of the historical series of data;

(c) The early warning and agricultural production forecasting (*Alerte Précoce et Prévision des Productions Agricoles*) project, enabling the development of an integrated system, which utilizes both the classification of the structural vulnerability and the year-based risk assessment. The second phase, which started in 1999, should make it possible to extend to all the countries of the Sahelian area the extremely positive results that were obtained during the first phase.

In East Africa, as well, the initiatives have concerned both the subregional and the local scale. At the regional level, a regional early warning system for countries of the Intergovernmental Authority on Development (IGAD) has been implemented through the FAO. An extremely important regional database has been

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3/ ZAR: Zones à risques.

established, which is still the basic source of information for all the structural analyses carried out at the subregional level.

Based on this experience, a programme East Africa was also developed and executed by the FAO. This programme aims at the development of operational systems for environmental information processing and for thematic mapping.

At the sub-national level, the projects implemented in Ethiopia and Eritrea for the development of systems that can contribute to both early warning and resource planning are worth mentioning.

II. ITALIAN INSTITUTIONS OPERATING IN THIS FIELD

The sustained Italian commitment has facilitated the development in this sector of a number of Italian institutions operating at the international level:

Centro Studi per l'applicazione dell'Informatica in Agricoltura (CeSIA) - Accademia dei Georgofili: early warning and vulnerability classification
Centro di telerilevamento per il Mediterraneo (CTM): remote sensing database
Ente Nazionale per l'Energia e l'Ambiente (ENEA): remote sensing classification and training
Fondazione per la meteorologia applicata (FMA): rainfall forecasting
Istituto per l'agrometeorologia e l'analisi ambientale applicata all'agricoltura/consiglio nazionale delle ricerche (IATA-CNR): remote sensing methodologies development
Istituto Agronomico per l'Oltremare: remote sensing training
Telespazio: thematic mapping
University of Venice: vulnerability classification
University of Trieste: environmental monitoring.

III. ITALIAN CONTRIBUTION TO EWS AND DESERTIFICATION

A. Background

In order to contribute to the preparation of the third session of the Committee on Science and Technology and in accordance with decision 12/COP.2, the Italian Co-operation and the UNCCD secretariat have convened a four-day workshop at the Agrhymet Regional Centre in Niamey, Niger (from 25 to 28 October 1999).

The specific objectives of this initiative are:

(a) To provide the Committee on Science and Technology with an evaluation of the prospects of integrating early warning systems with environmental information, in particular that on desertification;

(b) To create an "enabling environment" for the development of early warning systems on desertification, by:

(i) Supporting the establishment of operational exchanges between existing projects in the fields of early warning and environmental monitoring in Africa;

(ii) Promoting the development and the testing of practical examples for the integration of early warning approaches with those of desertification.

To prepare for this workshop, the *CeSIA - Accademia dei Georgofili*, on the basis of the arrangements between the UNCCD secretariat and the Italian Cooperation, prepared a global report on early warning systems and desertification. The text below is the executive summary of this report.

B. Introduction

Late in the 70s, as a consequence of the dramatic drought in West and East Africa, famine struck millions of people. The affected areas' administrations and the international community were faced with the need to provide the appropriate tools to facilitate the mobilization of measures aimed at mitigating the impact of recurrent droughts.

The EWSs that were conceived and implemented in that period could be considered the ancestors of the systems in use today. In fact, from a methodological point of view, they aimed at forecasting the establishment of a risk situation at two levels: (i) the geographic area, and (ii) the population involved.

Since then, as a consequence of both the great results expected from the EWSs - due to their theoretical potential as well as to the financial investments involved -and the unimpressive results obtained, a passionate debate has been generated at the international level to find the most appropriate solution.

It was only in the mid 1990s, when the technological evolution in telecommunications (the Internet) and information technology (hardware and software) took place in parallel, that the conceptual revision of the structural constraints of technological type enabled the parallel experimentation of new operational approaches.

Based on the above elements, the EWSs are still evolving, thanks to the development of the vulnerability mapping systems, towards the integrated management of structural vulnerability analysis. The last-mentioned means the capability of a population, a village, a social group to face a negative event, with the risk forecast, that is the possibility that a negative event may occur in a given time.

At present, most of the operational EWSs do not address the environmental aspects, in particular desertification, either in terms of indicators or of factors affecting food security. At the same time, the systems dealing with the monitoring of natural resources have given priority to the environmental aspects, leaving aside the human being, as the affected and affecting element of desertification.

The future scenario now seems particularly favourable for further evolution of EWSs, thanks to:

(a) Increasingly accessible and timely information;

(b) The development of data integration techniques aimed at producing immediate, useful and diversified information, according to the needs of the different end-users.

In fact, a complex and global system is being developed, formed by 'entities' producing and distributing processed data, those which are more immediately involved in early warning and those which create a favourable environment for the circulation of information.

C. Early warning, data dissemination and information dissemination systems: the present scenario

An EWS is based on three main components, namely:

(a) The collection of data;
(b) The processing of data and the production of information; and
(c) The dissemination of information.

On the basis of this classification, a comparative analysis of the systems operating on the Internet has been undertaken. As a result of this, relatively few early warning systems can be considered as such in the strict sense of this expression. Information dissemination systems are still less numerous, but there is a definitely larger number of data dissemination systems.

The systems inventoried are as follows:

A. *Early warning systems*:
1. Alerte précoce et prévision des productions agricoles (Agrhymet) project
2. Famine Early Warning System (United States Agency for International Development)
3. Food Security Programme (Southern African Development Community)
4. Global Information and Early Warning System on Food and Agriculture (FAO)
5. Food Insecurity and Vulnerability Information and Mapping Systems (FAO)
6. Vulnerability Analysis and Mapping (World Food Programme)

B. *Information Dissemination Systems* on environment or desertification:
1. Regional Environmental Information Management Project (World Bank)
2. Environment Information Systems in Sub-Saharan Africa (World Bank)
3. System for the Circulation of Information on Desertification / Environmental Information and Monitoring System on the Internet (Observatory of the Sahara and the Sahel)

4. SCOT4/ Conseil and Medias-France Desertification Data and Information System
5. CEO5/ - Desertification Information Network

C. *Data dissemination systems*:

1. European Space Agency IONIA
2. Environmental Systems Research Institute, digital chart of the world
3. EUMETSAT
4. FAO-AFRICOVER project
5. FAOSTAT
6. Satellite Active Archive (National Oceanic and Atmospheric Administration) (NOAA)
7. NOAA/NASA Pathfinder
8. PENN STATE UNIVERSITY, Digital Chart of the World Data Server
9. Africa Nutrition Database Initiative (United Nations)
10. Global Resource Information Database (GRID) (UNEP)
11. Central African Regional Programme for the Environment (CARPE) (USAID)
12. Africa Data Dissemination Center (United States Geological Survey) (USGS)
13. Earth Resources Observation Systems Data Center (USGS)
14. Land distributed Active Archive Centre (LANDDAAC) (USGS)
15. Global Land Information System (USGS)
16. Global Land Cover Characteristics (USGS)
17. Centre for Environment and Development for the Arab Region and Europe GIS database
18. Global Climate Observing System (World Meteorological Organization)
19. European Centre for Medium-Range Weather Forecasts
20. World Conservation Monitoring Center - Forest Conservation

D. Basic characteristics of EWSs

The final users of the early warning system should be the monitored populations (target groups). However, in general, information is not directly reaching these users; it is filtered through the national and local institutions, which provide them with the most objective basis on what are the necessary actions to be taken.

Therefore, the final objective of any EWS is to provide the decision-makers with the necessary and timely information on the present food situation in the relevant areas, and the forecast for the end-of-season. As far as objectives and products are concerned, every single system is different depending on the geographic area of application. These differences are often due to the availability of financial

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4/ SCOT: Service et conception de systèmes en observation de la terre.

5/ CEO: Centre for Earth Observation.

resources, the availability of data in the national setting, and the specific agency requirements for the structure and the contents of outputs.

The most modern EWSs are based on a very extensive, multidisciplinary analysis. The socio-economic aspect is becoming predominant, but it is interesting to note how some systems place particular stress on a specific indicator, such as prices and market trends, food availability, health or malnutrition. On the other hand, the statistical approach and a complex approach integrating data from various sources are still in use. This is the demonstration of how heavily the system's operating environment affects methodology.

Indicators and thresholds represent the conceptual content of the information to be produced. In fact, the indicator is an intermediary step between the input data and the final information level. Therefore, indicators could be based on basic data or on benchmarks, depending on the complexity of the phenomena to be represented. As regards the thresholds utilized for each indicator, in order to determine the early warning or risk level, the variability between one system and the other and between one application and the other within the same system is quite important.

E. EWSs and desertification: recent trends and future needs

The existing EWSs utilize environmental and socio-economic data and indicators, which could be employed directly to assess land degradation or to monitor desertification. EWSs focus on food security and approach other fields of application just occasionally, more for institutional reasons than for technical causes, in order to avoid any possible conflict between traditional and new stakeholders.

Therefore, only increasing pressure from users could facilitate an extension of the field of activity from food security to natural resources management.

Land degradation being both a cause and an effect of food scarcity, it is generally indirectly monitored by the EWS. Due to its intrinsic correlation with human and socio-economic factors, desertification could be measured by means of the same methodologies as those utilized for food security.

Nevertheless, some important distinctions must be made. The temporal scale of a food security EWS is basically conditioned by the rapidity of evolution of the processes under examination, but the desertification processes take place in the medium and long term period. The effects of climatic changes and of land degradation are too slow to be included in a risk analysis such as a crop or agro-pastoral analysis. Consequently, the timescale of an EWS for desertification should be extended over a period of several years in order to bring changes into evidence.

Two items of greatest impact meriting attention are:

(a) The micro-level analysis of the effects of populations and environment dynamics in (i) areas where desertification processes are particularly rapid, (ii) areas with population migrations and (iii) areas where modifications of the productive systems occur at the same time as great climatic changes;

(b) At the regional and global level, the assessment of the state of desertification, thus enabling the analysis of the changes that have occurred in the last decades, for (i) the quantitative assessment of the advance of desertification and (ii) the identification of the degree of vulnerability.

IV. CONCLUSIONS

Today, EWSs are in a state of change, due to the changes that have occurred in the technological environment in which they operate. However, this process should take into account the present and potential end-users, who also live in a new workd of information technology and communications.

The key questions revolve around how to set up a real demand-driven EWS, rather than a system that is the fruit of technological push.

Need to develop a common language. The integration of risk analysis with vulnerability analysis, as a structural framework of reference, has become a generally shared approach. The different meanings of the terms, vulnerability and risk, in different systems is still misleading, making interaction difficult and causing isolation.

Access to and transparency of data. At the present time, access to baseline data, in particular, is really neither free nor easy, due both to the difficulties in making the data banks' network operational and to the idea that the final objective is data collection.

Accelerated interaction towards the real partnership. A complex system requires - especially at this stage - real willingness to cooperate and a partnership attitude vis-à-vis those institutions that might contribute to its development and the donor agencies that are asked to establish a political and institutional 'enabling environment'.

Production of a focused information for decision-making. The ability to interpret information still lags behind the potential to produce it, and the risk arises that unfocused information will be generated. This would assign to the user the task of selecting the information, rather than commanding it.

Users are required to identify the information they need. Users are not a homogeneous category, as regards both their technical skills and their information

demand. This is certainly a further difficulty facing the EWSs that must decide, without any active interface, the type of information that is to be provided.

Adequate development of national and sub-national nodes. All the systems under consideration operating at regional or subregional level, even if they produce information at the national or local level. How can any national or local EWS be functionally and institutionally developed, so as to be introduced into the existing network of systems like those under consideration?

Acceleration of the passage from food security to security. All the early warning systems under consideration are expanding into new fields, such as economic planning and management of natural resources. Similarly, vulnerability analyses are moving towards improved interaction between environmental and socio-economic classifications. In this regard, attention is being drawn to the concept of 'security', which is based on an organic complex of data and differs only as regards the path of analysis.

Technological development should not be considered as a priority. Information technology is developing quickly. New generations of satellites will become operational soon. Therefore, the EWSs are endowed with theoretically more and more powerful tools. In this framework, it is of capital importance that - with respect to these new tools - priority be given to the development of those applications that really meet the needs of the final users.

Annex IV

CONTRIBUTION OF MALI

I. DATA ON EXPERIENCE ALREADY ACQUIRED WITH THE EARLY WARNING SYSTEM

In Mali the early warning system (Système d'alerte précoce – SAP) has been instituted in order to forecast food crises with the aim of improving the provision of the aid required.

It constitutes a response to the following questions, inter alia:

(a) Which are the areas and population groups at risk of food or nutrition problems?

(b) What aid should be provided? How should it be used?

The SAP monitors the traditionally risk-prone areas, i.e. those which have already experienced severe food crises – 173 arrondissements north of the 14th parallel. It is based on the continuous collection of data relating to the food and nutritional status of the population groups. The information, covering a wide variety of areas, is gathered from the administrative and technical authorities from the grass roots up, and compiled in the form of a monthly report which is reviewed and adopted by the SAP working group and then published and distributed as a monthly bulletin.

The bulletin is composed of the following:

(a) An assessment of the food situation and recommendations for action;

(b) A synthesis containing the summary of the previous month's situation and the situation in terms of each indicator and region. This synthesis is intended first and foremost for decision makers;

(c) A description of the situation in each cercle and region for the current month, intended for technical staff.

The indicators analysed for each cercle are as follows:

(a) Rainfall;

(b) Crop pests;

(c) Crop season;

(d) Stock-raising/fisheries (transhumance – status of rangeland);

(e) Migration (arrivals – departure of sedentary farmers);

(f) Market prices (grain and livestock);

(g) Changes in eating habits;

(h) Food stocks;

(i) Health - nutrition.

The SAP started up in Mali in April 1986. Since then, it has regularly and promptly supplied the information on the area concerned which is required for appropriate assistance. It has made regular progress and has developed reliable indicators which have benefited from increasingly higher-grade analysis. Today the SAP is a tool for prevention used both by the Government and by lenders and other donors.

II. ENVIRONMENTAL MONITORING IMPACT INDICATORS

One of the lessons drawn by the Convention to Combat Desertification from past experience is the need for regular monitoring of progress in efforts to combat desertification, so that any corrective measures can be taken before it is too late to react. In this context it is important to have tools to measure the efforts made, tools to evaluate gaps to be filled, in order to guarantee that the action programmes adopted are fully implemented, and at all levels - local, subnational, regional and international. These are the indicators.

At its first session, the Conference of the Parties adopted, on a proposal from the Committee on Science and Technology, a matrix of indicators relating to the implementation of the Convention. The Conference of the Parties also called for this matrix to be tested in various interested countries so that it could be adapted to national circumstances and validated.

The standing technical secretariat of the institutional framework for the management of environmental issues plays the role of national coordinating body for the Convention in Mali. It should be mentioned that this body has not tested impact indicators. However, since 1997 the natural resources management project has embarked on a process of broadening its databases to cover impact monitoring with the support of the World Bank. The table below summarizes the activities that have been conducted since 1997.

In addition, the sectoral round table on environmental financing held from 27 to 29 May 1999 in Bamako presented to the lenders a national environmental information management programme. The programme is in two parts: the national environmental information system and the national environmental monitoring network. The former will build up an inventory of earlier experience in environmental information systems. As regards environmental monitoring, several observation networks have been set up in Mali since 1985.

All these observation networks have made use of similar methodologies. In order to draw greater benefit from the achievements so far, the national environmental monitoring network will ensure complete coverage of the country.

Hence it may be said that there are activities in prospect in the field of environmental monitoring impact indicators in Mali.

PROJECT COMPONENTS	EXPECTED RESULTS AT THE END OF THE PROJECT	ACHIEVEMENTS 1997	ACHIEVEMENTS 1998	ACHIEVEMENTS 1999	OBSERVATIONS
1. Extension of the database to impact monitoring		Validation test for impact monitoring records	Organization of four workshops	Organization of consultant support for personnel supervising monitoring	Ongoing activity
2. Database management					
2.1 Implementation of impact monitoring and evaluation	The evaluation test for the impact monitoring records was evaluated and modifications made. The tools and media for the impact monitoring were finalized				
2.2 Monitoring of the implementation of the monitoringevaluation system	The analytical concept of the impact monitoring module was finalized. The terms of reference for the studies relating to the four elements of the monitoring-evaluation framework are being developed			Continuation of the implementation of the impact monitoring	
2.3 Monitoring of data collection	Support for the implementation of 149 DTs, 149 SATs, 108 PATs, 16 PAFs				Ongoing activity
2.4 Verification of data					
2.5 Development of the internal environmental monitoring system					Ongoing activity

2.6 Assessment of the degree of control of the planning process on the part of the support structures					
2.7 Production of periodic progress reports		Four quarterly reports, two half-yearly reports, one annual report	Four quarterly reports, two half-yearly reports, one annual report	Four quarterly reports, two half-yearly reports, one annual report	
2.8 Evaluation of decentralized planning			26 communal diagnoses and 26 SACs prepared	Progress in the development and application of the documents drawn up in 1998	Following the setting up of the rural communes
2.9 Development of a method of participatory self-evaluation		Training with the planning machinery in Kayes, Kati and Dioïla Planning machinery evaluated in Bankass and Bafoulabé Training workshop organized for AT/CAT communicators	Continued evaluation of the planning machinery in the other areas	Organization of workshops for training in self-evaluation	
2.10 Dissemination of the results of the monitoring at various levels					Provision of information once a quarter at the various levels
2.11 Organization of ad hoc support for technical				Support once every	

machinery and rural communes				six months	
2.12 Evaluation of the first phase of the natural resources management project					Analysis of the methodology and the results of the PNGT evaluation of Burkina Faso: -Planning the evaluation -Drawing up the terms of reference for the consultants -Forming the evaluation team -Training the team -Collecting the information -Drafting the evaluation report
2.13 Initiation of preparations for the second phase					Making use of the evaluation report -Making use of the results of the monitoring-implementation -Making use of the results of the impact monitoring -Making use of the results of the environmental monitoring -Drawing up the draft document of the project phase II.

Annex V

CONTRIBUTION OF SAUDI ARABIA

Ongoing early warning experiments in Saudi Arabia

1. Observing extreme temperature periods, when they are over or under the yearly average and registering this data.

2. Observing the extremely low precipitation and its data.

3. Observing strong windy periods and their impact on sand movement.

4. Observing the outbreaks of insects and plagues. The study of their migration, migration directions and their reproductive areas. For example: the grasshopper.

5. Observing the regenerative natural resources and farmproduction as well as evaluating its condition, i.e.: how well or how badly is it reproducing.

6. Using modern technology to monitor and observe the reproductive natural resources and farmproduction.

The departments using and working in the early warning systems are:

1. Ministry of Land and Water

2. Weather Ministry and the Department of Conservation

3. National Commission for Protecting the Growth of the Animal World

4. Centre for Sahara Studies, King Saud University

5. Faculty of Agriculture, Kind Saud University (Riyadh-Qasim)

6. Faculty of Climate and the Study of Pollution, King Abdulaziz University (Jeddah)

7. King Abdulaziz Centre for Science and Technology

8. Experimental Institute, King Fahd University for Oil and Minerals

Annex VI

CONTRIBUTION OF SWITZERLAND

CONTENTS

Summary

I. Introduction
II. Early warning system today: starting point
III. Main questions
IV. Steps to be taken
V. Conclusion

Annex

Abbreviations

Summary

First of all, it should be stated that the implementation of an early warning system (EWS) dealing with desertification should be based on a technology which transcends national and administrative borders. Thus the most adopted technology will be the Internet.

To gain some idea of the information available on the Internet about desertification and in particular of information which could be used for an early warning system, a first analysis of 12 sites on the World Wide Web (WWW) was performed.

The analysis revealed that a lot of information is available but it is not easy to access and is rather heterogeneous in form. Clearly, some thematical fields (e.g. meteorology, indicators), and some geographical regions (particularly in Africa) and there rather regional or national) predominate. From the Swiss viewpoint, a certain lack of local information was identified. Furthermore, the link between the information generated and the decision-making process was not clear.

Another conclusion of the analysis was the need for quality approval and check of the information published by an EWS. Only information which is reliable and of good quality can ensure the credibility and long-term use of a EWS. A so-called review element and user-need driven evaluation should be established as part of the EWS.

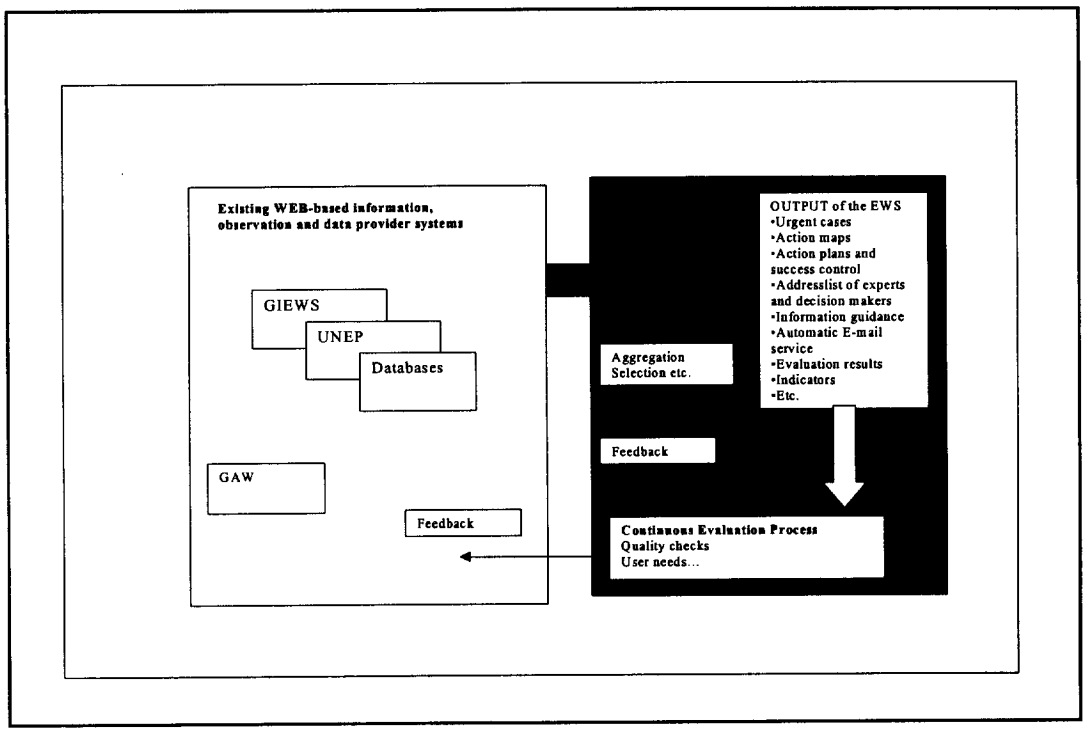
In light of the results of the first evaluation, some main questions are formulated in the paper. The points thus raised could serve to guide future discussion on the implementation of an EWS dealing with desertification.

I. INTRODUCTION

This paper presents some ideas and questions in order to guide the discussion on developing an EWS focused on desertification.

In recent years, the flow of information increased, not only in the commercial but also in the governmental and non-governmental organizations sector. Today, access to information is faster and easier, but the weight of information makes it more and more difficult to extract the part needed. These common problems apply also to information and data on desertification and their use as an early warning system (EWS). The kind of information that should be available, its transmission and to whom it should be made available, has to be defined. To structure the discussion, we tried to define in a general way the elements of an EWS (see fig. 1).

Figure 1. General structure of an early warning system



Note: This figure shows the general structure of an EWS mainly based on existing services. The grey box includes the part which might be of highest priority and interest for the Convention. The evaluation process should continuously improve the output.

The first question of interest concerns the output of highest priority to be produced by the EWS. For this paper, the EWS was taken as a system which should provide reliable information on the most urgent and important problems at global, continental, regional and/or national level in relation to desertification, as well as on action to be taken to overcome or mitigate those problems. This action may be of short-, medium- or long-term importance. The EWS should inform also about action plans, with additional information on their success (or failure), in order to improve the exchange of experience in the field of combating desertification.

Only fast and easy accessible information technology will be able to fulfil the condition mentioned. The technology should therefore be based on the WWW.

The question of how national or local information could be gathered and integrated into the EWS was not examined but is of major interest and must be discussed in future. In this paper, some ideas and questions are put forward to guide future discussion of an efficient way to develop an EWS (see fig. 1).

II. EARLY WARNING SYSTEM TODAY: STARTING POINT

12 existing sites on the WWW (see table 1), which might be a useful basis for an EWS dealing with desertification, have been analysed and classified as shown in table 1. Table 2 presents a summary of the kind of information, the geographical context and thematic field concerned. The 12 sites considered certainly do not represent all the sites available on the WWW containin important information, observations or data on desertification. The analysis simply gives a first and preliminary overview of the information available today (April and June 1999).

Table 1: WWW sites investigated for the first evaluation

SITE-ADDRESSES
http://edcintl.cr.usgs.go/adds/adds.html
WWW.Agrhymet.ne
WWW.cpc.ncep.noaa.gov/products/african_desk/index.html
WWW.disastercenter.com/drought.htm
WWW.eden-foundation.org/project
WWW.fao.org/WAICENT/FAOINFO/ECONOMIC/GIEWS/ENGLISH/giews.htm
WWW.idndr.org
WWW.info.usaid.gov/fews/fews.html
WWW.medalus.leeds.ac.uk/medalus.html
WWW.unep.ch/earthz
WWW.wcmc.org.uk
WWW.wmo.ch/web/www/GOS.html

The review showed the heterogeneity of the information available. There are many systems, with different thematic focuses, on different geographical dimensions, different topics and providing different kinds of information (e.g. forecasting, monitoring, papers, data, graphical presentations, maps).

This preliminary study did not attempt to assess the quality of the information found.

Table 2: Number of information categories found in the 12 web sites considered

Information included about / Thematic field	Information class	Forecasting	Intervention programme	Evaluation	Monitoring	Indicators	Modelling	Research	Geography	Africa	America	Asia	Australia	Europe	Resolution	Regional	National	Local	Information	Every day	Every week	Every month	More than a month	Not indicated	TOTAL
Physical/ecological conditions																									
Water resources	3					2		1	4	2		1		1	4	1	2	1	3					3	25
Desertification (soil erosion)	7		2		1	2		2	7	3		2		2	5	4		1	4				1	3	39
Pests (e.g. locusts)	3	1	1			1			1	1					2	1	1		1			1			11
Climatic conditions	15	3	1		3	5		3	13	6	2	2	1	2	10	5	3	2	9	1	3	3	1	1	79
Agroecological zones	3					2		1	4	2		1		1	5	2	2	1	3					3	27
Vegetation cover / Land use	5		2			2		1	5	3		1		1	5	3	1	1	4				1	3	35
Socio-economic conditions																									
Health conditions	0								0						0				0						0
Environmental refugees/migration	0								0						0				0						0
Livestock production/range/ animal numbers	1					1			1	1					1		1		1					1	7
Market indicators	8	2	1		1	4			4	4					5	3	2		4		1			2	34
Population density	1					1			1	1					1		1		1					1	7
Self-sufficiency	2					1		1	1	1					1		1		1					1	8
Crop production	7	1	2		1	3			4	4					4	3	1		5		2	2	1		33

Despite a certain subjectivity in choosing the classification scheme (see thematic subclasses, geographical context in table 2) some conclusions are possible (see figures 2 and 3):

(a) The available information is concentrated geographically on Africa, and there on a regional or national level;

(b) Concerning thematic fields, the climatic aspect is outstanding;

(c) Often information on indicators is included;

(d) Almost nothing was found on the evaluation results of programmes.

Preliminary conclusions:

The basic information for an EWS on desertification is available in a somewhat dispersed way on the WWW, with some thematic and geographical concentrations. But the information is not harmonized or aggregated in such a was as to be directly usable for decision-making. Additionally, the quality of the information needs to be checked to guarantee the credibility needed for an EWS. For some thematic fields and geographical regions, information sources are few or at least could not be found easily.

It is a fact, as recent experience has shown, that similar difficulties concerning information flow and aggregation exist for the implementation of other conventions (e.g. Convention on Biological Diversity, United Nations Convention on Climate Change, the Alpine Convention). On several servers (e.g. FAO), the coordination with other conventions is mentioned. In particular concerning the tools which might be used for similar tasks (e.g. information exchange, success control, document servers, data access synergies are possible and may open new opportunities.

Figure 2: Number of information categories found: kind of information, geographical context, geographical resolution and frequency of updating

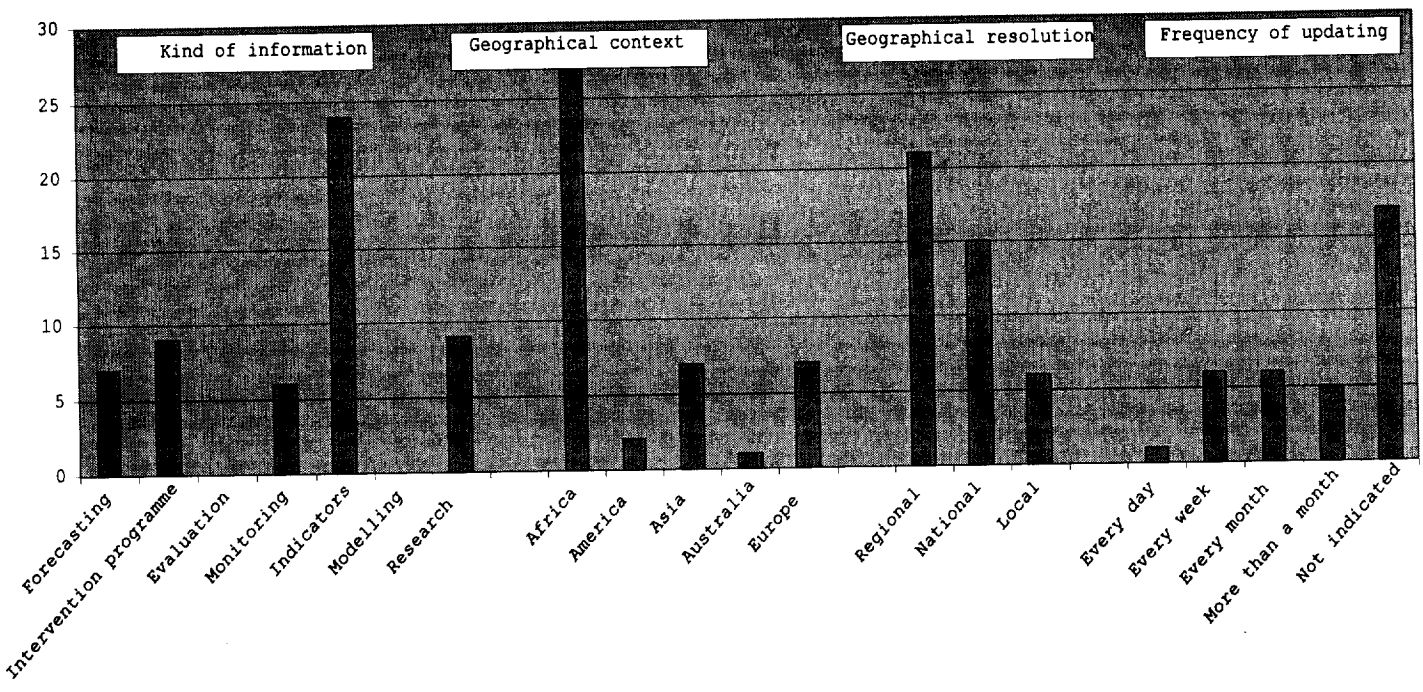
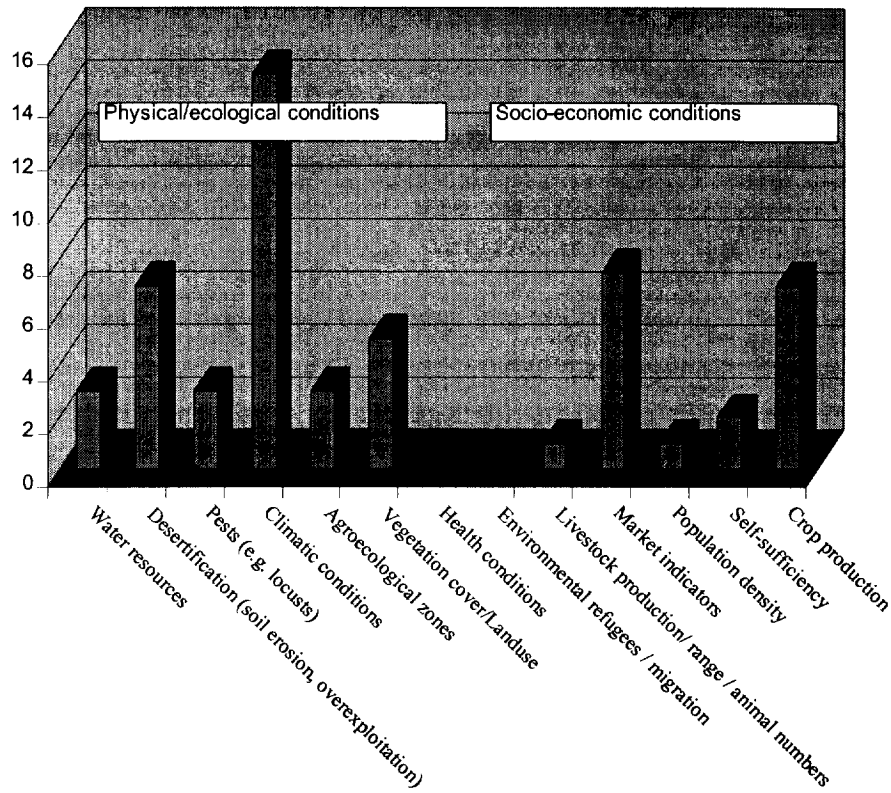


Figure 3: Information categories found in the web sites



III. MAIN QUESTIONS

Using the results of table 1 and the concept shown in figure 1, some major questions occur. The answers may help to guide future discussion on an EWS dealing with desertification and to implement a user-needs-driven system. The questions are:

(a) Which user group should be addressed and which should have the highest priority?

(b) Which are the most important outputs needed by the different user groups?

(c) Who prepares what kind of basic information, data, observations?

(d) Who should be responsible, and at what level, for the aggregation, evaluation and quality assurance?

(e) How can information be made available at the local level?

IV. STEPS TO BE TAKEN

Which user groups should be addressed and which should have the highest priority?

The possible list of users of an EWS dealing with desertification is long but from our point of view, the EWS should improve the decision-making process and therefore address decision makers and professionals (specialized institutions, non-governmental organizations, etc.) at all levels, but focussing on regional, subregional, national and district levels.

The following order is not complete and does not reflect any priority, the groups mentioned may overlap with one another:

Decision makers and professionals (persons, institutions, organizations etc.)
Convention countries and their institutions, non-governmental organizations and associations (prevention, production, research)
Non-governmental organizations
National, regional and local authorities
Public in general
Media and news producers

A priority order should be fixed by the Parties to the Convention.

The EWS should be open to all users in a regular way, with reliable and up-to-date information, easy to use and broadly accepted. This will guarantee the long-term credibility needed.

Which are the most important outputs needed by the different user groups?

Many outputs can be produced by the existing information technology (web sites, databases, news, mailing lists, reports) and the priority will differ depending on the user groups. Some possible products are listed below.

Overview of problems in synoptic form
Results and summaries of action programmes (evaluation reports and summaries)
Indicator systems
Forecasting models
Push information (news servers)
Expert and address lists
Discussion groups
Document servers
Data inventories
Maps

In establishing a regular evaluation procedure guided by users, their feedback will be used to improve the products. On the web sites analysed for this working paper, more or less all of the listed products are available somewhere but only for certain

thematic fields or limited geographical regions.

Highly aggregated information on existing or upcoming problems (in the sense of forecasting) in the context of desertification might be one of the most important products needed by decision makers. This information should not be produced by establishing further observation and data collection systems needing heavy, long-term investments, but should be the product of intelligent aggregation processes on well defined rules and quality criteria (which information base is used and how).

For the aggregation process and the forecasting approach, different methods might be used. If the results obtained are different, the reasons and uncertainty may be explained.

Another product group of great importance is the exchange of experience, particularly in dealing with measures and action plans. Today, there is scant information about successful programmes on the WWW. Looking at the geographical resolution of the information found in our analysis (see table 2), it is evident that the local level is rarely represented, despite the fact that actions primarily concern this level.

Who prepares what kind of basic information, data, observations?

Today more and more meta-data directories6/ are used for information and data research on the WWW.

To aggregate decentralized information, an overview is needed. The meta-data directory indicates who can deliver what kind of information and about which geographical region. Furthermore, it may indicate since when the data and information have been collected and till when. Such a kind of instrument might be the starting-point to overcome the lack of overview and to allow the type and quality of information needed to be extracted quickly.

The inventory also makes it easier to identify information and data gaps. Synoptic overviews, as in table 1, can reveal for example, in which region (local level) or in what kind of thematic field little or no information is available.

Who should be responsible, and at what level, for the aggregation, evaluation and quality assurance?

Besides a so-called information inventory, the aggregation processes, indicators and data needed for the models used etc. should be defined. From our point of view, it is very important that the COP defines some rules and standards, information sources and quality standards to be used for the EWS. Based on the agreed

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[6] For example, catalogues of data sources in Switzerland and in the European Union.

information sources and the evaluation procedure, the EWS will be broadly accepted and used.

In addition to the previous points, the responsibilities for the aggregation process and the quality assurance of basic information should be fixed. The products of the EWS dealing with desertification, as a result of the very complex interaction of different basic data and information producers, needs a coordination unit. How far this unit should aggregate the information itself or delegate this kind of work is of less importance than the fact that the work flow is documented and it is clear who has to do what. This will be a major task of the experts and partners involved.

How can information be made available at the local level?

Looking at the WWW, it is evident that local or national organizations rarely contribute to the data available. However, such organizations have more detailed data and observations to offer. Inclusion of these very important data producers in the EWS should be discussed as well. Furthermore, it is the local or national organizations which can induce the adoption of efficient measures.

V. CONCLUSION

1. An EWS dealing with desertification at regional, subregional, national, district and local levels should be based on WWW technology and on basic information (data etc.) already available.

2. To establish an efficient EWS, the five questions formulated above should be answered.

3. Coordination with the secretariats of other conventions (on climate change, biodiversity etc.) in using different information management tools may accelerate the work to be performed.

4. The information produced by the EWS dealing with desertification should be made accessible to a broad user community worldwide by publishing aggregated information supporting the decision-making process and experience exchange. An evaluation and quality assurance process should be part of the system.

5. Follow-up of the information should be included.

Appendix

ABBREVIATIONS

AGRHYMET	Sahelian Regional Centre for Agrometeorology and Applied Hydrology , Niamey, Niger
CBD	Convention on Biological Diversity
CCD	Convention to Combat Desertification
CEO	Centre of Earth Observation
CERN	Caribbean Environmental Reporters' Network
CHM	clearing-house mechanism
CILSS	Comité Inter-Etats pour la Lutte contre la Sécheresse au Sahel
CBOs	Community-based organizations
COP	Conference of the Parties
CST	committee on Science and Technology
EAEN	Eastern Africa Environmental Network
ELCI	Environnement Liaison Centre International
ESA	European Space Agency
EWS	early warning system
FAO	Food and Agriculture Organization
GAW	Global Atmosphere Watch
GEF	Global Environment Facility
GIEWS	Global Information and Early Warning System on Food and Agriculture
GIS	geographical information system
IALC	International Arid Lands Consortium
IFAD	International Fund for Agricultural Development
IFN	International Friends of Nature
IGAD	Intergovernmental Authority on Development
LQI	Land Quality Indicators Project
NGO	non-governmental organization
OSS	Observatoire du Sahara et du Sahel
PACD	Plan of Action to Combat Desertification
PMAMD	Provisional Methodology for Assessment and Mapping of Desertification
REDESERT	Desertification Information and Documentation Network
RIOD	Réseau International d'ONG sur la Désertification/The International NGO Network on Desertification and Drought
ROSELT	Réseau d'observatoires sur le suivi de l'environnement à long terme
SADC	Southern African Development Community
SEPADO	Somalia Environmental Protection and Anti-Desertification Organisation
UIA	Union of International Associations
UMA	Arab Maghreb Union
UNCOD	United Nations Conference on Desertification
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research
UNSO	Office to Combat Desertification and Drought
WAICENT	World Agricultural Information Centre
WHO	World Health Organization
WIEWS	World Information Early Warning System
WIR	World Resources Institute
WMO	World Metereological Organization
WWW	World Wide Web
