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Establishing the Structure of an IGADD National and Sub-Regional Early Warning System

Volume 1
Executive Summary

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VOLUME 1 - EXECUTIVE SUMMARY

ESTABLISHING THE STRUCTURE OF AN IGADD NATIONAL AND SUB-REGIONAL EARLY WARNING SYSTEM

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by

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NOTICE

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FOREWORD

The Final Report on Establishing the Structure of an IGADD National and Sub-Regional Early Warning System consists of three volumes. Collectively, they provide a complete treatment of the findings, conclusions, and recommendations suggested by the USGS team. The three volumes are:

Volume 1 - Executive Summary

Contents include a brief summary of a strategic plan for an IGADD sub-regional early warning system (EWS). Topics include (1) a suggested EWS model, (2) IGADD's role in early warning, (3) priorities and actions, and (4) critical issues.

Volume 2 - Main Report

This volume provides a detailed discussion of the overall findings, conclusions and recommendations for an IGADD sub-regional EWS.

Volume 3 - Country Reports

Contents include country reports detailing the status and needs for early warning systems in the six IGADD member states. The country reports are the working documents prepared by the USGS team to develop the overall conclusions and recommendations.

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LIST OF ACRONYMS

Acronym	Definition
A.I.D.	Agency for International Development
ACMAD	African Center for Meteorological Applications for Development
ADP	Automatic Data Processing
AGRHYMET	Agriculture, Hydrology, Meteorology
AISC	Assessment and Information Services Center, NOAA
AMCEN	American Ministerial Council
ARC	AGRHYMET Regional Center
ARTEMIS	Africa Real Time Environmental Monitoring Using Imaging Satellites
AVHRR	Advanced Very High Resolution Radiometer (NOAA)
BPI	Bits Per Inch
CAC	Climate Analysis Center, NOAA
CAC	Coordinating and Advisory Committee of AGRHYMET
CBS	Central Bureau of Statistics
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CLICOM	Climate Computing System
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTO	Regional Remote Sensing Center of Ouagadougou
DCP	Data Collection Platform
DIANA	Data in Africa Now Available
DLCO	Desert Locust Control Organization
DRSRS	Department of Resource Surveys and Remote Sensing
ECA	Economic Commission for Africa
EEC	European Economic Community
EGA	Extended Graphics Adapter
EOSAT	Earth Observation Satellite Company (LANDSAT)
ERDAS	Earth Resources Display and Analysis System
EROS	Earth Resources Observation Systems
ESA	European Space Agency
EWFIS	Early Warning Food Information System
EWS	Early Warning System
FAO	Food and Agriculture Organization (U.N.)
FAX	Facsimile Transmission
FCCAD	Foreign Crop Conditions Assessment Division
FEWS	Famine Early Warning System (USAID)
FEWS	Food Early Warning System (Somalia)
GAC	Global Area Coverage (AVHRR)
GEMS	Global Environmental Monitoring System
GIEWS	FAO Global Information and Early Warning System
GIS	Geographic Information System
GMS	~~Global Monitoring System~~
GNS	Global Navigation System
GOES	Geostationary Operational Environmental Satellite
GOS	Government of Sudan

Acronym	Definition
GOU	Government of Uganda
GPS	Global Positioning System
GRID	Global Resources Information Database (UNEP)
GSFC	Goddard Space Flight Center (NASA)
GTS	Global Telecommunications System
HRPT	High Resolution Picture Transmitter
IBM	International Business Machines
IDA	Image Display and Analysis
IGADD	Intergovernmental Authority for Drought and Development
IPS	Image Processing System
IPS	Inches Per Second
ITCZ	Intertropical Convergence Zone
KBPS	Kilobits Per Second
KMD	Kenya Meteorological Department
LAC	Local Area Coverage (AVHRR)
LANDSAT	Land Satellite of NASA, NOAA, EOSAT
LAS	Land Analysis System
METEOSAT	Meteorological Geostationary Observation Satellite (ESA)
MOA	Ministry of Agriculture
MOH	Ministry of Health
MSS	Multispectral Scanner (LANDSAT)
NAC	National AGRHYMET Centers
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data and Information Service (NOAA)
NEWS	National Early Warning System
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRMS	Natural Resources Management Systems
OAU	Organization for African Unity
OECD	Organization for Economic Cooperation and Development
PDUS	Primary Data Users Station
PTT	Post and Telecommunications Office
PVO	Private Voluntary Organization
RAFC	Regional Area Forecasting Center
RAM	Random Access Memory
RCSSMRS	Regional Center for Services in Surveying, Mapping, and Remote Sensing
RDMC	Regional Drought Monitoring Center
RNA	Requirements Needs Analysis
RRC	Relief and Rehabilitation Commission
SADCC	South African Development Coordination Conference
SAP	Systeme d'Alerte Precoce
SDUS	Secondary Data Users Station
SERISS	Sudan Emergency and Recovery Information and Surveillance System

Acronym	Definition
SHARE	Software Help in Applications Research and Education
SPOT	Systeme Probatoire d'Observation de la Terre
SWD&M	Sahel Water Data and Management Project
TAMSAT	Tropical Agricultural Meteorology Using Satellites
TIROS	Operational Orbiting Weather Satellite (NOAA)
TM	Thematic Mapper (LANDSAT)
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
UNEOS	United Nations Emergency Office for Sudan
UNEP	United Nations Environment Program
UNITAR	United Nations Institute for Training and Research
UNSO	United Nations Sahelian Office
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development (Bilateral Missions)
USDA	United States Department of Agriculture
USG	United States Government
USGS	United States Geological Survey
VGA	Video Graphics Array
WFP	World Food Program
WHARF	World Hunger Alleviation Through Response Farming
WHO	World Health Organization
WMO	World Meteorological Organization

Executive Summary

Establishing the Structure of an IGADD National and Sub-Regional Early Warning System

1.0 Study Purpose

This study was prepared for the Intergovernmental Authority for Drought and Development (IGADD) by the EROS Data Center of the U.S. Geological Survey's (USGS) National Mapping Division. The project was sponsored by the U.S. Agency for International Development Regional Economic Development Service Office, East and South Africa (USAID/REDSO) and the Famine Early Warning System (FEWS) Project of the Agency for International Development (A.I.D.) Bureau for Africa, Office of Technical Resources. Guidance was by provided to the USGS team by IGADD Secretariat staff and IGADD-sponsored national resource persons. In addition, the IGADD Secretariat financed the investigation for the nation of Ethiopia.

The goal of the study was to inventory early warning data and systems in the IGADD sub-region, and, based on the inventory, suggest a plan for establishing or strengthening national and sub-regional early warning systems (EWS). This report presents a strategic plan for an IGADD sub-regional system. The plan includes the suggested EWS model, IGADD's responsibilities, and priorities and actions for the initial stages of implementation.

Over 110 people representing nearly 50 government ministries, international donors, regional organizations, and NGO/PVO's were interviewed. The USGS team visited officials in Djibouti, Ethiopia, Kenya, Somalia, Uganda, and Washington, D.C. The remaining IGADD member, Sudan, was not visited due to civil unrest at the time the study team was scheduled to visit Khartoum.

2.0 Early Warning System Development

Item 13 of the IGADD Plan of Action (January 1986) calls for the "Establishment and Improvement of Information and Early Warning Systems" throughout the sub-region. Establishment of an effective food security EWS is an IGADD priority for meeting the long-term goal of recovery from drought and implementation of measures to combat drought.

2.1 Early Warning System Model

The purpose of a food security EWS is to eliminate the need for large-scale emergency famine relief operations. The EWS is an information system that relies on data and analysis, and is effective only when information is communicated to and used by decision makers.

This section describes a model that has been formulated based on perceived IGADD needs and from experiences with other EWS, especially A.I.D.'s FEWS and AGRHYMET. The model provides general concepts that are critical to successful implementation.

Figures 1 and 2 illustrate a conceptual model of components and linkages for an early warning system. A four-part structure is recommended. The EWS requires:

- National EWS Component linkages of decision makers, designated ministries providing data, and a central office with the responsibility for early warning. This national component is responsible for data collection, analysis, food emergency decisions, and response actions.

- Sub-Regional EWS Component composed of IGADD Secretariat administrative/technical offices. It (1) provides technical assistance, data, and services to national EWS, and (2) helps create awareness of the food security situation through preparation of sub-regional profiles based on national EWS inputs (brief national food security summaries with consistent treatment of important topics, and summaries of sub-regional food surpluses and deficiencies).

- Regional and International Technical Organizations Provide technical assistance and sub-regional data needed by the national and sub-regional EWS.

- International Community including donors and NGO/PVO's that provide commodities, technical assistance, and funding for EWS operations and development, and food emergencies.

2.2 User Needs

There are three types of users that require data and information relating to food security problems.

Analysts operating early warning systems require data that can be analyzed to produce reliable information describing food security.

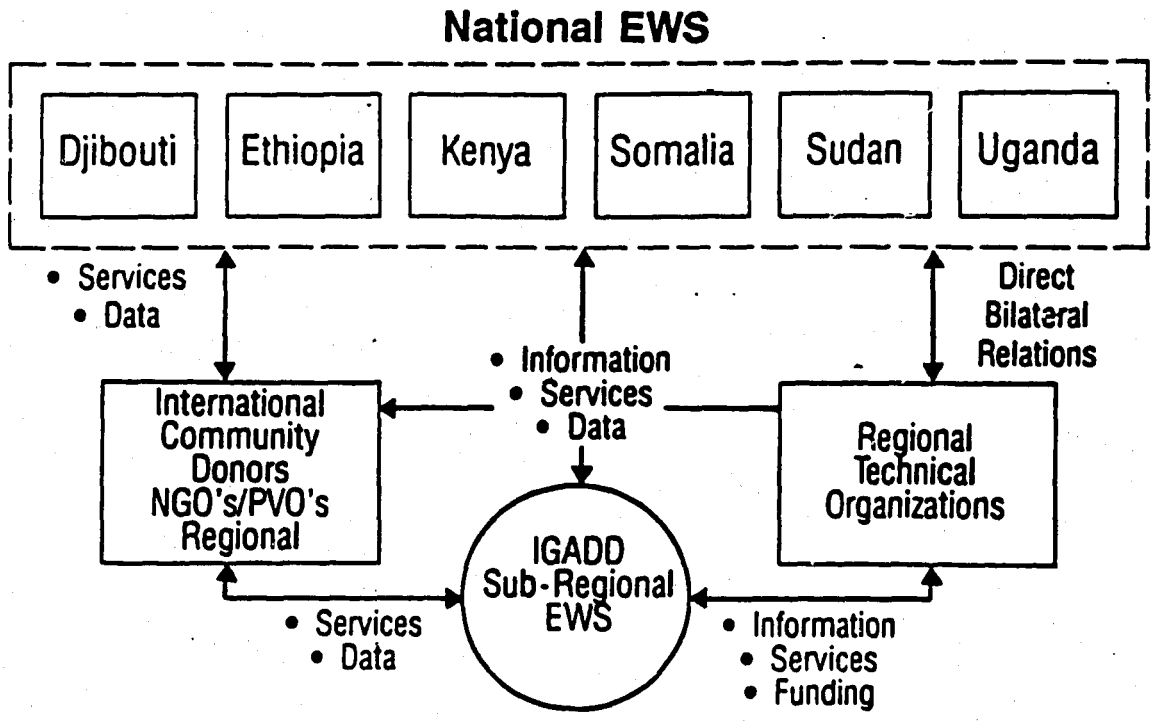

Figure 1. Conceptual model for national early warning systems. Typically, early warning units fit into existing government infrastructures.

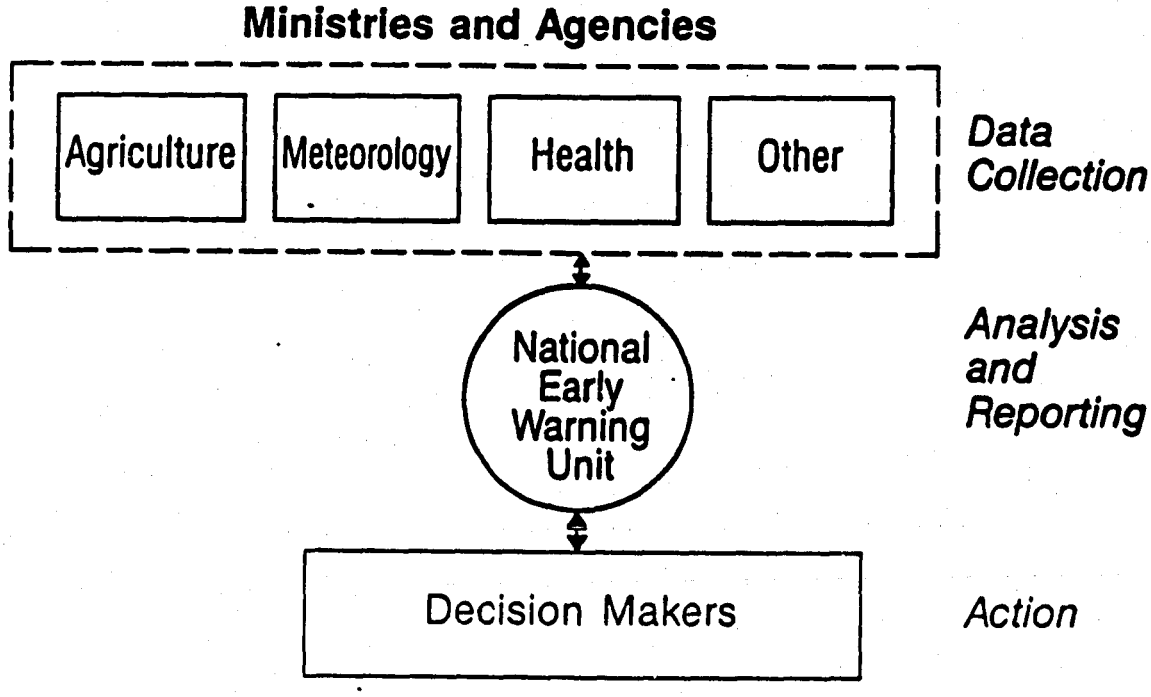

Figure 2. Conceptual model for an IGADD sub-regional early warning system.

Decision makers that commit and manage the resources needed to handle food emergencies and maintain commitment of resources.

Responders that implement the steps necessary to deliver food and supplies needed to avert famine.

Decision makers need credible, advanced warning of the location and number of people at-risk to food emergencies. They also require concise information to make decisions on relief, rehabilitation and development. The key decision makers are national government officials responsible for declaring food emergencies and providing the logistical and management support necessary to avert human suffering. Others include donor organizations and NGO/PVO's operating in each country that make decisions concerning the provision of food aid and logistics support.

2.3 Development Needs

The development of an effective EWS requires consideration of several critical needs. The needs serve the functional tasks of the EWS components. They include:

Strong national data collection programs

Linkages between the ministries and sub-regional organizations for communicating data.

Timely, credible data that are geographically based and represent both physical (such as agrometeorological), and socio-economic (such as local market prices and health) factors.

Analysis capabilities using a convergence of evidence approach with multisectoral data.

Analysis conducted at the national level based on local context.

Effective communication of data and results to national, sub-regional, and donor decision makers.

Relationship and communications with rehabilitation and economic development programs since the basis for both early warning and rehabilitation/development is timely, credible data.

2.4 Early Warning System Data Requirements

Data needed for early warning are diverse. Early warning concerns identifying areas where there is stress, and determining impact on the population. Each of these areas requires timely, credible, geographically-based data. The data sources will usually be ministries with established data collection programs, but will also include sub-regional organizations, and ad hoc sources such as informants, NGO's and PVO's. The specific data needed varies by country, but generally include:

Stress Indicators
- weather (rainfall, temperature)
- crop production (area and yield)
- crop condition
- land potential
- land use
- armed conflicts
- remotely sensed data

Impact Indicators
- nutrition
- health
- market prices (grains and livestock)
- emergency food stocks
- on-farm wealth (food, labor, saleable items)

Other data, describing demographics and infrastructure (roads, rail, waterways, telecommunications, medical, social, and political) are needed to calibrate the data or determine response options.

2.5 Staffing Needs

Both national and sub-regional EWS staff must have expertise in many areas to understand the complex famine process, tools, and data used in early warning. At any level, all EWS staff require certain skills and education to be effective. These include:

- An understanding of the famine process and the objectives of early warning (vulnerability forecasting and at-risk monitoring techniques)

- A general understanding of the tools used in early warning (computer operation, map reading, remote sensing, and statistics)

- Analytic skills to use tools for vulnerability forecasting and at-risk monitoring.

- The effective ability to communicate information. This includes skills to prepare and present information through oral and written communications.

Key staff qualifications are: program management, agricultural meteorology, socio-economics, and computer/data base operations. Staff trained in data entry also are essential. Other qualifications that may be needed in some situations include agricultural economics, nutrition, demography, statistics, geographic information systems, communications, and electronics.

2.6 Early Warning System Development Stages

All of the EWS are linked by a common purpose, with each component operating within the constraints of its level of capabilities and constituency needs.

IGADD's member states are all at different stages of evolution in their EWS capabilities. EWS development should progress through orderly and logical stages that consider both current capabilities and the ultimate form and capability the EWS needs. For purposes of prioritizing development needs of the IGADD EWS components, a conceptual framework for institutional development is outlined. Most EWS will develop concurrently, but defining the stages focuses the definition of priorities of implementation. The EWS will have functional capabilities while going through the development process. The level of sophistication will increase as the evolution through the development stages progresses. The logical EWS development steps are:

<u>Stage One - Organizational Definition</u>. Establish an early warning organization, structure, and mandates including its linkages. Definition of EWS expectations and responsibilities, determination of data and information needs and flow from early warning to response, and formulating agreements within the government(s) to insure continuing commitments of resources and cooperation must occur. Methods must be established for effective data communications, and for communication of results to decision makers.

Stage Two - Establish/Strengthen Data Systems. The EWS should concentrate on improving the timeliness, credibility and comprehensiveness of the national data collection infrastructure. This stage concentrates on developing the capabilities of those responsible for data collection - usually the line ministries. As the EWS develops, the kinds of analysis possible will not require computers. Manual interpretation of early warning data will provide useful information. The inclusion of remote sensing technology into the assessments can begin. This stage is of critical importance since the EWS has limited reliability if based on poor data. Improving data availability and quality is likely to be the most complex and expensive EWS implementation function. However, improved data also are related integrally making them beneficial to national development programs, not just EWS.

Stage Three - Establishment of Computer Data Bases. Computerization of data improves the timeliness, quality, and reporting of results, facilitates quantitative analysis, promotes data sharing, and ultimately increases the value of data. The establishment of computer data bases increases the complexity of an EWS by requiring conditioned, reliable electrical power and cooling systems, computer hardware and software, and trained staff. However, the advantages have been demonstrated to be worth the investment. Efforts to establish guidelines for data formatting, protocols for sharing, and priorities for data entry must be initiated.

Stage Four - Transition to Geographic Information System. Food security is a geographic problem. Therefore, data collected for early warning should be referenced to maps. Stage four builds on the previous by incorporating the computer data bases into a geographic information system (GIS) that provides advanced spatial analysis capabilities. A GIS permits storage of "computerized maps" for both statistical and spatial analysis. In addition, a GIS (1) helps staff look at multisector data, (2) facilitates formatting of results for communication to decision makers, (3) provides a link to response functions, and (4) provides a link to rehabilitation and development programs.

Stage Five - Increased Use of Advanced Modelling and Analysis Methods. With GIS and computer data bases in place, use of famine parameter modelling (i.e., structural vulnerability, crop phenology, soil water budgets) is possible. The individual models can be linked together using the GIS for site specific evaluations. The cost of adding advanced methods is relatively low if appropriate data are available.

3.0 IGADD Role in Early Warning

Data needed for early warning, and decisions concerning food emergencies originate at the national level. Therefore, by definition, IGADD's goal calling for establishing and strengthening EWS only can be met when national EWS reach acceptable levels of capabilities. With this, the key objectives for IGADD would be to strengthen and support national EWS components. The IGADD Secretariat EWS team should facilitate this objective.

The IGADD Secretariat can make an important contribution to early warning in the sub-region by working to strengthen and support the national EWS. It can work toward the establishment of consistent, timely, and credible reporting of the food security situation. Sub-regional early warning can, by definition, only be successful if the national EWS are strong. Potential IGADD Secretariat functions are:

1. Assist in Definition of national early warning priorities, plan strategies for cooperation with other national programs to assure a complimentary relationship, and develop strategies for sustaining national programs during non-emergency periods.

2. Planning and Coordination including establishing goals and objectives, coordinating with governments to obtain required resources, and assisting in the development of detailed implementation plans that document inputs and outputs.

3. Facilitate communications including serving as a catalyst for national and sub-regional data sharing, providing neutral forums for idea exchange, and providing leadership to consolidate studies on topics common to several countries in the sub-region.

4. Publish bulletins and technical reports on early warning topics that can be used by personnel in the sub-region involved in food security. The bulletins can include descriptions of appropriate technology, methods, and case histories. This is an effective, high-impact use of staff that will provide immediate benefit to the national EWS.

5. Coordinator/broker of training and technical inputs.

6. Coordinate regional and international cooperation.

7. Plan and support workshops, seminars, and conferences on early warning.

8. Define and coordinate assistance provided by regional technical institutes.

9. Sponsor arrangements to provide remote sensing data to national programs.

4.0 Priorities and Actions

The EWS components in the sub-region are at different stages of development. In the short-term, IGADD can assist each EWS reach a minimum level of capabilities that will allow it to provide basic early warning services to it constituency. The long-term strategy can guide the development of each national system to an advanced level of capabilities that can provide the kinds of information needed by the full range of system users.

4.1 Short- and Long-Term Priorities

The short-term priorities should be to insure that each country has:

1. A national EWS organization designated and recognized by its government.

2. Adequate data (weather, market prices, crop production, population, health and nutrition status).

3. Staff with technical abilities to analyze data and communicate results of vulnerability and at-risk assessments.

4. Capacity to build computerized data bases that permit data entry, query, and multisector analysis of famine indicators.

5. Vegetation index information from AVHRR data that can be used to monitor national and regional vegetation conditions.

6. Basic analytical tools for interpretation of data and production of food situation reports.

When the national programs approach the basic level of capability, efforts should be undertaken to advance individually each EWS to a higher level that includes:

1. Use of geographic information system for storage, analysis and presentation of data.

2. Use of computer models for vulnerability and at-risk modelling and monitoring.

4.2 National EWS Component Priorities

The status of EWS varies considerably in the sub-region. Most countries are involved in EWS development. Based on the logical development sequence described in Section 2.6, the following text identifies the stage where assistance is needed immediately, and the key inputs needed in each IGADD member state. Secondary actions, where relevant, are also noted. Long-term efforts in other stages should be defined and planned concurrent with the short-term activities.

Djibouti - Stage 1 - The need for an EWS is questionable. An early warning system, if established, should focus on food prices, food sources, and logistics.

Ethiopia - Stage 3 - Assistance should focus on facilities and technical assistance to build computer data bases, and increase computer analysis and reporting capabilities. Following this, efforts should concentrate on establishing a GIS.

Kenya - Stage 1 - Kenya does not have a formal EWS, but instead addresses food security issues through ad hoc activities coordinated by the Office of the President. As a result, routine monitoring of the national situation is by exception rather than routine. Efforts are needed to gain an organizational definition and commitments on early warning responsibilities. While Kenya does not have a designated early warning unit, it's ministries are using computer systems and GIS. Because of this situation, Kenya could receive training and technical assistance to use advanced technology for vulnerability assessment and at-risk monitoring.

Somalia - Stage 3 - Assistance should be directed toward building computer data bases, and increasing analysis and reporting of multisectoral data. Concurrent efforts to strengthen the Ministry of Health to provide nutrition and health data is also needed.

Sudan - Stage 3 - Considerable donor assistance currently is underway to strengthen Ministries involved in data collection. Assuming this emphasis continues, assistance should concentrate on capabilities to build computer data bases that can lead to improved analysis and reporting capabilities.

Uganda - Stage 1 - The primary needs are planning and design services directed toward creating an early warning unit. Restoration of ministry data collection programs also must be a high priority.

4.3 Ongoing Actions

There are several actions that must be initiated by IGADD and maintained over the long-term. These include:

1. Provide technical advice to national EWS components. This should be accomplished either through a combination of IGADD EWS staff or consultants. Assistance can cover the full range of tasks. Initial assistance, however, should concentrate to provide planning and design expertise needed in the national EWS components.

ACTION: IGADD Secretariat should consult with national EWS and define priorities for assistance. Following this, Secretariat should coordinate with donors to arrange the necessary assistance.

2. Improve early warning data. When possible, national EWS should use data collected by line ministries. Thus, linkages must be established to receive the needed data.

ACTION: IGADD Secretariat should assist national EWS to identify data infrastructures that are limiting their early warning activities. IGADD should coordinate training to the ministries involved in collecting the required data.

3. Communications -- Every effort should be taken to participate in programs that may solve the many communications problems facing the sub-region. This includes basic data communications from field to central ministries; from ministries to national EWS facilities; from national EWS to IGADD Secretariat; and from IGADD Secretariat or other sub-regional organization (in case of remote sensing) to national EWS.

ACTION: IGADD Secretariat should participate in programs that may strengthen communications systems in the sub-region.

4. Cooperate with relevant technical organizations that can help further IGADD's EWS goals. The IGADD EWS effort can benefit by tapping into the data and expertise of other programs.

ACTION: Establish either formal or informal cooperation with organizations that can benefit early warning activities in the IGADD sub-region. Potential cooperators include:

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A. The FAO/Rome Africa Real Time Environmental Monitoring System (ARTEMIS) Project can provide coarse resolution AVHRR-based vegetation index data, and METEOSAT-based rainfall data to the sub-region. Currently, ARTEMIS is the only comprehensive source of vegetation index and rainfall data over East Africa. However, as direct AVHRR data reception in the sub-region becomes available, and METEOSAT reception becomes available at the national level and through RCSSMRS, the need for ARTEMIS data will be reduced.

B. The Data in Africa Now Available (DIANA) pilot project of the FAO and the European Space Agency (ESA) is designed to provide medium speed data communications from Rome to selected Africa sites and low speed return transmission. ARTEMIS data will be available on DIANA. The cities of Nairobi and Djibouti have been invited to serve as pilot test cases. IGADD's first priority is communication between African nations rather than dialogue through Europe. It is questionable how valuable DIANA services will be to the national EWS. However, because the technical lessons learned through DIANA are important, IGADD should consider participation in DIANA.

C. RCSSMRS is the logical site for remote sensing and GIS training, AVHRR products, remote sensing applications, and LANDSAT/Spot data products. However, careful monitoring of the Center's ability to provide the required products and services is necessary.

D. The French Ministry of Cooperation has proposed a two-year project that would look at techniques for using remote sensing to evaluate the impact of weather on crops and livestock, and investigate communications improvements. The French proposal has much merit, especially if modified to include even greater emphasis on communications. IGADD must make sure that this activity is integrated into related efforts in the sub-region in order to achieve the maximum benefit.

E. The A.I.D. Famine Early Warning System (FEWS) has been innovative in its use of remote sensing and GIS. It has, and will continue to develop software tools and methods specific for use in early warning. Other strengths that can be shared with IGADD include strategies for stress/impact monitoring of food security, and publication of early warning findings. A technical relationship with FEWS will be advantageous to IGADD.

F. The AGRHYMET Program in Niamey, Niger has traveled many of the roads that IGADD will test soon. IGADD should establish a professional relationship with AGRHYMET staff and share ideas on mutual issues.

G. SADCC is trying to establish capabilities similar to those needed by IGADD. Since early warning problems are related, coordination would result in the sharing of ideas and solutions.

H. The United Nations Environment Program/Global Environmental Monitoring System (UNEP/GEMS) plans to provide computers, GIS, and image processing software to 15 African countries. The participating countries will receive equipment and three months of training. UNEP/GEMS plans to put three systems in the IGADD sub-region (the Uganda Ministry of Environment has already been selected). Any of the national EWS in the sub-region would benefit if selected to receive the equipment and training. IGADD can help UNEP achieve its program objectives by insuring that the systems would be used for decision making, and that the necessary technical backstopping needed to maintain the GIS activities would be provided. IGADD should encourage UNEP/GEMS to select national EWS programs in the sub-region.

I. A Drought Forecasting Center (DFC) has been proposed by the World Meteorological Organization (WMO) and United Nations Development Program (UNDP). The Center will share facilities with the Kenya Meteorological Department and address medium- and long-term drought forecasting in Eastern Africa. IGADD should monitor the development of the DFC and establish a suitable relationship once the program becomes operational.

4.4 Immediate Actions

IGADD's immediate actions for strengthening national early warning systems should be to broker/coordinate inputs needed by the EWS components. Initial efforts should be to coordinate inputs that allow the national EWS to achieve a basic level of capabilities (stages 1-3). Specific actions include:

1. Develop an implementation plan that defines the directions for the implementation of IGADD's early warning activities over the next five years.

ACTION: IGADD Secretariat should develop a five-year plan and establish Technical Coordinating Committee to assure availability of technical assistance and inputs that can guide IGADD national EWS efforts toward effective, integrated operations.

2. Publish technical bulletins and reports on early warning topics that can be used by personnel involved with food security.

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ACTION: IGADD Secretariat should initiate a newsletter and a special reports program designed to provide relevant, practical information to national EWS staff.

3. Data and information exchange -- The long-term process of establishing data and information exchange between the national programs and the IGADD Secretariat, and eventually between the member countries, must be started. This not only will include agreements to share data, but also will involve the establishment of data guidelines and an archiving strategy to insure data integrity over time. In addition, it will provide a forum for national EWS staff to share experiences and ideas with colleagues in other countries.

ACTION: IGADD should sponsor a conference of officials responsible for data collection to define: (1) the feasibility of data sharing, (2) guidelines for data archiving, dissemination, cataloging and documentation, and (3) permit national EWS staff to exchange information and experiences.

4. Sponsor remote sensing data -- The need for remote sensing inputs is universal in the sub-region.

ACTION: The IGADD Secretariat should take the lead in making arrangements to satisfy remote sensing needs. The recommended actions are:

A. Insure that the Regional Center for Services in Surveying, Mapping, and Remote Sensing (RCSSMRS) provide vegetation index products to national EWS from U.S. National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites (based on the one-kilometer resolution data from the Advanced Very High Resolution Radiometer - AVHRR - sensor).

B. Until the one-kilometer data can be provided on an operational schedule, continue the distribution of ARTEMIS vegetation index products.

C. Distribute METEOSAT (METEOrological SATellite) data from the RCSSMRS Primary Data Users Station (PDUS) to IGADD states that do not have in-country access to a PDUS (Uganda, Djibouti). Note that Sudan, Somalia, Uganda, and Kenya have METEOSAT receiving facilities.

5. Develop a curriculum of training courses that cover the gamut of early warning topics (see Section 5.0). The courses should be applied and based on the unique problems of the sub-region.

ACTION: IGADD Secretariat should: (1) investigate establishment of training facilities (see Section 5.0), (2) provide training for Secretariat staff in early warning principles, and (3) prepare a 1990 calendar of training courses covering topics relevant to national EWS. The initial courses that are recommended include:

Role of EWS in National Food Security (for managers)
EWS Principles and Tools
Data Base Design
Interpretation of Socio-Economic Data
Interpretation of Agrometeorological Data
Remote Sensing for Early Warning
Vulnerability Modeling and Analysis
Methods for At-Risk Monitoring

4.5 Secondary Actions

As the IGADD EWS components achieve the basic level of capability, other actions should be initiated. RCSSMRS is the likely organization to assist in these actions. They include:

1. Offer advanced training courses. Potential topics include:

   Use of GIS for Early Warning
   Spatial Analysis Methods
   Computer Operation and Maintenance
   Rapid Assessment Methods
   Reporting and Communications Techniques

2. Implement geographic information systems. The installation of GIS technology for early warning will have a noticeable impact on program activities. A GIS will provide substantial benefits but at a cost. Before a specific GIS is selected, there must be an understanding of what, and how it, will be used. Efforts should be directed toward use of microcomputer-based GIS tools employed by other organizations with similar purposes. This will allow several groups to contribute to a simple-to-operate, yet powerful "IGADD GIS". Other programs, including FEWS/USAID and UNEP/GEMS, will be using the PC-ARC GIS software system, making it the candidate system for use by IGADD. These groups can contribute to the development of menu-driven functions that can serve as a starter kit for early warning.

3. Establish a GIS Service Center. This center can provide the technical backstopping in data base development, special products, and analytical procedures not available at the national level.

5.0 Critical Early Warning System Issues

There are three issues common throughout the IGADD sub-region that must be considered in the design of EWS.

1. Will to Communicate and Share Data This is the most critical problem that IGADD can address. Collection of primary data of any kind and assembling it within data bases is a difficult task. Once assembled, sharing these data should be both technically and politically possible. However, sharing data among government entities is not a common practice. There is an apparent lack of will to share data, and a lack of understanding of the good that comes from such sharing. This phenomenon should be addressed at the highest management levels and arrangements made so that all data needed to support EWS can be made available to both national and sub-regional organizations in a timely manner.

2. Communications Problems Rapid, efficient communications are the lifeblood of early warning. Existing communications systems in the IGADD sub-region are inadequate to support the rapid exchange of early warning information. The problem is much larger than early warning. Communications deficiencies are a major technical problem that will plague not only IGADD's early warning efforts, but also slow the overall economic development of the sub-region. Clearly, IGADD should strive to stimulate the further development of telecommunications and data communications links within and among member states. IGADD should participate in projects underway in the sub-region that address communications.

3. Need for AVHRR Product Center -- IGADD needs a technical center that can provide AVHRR-based vegetation index products and archiving services in a reliable, timely manner. RCSSMRS, in cooperation with the Kenya Meteorological Department, is the logical element of this activity. IGADD should facilitate the development of a product center through negotiations with donors interested in providing the needed support.

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Establishing the Structure of an IGADD National and Sub-Regional Early Warning System

Volume 2
Main Report

EROS Data Center
National Mapping Division
U.S. Geological Survey
Sioux Falls, South Dakota USA

December 1989

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VOLUME 2 - MAIN REPORT

ESTABLISHING THE STRUCTURE OF AN IGADD NATIONAL AND SUB-REGIONAL EARLY WARNING SYSTEM

Prepared under A.I.D. PASA No. AFR-0510-P-IC-7022-22

Submitted to:

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IGADD Secretariat, Djibouti

and

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REDSO/ESA
Nairobi, Kenya

by

EROS Data Center
National Mapping Division
U.S. Geological Survey
Sioux Falls, South Dakota

December, 1989

NOTICE

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FOREWORD

The Final Report on Establishing the Structure of an IGADD National and Sub-Regional Early Warning System consists of three volumes. Collectively, they provide a complete treatment of the findings, conclusions, and recommendations suggested by the USGS team. The three volumes are:

Volume 1 - Executive Summary

Contents include a brief summary of a strategic plan for an IGADD sub-regional early warning system (EWS). Topics include (1) a suggested EWS model, (2) IGADD's role in early warning, (3) priorities and actions, and (4) critical issues.

Volume 2 - Main Report

This volume provides a detailed discussion of the overall findings, conclusions and recommendations for an IGADD sub-regional EWS.

Volume 3 - Country Reports

Contents include country reports detailing the status and needs for early warning systems in the six IGADD member states. The country reports are the working documents prepared by the USGS team to develop the overall conclusions and recommendations.

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LIST OF ACRONYMS

Acronym	Definition
A.I.D.	Agency for International Development
ACMAD	African Center for Meteorological Applications for Development
ADP	Automatic Data Processing
AGRHYMET	Agriculture, Hydrology, Meteorology
AISC	Assessment and Information Services Center, NOAA
AMCEN	American Ministerial Council
ARC	AGRHYMET Regional Center
ARTEMIS	Africa Real Time Environmental Monitoring Using Imaging Satellites
AVHRR	Advanced Very High Resolution Radiometer (NOAA)
BPI	Bits Per Inch
CAC	Climate Analysis Center, NOAA
CAC	Coordinating and Advisory Committee of AGRHYMET
CBS	Central Bureau of Statistics
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CLICOM	Climate Computing System
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTO	Regional Remote Sensing Center of Ouagadougou
DCP	Data Collection Platform
DIANA	Data in Africa Now Available
DLCO	Desert Locust Control Organization
DRSRS	Department of Resource Surveys and Remote Sensing
ECA	Economic Commission for Africa
EEC	European Economic Community
EGA	Extended Graphics Adapter
EOSAT	Earth Observation Satellite Company (LANDSAT)
ERDAS	Earth Resources Display and Analysis System
EROS	Earth Resources Observation Systems
ESA	European Space Agency
EWFIS	Early Warning Food Information System
EWS	Early Warning System
FAO	Food and Agriculture Organization (U.N.)
FAX	Facsimile Transmission
FCCAD	Foreign Crop Conditions Assessment Division
FEWS	Famine Early Warning System (USAID)
FEWS	Food Early Warning System (Somalia)
GAC	Global Area Coverage (AVHRR)
GEMS	Global Environmental Monitoring System
GIEWS	FAO Global Information and Early Warning System
GIS	Geographic Information System
GMS	Global Monitoring System
GNS	Global Navigation System
GOES	Geostationary Operational Environmental Satellite
GOS	Government of Sudan

Acronym	Definition
GOU	Government of Uganda
GPS	Global Positioning System
GRID	Global Resources Information Database (UNEP)
GSFC	Goddard Space Flight Center (NASA)
GTS	Global Telecommunications System
HRPT	High Resolution Picture Transmitter
IBM	International Business Machines
IDA	Image Display and Analysis
IGADD	Intergovernmental Authority for Drought and Development
IPS	Image Processing System
IPS	Inches Per Second
ITCZ	Intertropical Convergence Zone
KBPS	Kilobits Per Second
KMD	Kenya Meteorological Department
LAC	Local Area Coverage (AVHRR)
LANDSAT	Land Satellite of NASA, NOAA, EOSAT
LAS	Land Analysis System
METEOSAT	Meteorological Geostationary Observation Satellite (ESA)
MOA	Ministry of Agriculture
MOH	Ministry of Health
MSS	Multispectral Scanner (LANDSAT)
NAC	National AGRHYMET Centers
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data and Information Service (NOAA)
NEWS	National Early Warning System
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRMS	Natural Resources Management Systems
OAU	Organization for African Unity
OECD	Organization for Economic Cooperation and Development
PDUS	Primary Data Users Station
PTT	Post and Telecommunications Office
PVO	Private Voluntary Organization
RAFC	Regional Area Forecasting Center
RAM	Random Access Memory
RCSSMRS	Regional Center for Services in Surveying, Mapping, and Remote Sensing
RDMC	Regional Drought Monitoring Center
RNA	Requirements Needs Analysis
RRC	Relief and Rehabilitation Commission
SADCC	South African Development Coordination Conference
SAP	Systeme d'Alerte Precoce
SDUS	Secondary Data Users Station
SERISS	Sudan Emergency and Recovery Information and Surveillance System

Acronym	Definition
SHARE	Software Help in Applications Research and Education
SPOT	Systeme Probatoire d'Observation de la Terre
SWD&M	Sahel Water Data and Management Project
TAMSAT	Tropical Agricultural Meteorology Using Satellites
TIROS	Operational Orbiting Weather Satellite (NOAA)
TM	Thematic Mapper (LANDSAT)
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
UNEOS	United Nations Emergency Office for Sudan
UNEP	United Nations Environment Program
UNITAR	United Nations Institute for Training and Research
UNSO	United Nations Sahelian Office
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development (Bilateral Missions)
USDA	United States Department of Agriculture
USG	United States Government
USGS	United States Geological Survey
VGA	Video Graphics Array
WFP	World Food Program
WHARF	World Hunger Alleviation Through Response Farming
WHO	World Health Organization
WMO	World Meteorological Organization

Volume 2 - Main Report

Establishing the Structure of an IGADD National and Sub-Regional Early Warning System

1.0 Scope of Work

This study was prepared for the Intergovernmental Authority for Drought and Development (IGADD) by the EROS Data Center of the U.S. Geological Survey's (USGS) National Mapping Division. The project was sponsored by the U.S. Agency for International Development Regional Economic Development Service Office, East and South Africa (REDSO/ESA) and the Famine Early Warning System (FEWS) Project of the Agency for International Development (A.I.D.) Bureau for Africa, Office of Technical Resources. The study was funded as a FEWS buy-in and implemented through a Participating Agency Service Agreement (PASA AFR-0510-P-IC-7022-22) with the USGS. In addition, the IGADD Secretariat financed the Ethiopia investigation. The USGS study team was comprised of the following:

Thomas Loveland	- Team Leader and GIS/Remote Sensing Specialist
Donald Reilly	- Natural Resources Specialist
William Trayfors	- Socio-economic Specialist
J. Ian Stewart	- Agricultural Meteorologist

In addition, the following individuals provided guidance to the team during the field study:

Deborah Prindle	- REDSO/ESA Project Manager
Dr. Makonnen Kebret	- IGADD Executive Secretary
Professor Ahmed El Houri Ahmed	- IGADD Director of Planning, Research, and Information
Ahmed Habbane	- IGADD Research and Early Warning Officer
Hassan Aden Bouraleh	-IGADD National Resource Person, Djibouti
Ali Abdi Odowa	- IGADD National Resource Person, Somalia
Y.K. Dhamutudha	- IGADD National Resource Person, Uganda
Melaku Ayalew	- IGADD National Resource Person, Ethiopia
Wilbur Otichillo	- IGADD National Resource Person, Kenya
Jonathon Olsson	- A.I.D. FEWS Technical Specialist
Donald Moore	- EROS/U.S. Geological Survey
Barry Henrickson	- FAO/IGADD Remote Sensing Scientist, RCSSMRS

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The study, IGADD Plan for Establishing the Structure of a Sub-Regional and National Early Warning System, was initiated to provide IGADD with a plan to establish the structure of both sub-regional and national famine early warning systems.

1.1 Study Objectives

The objectives of the IGADD early warning system (EWS) study include the following:

1. Inventory the resources and operations of the basic components of the IGADD early warning systems (both national and sub-regional).

2. Identify critical data gaps, and determine whether they can be filled by existing data collection infrastructure.

3. Identify training needs of national EWS personnel and recommend a training program.

4. Suggest a strategic plan to achieve an IGADD sub-regional EWS that interfaces with national EWS units. Provide a blueprint for the development of that structure including specific recommendations to collaborate with the A.I.D. FEWS Project.

1.2 Summary of Team Activities

Over 110 people representing nearly 50 government ministries, international donors, regional organizations, and NGO/PVO's were interviewed to provide the information needed to prepare this report. The USGS team visited with officials in Djibouti, Ethiopia, Kenya, Somalia, Uganda, and Washington, D.C. during the course of the study. The sixth IGADD member, Sudan, was not visited because of circumstances beyond the control of the team. The entire team conducted the assessments of Djibouti and Kenya, while split teams traveled to the remaining countries. The schedule was:

Washington, D.C.	- May 23-24, 1989 (Loveland, Trayfors)
Djibouti	- June 18-24, 1989 (full team)
Ethiopia	- June 25-July 1, 1989 (Trayfors, Stewart)
Somalia	- June 25-July 2, 1989 (Loveland, Reilly)
Uganda	- July 5-8, 1989 (Loveland, Reilly)
Kenya	- July 3-13, 1989 (full team)

A summary of people and organizations contacted during the field study is in Appendix A.

2.0 EWS Plan Goals and Objectives

Item 13 of the IGADD Plan of Action (January, 1986) calls for the "Establishment and Improvement of Information and Early Warning Systems" throughout the sub-region. It is part of the short- and medium-term programs aimed at recovery from drought and implementation of measures to combat drought. Item 13 states IGADD's intentions to:

1. Assist in the establishment or strengthening of national EWS in each of the six member states.

2. Establish a sub-regional EWS that will "process and disseminate data and information regarding the early warning system and will coordinate national, sub-regional, regional, and international efforts..."

2.1 IGADD Early Warning System Model

The purpose of a food security early warning system is to eliminate the need for large-scale famine relief operations, not to improve famine management. By presenting timely evidence of stress, decision makers can take non-emergency steps to head-off food shortages.

A food EWS is an information system that includes data and analysis, and a means to communicate information to decision makers. The primary objectives of an EWS are to:

- Identify areas where populations are vulnerable particularly to food shortages.

- Monitor vulnerable at-risk groups to signal a problem in time to head-off suffering.

- Provide data needed to implement a response that averts a food crisis.

Figures 1 and 2 provide a conceptual model for an IGADD early warning system. Based on experiences gained in other early warning systems, a four-level structure is recommended.

- National EWS forms the structure's first level and is the foundation of the program. Because both data collection and food emergency decisions are national problems, the national EWS must be responsible to satisfy the three objectives previously mentioned (vulnerability analysis, at-risk monitoring, and links to response activities).

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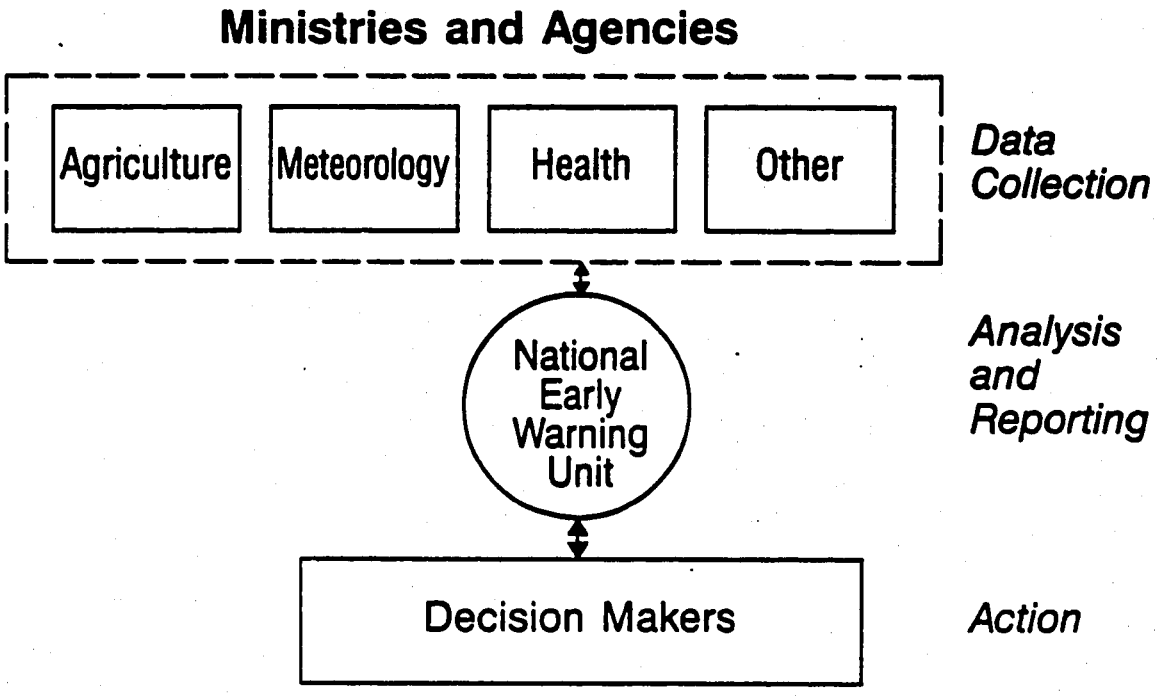

Figure 1. Conceptual model for national early warning systems. Typically, early warning units fit into existing government infrastructures.

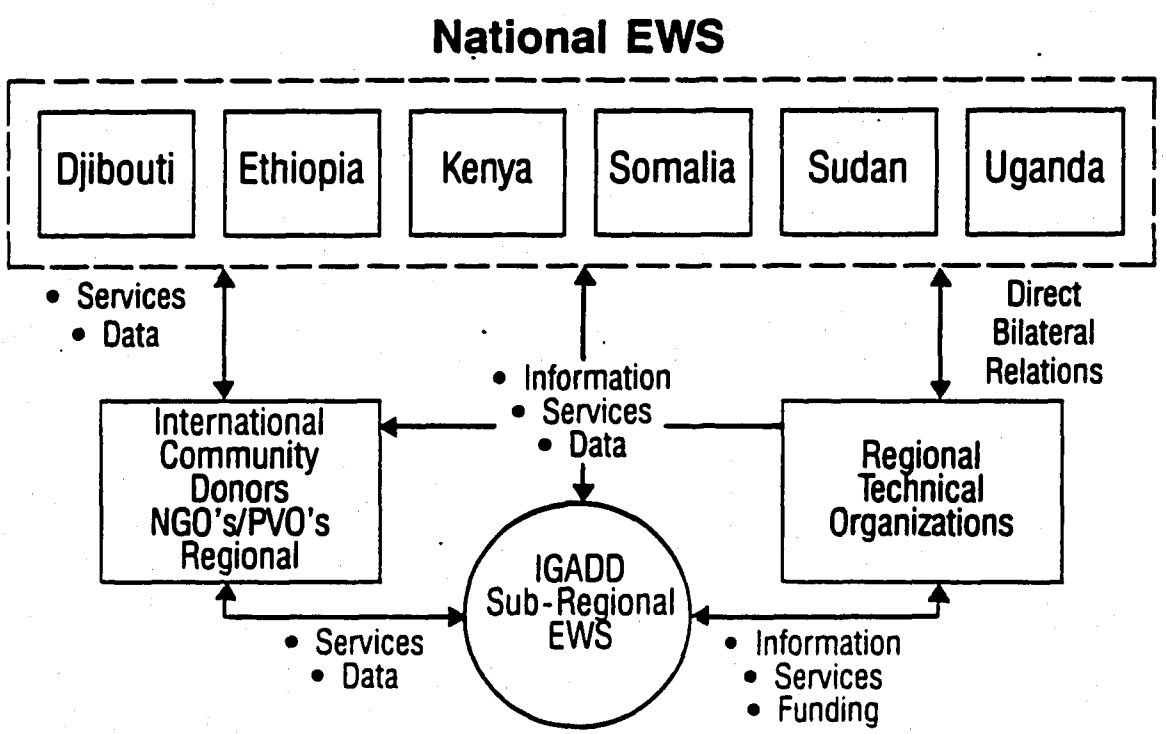

Figure 2. Conceptual model for an IGADD sub-regional early warning system. The model assumes functionality in data collection, analysis, decision making, and response.

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- Sub-Regional EWS provides assistance to the national EWS. It also helps create awareness of 1) the sub-regional food security situation, and 2) national EWS needs. The first item can be done through consolidation of national food security assessments in brief sub-regional profiles. The second point can be met by coordination between parties and as broker between national interests and donors. To be most effective, the sub-regional EWS must operate under the premise that it "must give more than it gets".

- Regional and International Technical Organizations provide technical assistance and data needed by the national and sub-regional EWS. This may include remote sensing data, training, and research results.

- International Community provides support to the other system components. The support includes commodities, technical assistance, and funding needed both to operate the various elements of the early warning system, and assist in relief efforts.

The data needed for EWS are geographically-based and both physical (such as agrometeorological), and socio-economic (such as local market prices and health). The diverse data used to indicate food security problem areas require that an early warning unit have established linkages to the ministries responsible for collecting the needed data. Generally, EWS should rely on other government organizations for data since the EWS function is to analyze food security, not to be in conflict with the responsibilities of the ministries who are providing the data.

The analysis process relies on a "convergence of evidence" approach based on both physical and socio-economic data, rather than a single, potentially misleading data source or rigid statistical procedures. Assessments must be carried out under a local context to take full advantage of available data. Conclusions should be tested in the field through verification of problems by site visits and/or informants.

An important advantage of an early warning information system is its relationship to rehabilitation and economic development. The basis for both early warning and rehabilitation/development is timely, credible data on which decisions and appropriate actions can be made. The same information system and corresponding data and analysis functions used for food early warning also can be used to develop and evaluate rehabilitation and development alternatives. The IGADD EWS initiatives can thus serve the short-, medium-, and long-term objectives specified in the IGADD Plan of Action.

3.0 IGADD Early Warning System Development Concepts

3.1 Famine and Famine Detection

Famine is an acute, prolonged deprivation of food among an identified population, the continuation of which would lead to acute malnutrition and death. The key concept here is a serious, prolonged, and atypical food shortage within an identifiable population group. The reasons for such food deprivations may be multiple: drought, flooding, pestilence, national policies, war or other political disruptions, and the numerous socio-economic perturbations that often follow these events.

Famine is a slow onset disaster. It characteristically develops over a substantial period of time, sometimes years. This is an important factor since the temptation to equate crop failure with famine is great but usually misleading. Famine is best viewed as a socio-economic <u>process</u> in which those most affected increasingly are unable to secure the food needed to sustain them. A bad crop year may be offset by on-farm stocks built up from previous good harvests. It also may be offset by assets (personal property, capital, livestock, and savings) available to exchange for the needed food. In the final analysis, famine is the result of a series of events (perhaps several crop failures, loss of income, escalating market prices, etc.) that deplete available resources necessary to make food available. Wealthy persons are never famine victims; those low on the socio-economic scale (landless laborers, indigents, subsistence farmers) tend to be most affected.

The detection of famine is a <u>two-part process</u>. The first part involves the identification of stress (man-made as well as natural) within the famine process leading to famine development. This is the most easily understood part, especially as related to the role of catastrophic events such as natural calamities (floods, droughts, pestilence) and political disruptions.

The second part is more subtle, but very important for early warning. It involves the detection of impacts that affect access to food. These are exhibited through <u>behavioral changes</u> and <u>socio-economic changes</u> that accompany famine development over time. These vary with different populations, time and locations. They also may provide some clue as to appropriate interventions to forestall or mitigate the impending disaster.

Early detection of famine and famine conditions can maximize the options available to policy makers for strategic intervention. If one waits until the final stages of famine (e.g., until families are migrating in search of food), there is only one option and it is often a very expensive one, both in financial terms and in terms of human life.

The term "famine detection" implies the identification of phenomena that are atypical, i.e., abnormal for a given place, population, and time. To detect unusual or abnormal events, it is necessary to have a reasonably good understanding of what is "normal". This means it is important to have time-series historical data on events and processes (indicators) related to famine development: cropping patterns and trends; food production trends; climatic trends; population migration trends; nutritional status trends; market price trends for food, including livestock; food supply trends (storage, emergency stockpiles, imports, production, losses). This information is needed on as fine a geographic level as can be obtained economically, since patterns of "normalcy" vary in place and in time. Thus, the development over time of a reasonably detailed and complete database is an essential element of credible early warning systems.

3.2 Food Security and Early Warning Systems

Food security in the IGADD Sub-region requires reliable and effective famine early warning systems. However, the existence of EWS does not constitute adequate food security. A good EWS is simply a critical part of the strategic intelligence function required to win the war against famine.

The need for an EWS varies from country to country in the IGADD sub-region, as does the reason for that need. For example, because Djibouti produces virtually no foodgrains an EWS may be limited principally to obtain good intelligence on the performance of foreign grain markets (where it purchases much of its food) and on the present status of livestock, fish, fruits, and vegetables in Djibouti and neighboring countries. Ethiopia, on the other hand, is highly dependent on indigenous food sources, external markets, and food aid. Ethiopian needs are more complex and larger in scale. Meanwhile, Sudan has excellent agricultural potential in the east, but traditional deficits occur in the western parts of the country where 6 million people live. A fragile transportation and communications infrastructure exacerbates the problem and creates a need for a particularly active and effective FEWS. Kenya and Uganda both have the potential for food exports, despite occasional localized food problems in each country. Somalia has the full gamut of severe problems: production, import, refugee, insurgency, transportation, and communications, thus mandating a comprehensive and efficient EWS.

Whatever the rationale for a national EWS, it is imperative that the outputs from it be linked closely to both national and international response mechanisms, else the identified famine likely will go remarked but unattended. True food security (i.e., the avoidance of famine disasters) only can be facilitated by a EWS that is linked closely to the policy making and response arms of the host government, as well as to potential donors and outside assistance sources.

3.3 Planning and Design Concepts

The IGADD early warning community is comprised of seven geographically separated components - the six existing or proposed national early warning systems in the member countries, and the sub-regional early warning system in the Djibouti headquarters of IGADD. It also includes regional technical institutions, most notably, the Regional Center for Service in Surveying, Mapping, and Remote Sensing (RCSSMRS) in Nairobi. While linked by a common purpose, each component must operate within the constraints of its own unique environment and satisfy the specific needs of its constituency.

Planning for IGADD's EWS, both national and sub-regional, must be done with sufficient attention to detail so that the broader goals and objectives of each program can be realized in a realistic time-frame. The goals and objectives set forth in a master plan then must be incorporated into a more detailed work-plan, or implementation-plan, that is separated into discrete elements that are pursued in a logical, chronological series of steps. The physical and human resources necessary to achieve each planning element must be plotted on a time scale so that realistic completion dates can be established. Provision must be made for preparation and lead-time necessary to define such things as procurement documents, training requirements, physical facilities, etc., so that actual on-site implementation is not scheduled for unrealistically short-time periods.

Professional guidance and assistance are required in the early planning stages to prepare work plans, schedules, technical specifications and procurement documents that will describe adequately physical infrastructure, equipment, hardware, software, training inputs etc. As a result, project needs will be met but not exceeded. Failure to do this can result in facilities that are either 1) not adequate to meet project needs or, 2) too sophisticated for project needs and thus wasteful of funds that could be used for other project inputs.

The design of project components to meet the needs of work plans is critical and must be done in a timely, yet cost effective manner. Technical requirements must be met without exceeding the foreseen requirements and running up costs.

Systems must be integrated to assure that the various components are compatible, expandable where necessary, and not overly sophisticated or expensive. The guidelines discussed elsewhere will help assure integrated system selection and compatibility. A key to early warning is the mechanism to share data. The systems must establish data guidelines for exchange, and establish purposes and linkages for data sharing.

Technical specifications and procurement documents should be prepared and reviewed by experts in the field (communications, automation, GIS, etc.) to assure that all system components are covered and ultimately provided. The design must assure all the inputs needed to procure, ship, install, operate and maintain systems -- including provision for a structure, utilities, staff training, supplies, spare parts, maintenance and service contracts. The omission of any one of these inputs can only result in a system that will not operate long without failure.

Simply stated, integrated design at the project onset, assures that the physical and human resources needed for a system are planned and implemented, in a timely manner, at minimal cost. Where funding is limited, it may become necessary to prioritize system needs and develop it in phases.

Finally, each early warning system in the IGADD region then must have characteristics that are responsive to local needs. Technology and methodology must not determine program activities. National policies, information requirements of decision makers, and the characteristics of the national food security problem must determine each early warning system's needs and the organizational frameworks necessary to meet those needs.

3.4 Development Stages

EWS development must progress at an orderly and logical pace. The undertaking of complex tasks too early can jeopardize the success of the system. However, the evolution process is transitional and does not have abrupt starting and ending points. The process also includes products of increasing sophistication at all levels. There will be overlap between stages and development commonly is concurrent.

Stage One - Organizational Definition. The first step is to establish an early warning organization, define EWS expectations and responsibilities, and determine information needs and flow from early warning to response. Agreements must be made at the appropriate levels of government to insure that the information needed for early warning will be made available by the appropriate ministries. The relationships of regional and national organizations will be worked out in advance so that each party knows what to expect.

Stage Two - Establish/Strengthen Data Systems. Early warning requires a combination of natural, human and economic resources data. The data representing these sectors must be timely, reliable, and geographically based. If data are unavailable or do not offer the desired characteristics, efforts must be undertaken to either create or improve the respective data collection systems. This may take place either within the EWS group or in another ministry. The EWS should not replace existing agency data collection functions. Instead, it should concentrate on collecting data from the responsible agencies that can be merged and used for multisectoral analysis. Only when adequate data become available can credible analysis of the food security situation begin. At this stage, analysis of the collected data will be done using manual methods because data typically are not in a form conducive to quantitative assessments. The inclusion of remote sensing technology into early warning can begin at this stage. This stage is of critical importance since famine monitoring will not be reliable if it is based on poor data. Data collection also is likely to be the most complex and expensive stage.

Stage Three - Establishment of Computer Data Bases. Data used for early warning must be stored in an organized form for use in both present and historical analyses. Data computerization, through entry of information into computer-based data management systems, increases the speed and ease of data retrieval. As a result, the value of data ultimately increases. It creates an opportunity to increase EWS analytic capabilities, promotes sharing, and allows more flexible use of data bases. The establishment of computer data bases increases the complexity of an early warning system by requiring conditioned, reliable electrical power and cooling systems, computer hardware and software, and trained staff. However, complexity is balanced by increasing the credibility and timeliness of analysis, and making more efficient use of the limited human resources by decreasing staff time devoted to manual data analysis.

Stage Four - Transition to Geographic Information System. Food security is a geographic problem. All data collected for use in early warning represent geographic areas. Analysis of the geographic distribution of the data is crucial to understand the location and extent of food emergencies. A geographic information system (GIS) permits storage of data as "computerized maps" that can undergo both statistical and spatial analysis. In addition, a GIS: 1) helps staff look at complex multisector data, 2) facilitates formatting of analysis results for communication to decision makers, and 3) provides a link to response functions. The addition of a GIS will require additional equipment and staff training.

Stage Five - Increased Use of Advanced Modelling and Analysis Methods. The data management and processing capabilities established through the third and fourth stages of evolution provide the tools needed for advanced modelling and analysis of famine parameters. Tasks previously too complex can now be undertaken. Among the models and analytic tools that may be used include vulnerability and at-risk analysis, water budget, crop yield and production, population trends, and food balance forecasts. These individual models can be linked together using the GIS and used for site specific evaluations. The cost of adding advanced methods is relatively low if the data required are available. The computing facilities needed will have been largely provided through previous initiatives.

3.5 Critical EWS Issues

There are two issues common throughout the IGADD sub-region that must be considered in the design of EWS. Failure to initiate solutions to these problems will hinder IGADD's effort to achieve its stated EWS goal and objectives.

3.5.1 Will to Communicate and Share Data

Collection of primary data of any kind and assembling it in data bases is a difficult task. Once assembled, the sharing of these data should be both technically and politically possible. However, data sharing among government entities is not a common practice. In one instance, rainfall data were collected by four different groups in a country but none of the four shared those data with any of the others. This is not an isolated example. Throughout the IGADD sub-region, there is an apparent lack of will to share data, and a lack of understanding of the good that comes from such sharing. Sometimes data were not shared simply because no tradition of sharing data among institutions existed. However, data often is not shared due to a specific policy against such sharing. The concept that information is power is ingrained deeply in the bureaucratic cultures of East Africa and many other parts of the world. This phenomenon should be addressed at the highest management levels and arrangements made so that data, of whatever kind, necessary to support EWS can be made available in a timely manner to both national and sub-regional organizations.

3.5.2 Communications

Rapid, efficient communications are the lifeblood of early warning. While historical data are essential to the establishment of "normalcy" and past trends, current data are required for relevancy, credibility, and psychological impact. It is therefore imperative that information generated by an EWS be seen as current and authoritative.

International communications are such that if information are communicated from a capital city, the whole world knows. However, getting that information to the capital is often the delay. There must not be concern only for the international linkages, but also for internal channels.

In the IGADD sub-region, national and international communications capacities widely vary. Some countries have excellent international phone service via satellite; some have reasonably good internal telephone/telex service; some have little internal or external capacity. A few data communications links are beginning to appear, most notably the new microwave data link between the meteorological services in Ethiopia and Kenya. However, this is the exception. Existing telecommunications and data communications systems in the IGADD region are not adequate to support the rapid exchange of early warning information. Clearly, IGADD should strive to stimulate the further development of data communications links within and among member states.

4.0 User Needs

There are three types of users that require data and information relating to food security problems. The first, technicians operating early warning systems, require data that can be used to produce reliable information from which to base decisions and actions. The second group are the decision makers that commit and manage the resources needed to handle food emergencies. The third type of users are the responders to decision makers who must implement the steps necessary to provide relief and deliver food and supplies needed to avert famine.

These groups exist at many levels. The national level is important because the proclamation of food emergencies is made at the country level. On the other hand, the key warnings and decisions concerning food assistance are made by national EWS and decision makers. However, there also are organizations operating regionally or internationally that support, or lobby, for famine assistance. They need information describing the food security situation across the sub-region. IGADD must be sensitive to the information requirements of users at all levels.

4.1 Sub-Regional Users

At this level, early warning information creates an awareness of the sub-regional food security situation. The users of sub-regional early warning information likely will be the donor agencies that provide assistance during crisis periods.

4.2 National Decision Makers

The government organizations responsible for declaring food emergencies and providing the logistical and management support needed to provide aid are the most important users. Most of the IGADD member countries have designated one organization as the key decision body for food security issues. They are:

Kenya	-	Office of the President
Somalia	-	Ministry of Interior and the Drought Emergency Committee (Ministries of Interior, Health, Transportation and Agriculture, WFP, UNDP)
Ethiopia	-	Relief and Rehabilitation Commission and a proposed Interministerial Committee chaired by the Prime Minister
Djibouti	-	Commissioner (Mayor) of the Republic
Sudan	-	Relief and Rehabilitation Commission
Uganda	-	Ministry of Agriculture

In addition, the major bilateral organizations and NGO/PVO's operating in each country require assessments of the food security situation on which to base decisions concerning the provision of food aid and logistics support.

The most important need of decision makers is information that provides advanced warning of the location and magnitude of populations at-risk to food emergencies. They also require concise information that can be used to make decisions on relief, rehabilitation and development decisions and responses. Specific requirements are:

1. Earliest possible warning of potential and/or developing food security crises.

2. Verification of potential food emergencies.

3. Credible information on a scale sufficient to carry out directed famine mitigation programs (operating transportation networks, food storage locations and amounts, operating communications networks, weather forecasts, and non-food relief supply sources and quantities needed).

4. Information that can be used to formulate reliable national disaster preparedness strategies.

These should be provided through published reports of the national food situation and through access to data bases that contain specific, detailed information. Timely, brief, periodic published reports are useful to create an awareness of the national food situation based on the current crop and livestock situation, agricultural meteorology, food stocks, market prices, population movements, and health and nutritional status. The contents of the reports should reflect the current food security situation. During potential and actual emergencies, the reports should provide in-depth information on food aid needs, status of transportation systems, and assistance plans. During normal times, the reports may provide brief status of crop development, food stock levels, or other news.

4.3 Early Warning Systems

Early warning systems are both producers and users of data and information related to food security. They require analysis procedures and data that are suitable to produce the information needed by decision makers. They must possess:

- Accurate definition of information needs
- Timely delivery of data from collection agencies to EWS
- National physical and socio-economic data bases

- Neighboring country data and situation reports
- Remotely sensed data
- Interpretation models or hypotheses on how to interpret the available data
- Equipment
- Sound definition of who should receive information and what they expect
- Trained technicians to operate the information systems
- Trained scientists to use the systems for analysis

The indicator data typically needed by national EWS units are:

- Meteorological data (primarily rainfall)
- Hydrological data (stream flows)
- Crop condition
- Agricultural production
- Population (including population movement)
- Local market prices for important cereals and meats
- Market composition
- On-farm stocks
- Government food stocks
- Nutrition status
- Public health status
- Remotely sensed data

In addition to the above, national EWS units also need selected data from bordering countries. Rainfall, hydrology, cross-border trade, and population movements are of particular importance, although any data that will permit a better understanding of the national situation are desired.

The IGADD sub-regional EWS should provide international decision makers with regional profiles of food security. This will require the same categories of data used by the national EWS units but the scale will be more coarse.

5.0 Status of Early Warning Systems

The following sections summarize the status of national and sub-regional early warning systems. Volume 3 contains detailed country reports.

5.1 National Early Warning Systems

5.1.1 Djibouti

The Republic of Djibouti does not have a formalized early warning system, although discussions with IGADD on the need for an EWS have been held with Office National Affairs for Cereals (ONAC). ONAC is an autonomous management and finance group in the Ministry of Commerce charged with providing adequate food stocks to avoid shortages). There is not a government food security strategy other than stocking a 90-day supply of foodstuffs. As a result, there is no compelling need for a Djibouti EWS given the country's lack of agriculture and the absolute necessity to import foodstuffs.

The Mayor of Djibouti is the chief of the National Disaster Office. The mayor has authority from the Head of the State to mobilize whatever assistance is needed from the government agencies during disaster periods.

National data needed for early warning virtually is unavailable. Market price data are available. Meteorological records date back to the early 20th century, but there are gaps in the historical data. There are little-to-no agricultural, health, and nutrition data. While there are population data, the 1987 census did not include refugees.

5.1.2 Ethiopia

The Ethiopian early warning system was established in the Relief and Rehabilitation Commission (RRC) in 1976. Its structure and conceptual underpinnings include a sophisticated understanding of EWS needs and processes. RRC's data analysis is done principally by the three section heads and the Acting Head of EWS, using intermediate analyses generated by computer as well as other non-digital information. The RRC makes effective use of much non-quantitative information that it collects from other ministries, its own surveys, and paid informants.

The RRC publishes periodic reports, usually quarterly, and monthly bulletins during the key growing seasons. An end-of-year synoptic report is issued usually in January. These reports contain analyses of food stocks, weather/rainfall, crop situation and outlook, nutritional status and trends, and commodity prices.

Ethiopia has developed a diversity of data bases useful for early warning. These include:

- Meteorological data from an extensive network of stations
- Imagery from the METEOSAT satellite
- Meteorological data received from the World Meteorological Organization (WMO) and Kenya Meteorological Department (KMD)-affiliated Regional Forecast Center in Nairobi
- Crop area estimates received from the Ministry of Agriculture (MOA)
- Crop outlook estimates from the MOA and RRC surveys
- Water balance data derived from computer modelling
- Nutrition surveillance data from NGO's and RRC surveys
- Market price and quantity information from Central Statistics Agency and RRC
- Food stock situation reports from RRC, donors, and NGO's
- Migration, health, family purchasing power and related information from RRC surveys (qualitative information)
- AVHRR/GAC-derived photo products from FAO/IGADD/RCSSMRS project in Nairobi (FAO/ARTEMIS via regional remote sensing facility)

Ethiopia users include the Government and donor agencies (over 250 copies of the EWS reports are distributed to central and local government entities, NGO's, foreign donors, and libraries). Data are gleaned from many of sources including other government ministries, NGO's, RRC's own surveys, and informants.

5.1.3 Kenya

Kenya has no single organization responsible for famine early warning activities. Rather, several ministries and governmental bodies each collect and process information needed for early warning. Whenever it appears that a serious problem is unfolding, these groups are brought together under the chairmanship of the Office of the President to compare information and determine the nature and extent of the problem, and possible corrective actions needed. Because of Kenya's favorable food supply position, good infrastructure and communications networks, and good access to foreign credits and foreign markets, it seems that this somewhat ad hoc approach to food security and early warning may be appropriate.

Kenya's early warning apparatus is in many ways the most technologically advanced of any of the member states in the IGADD region. Data collection methodologies, data archiving, analysis, and reporting systems are relatively advanced. Regarding geographic information systems (GIS) use, Kenya is far-and-away the most sophisticated of all member states, especially concerning natural resource monitoring and the integration of remote sensing data, including aerial photography.

However, because there is no central authority ordained to perform the early warning task, the overall EWS approach in Kenya has an unbalanced emphasis on physical data, with little attention given to the human side of the early warning equation: socio-economic, demographic, and health information.

The primary users of Kenya's EWS information in an emergency are the Office of the President, and those ministries that are assigned responsibility for disaster mitigation and rehabilitation work by the Office of the President. Each government unit responsible for data collection uses the collected information for its programs and activities, as well as contribute to the larger early warning knowledge pool.

5.1.4 Somalia

The Somalia Food Early Warning System was established within the Ministry of Agriculture in the late-1970's. The goal is to improve food security in Somalia through the determination of the need for food assistance. In the Somali EWS, "food security" means assuring that there is enough food to cover the requirements of the population for reasonable time ahead.

The Early Warning Department is a Directorate within the Ministry of Agriculture. The Department is made up of three technical services (Agroclimatology, Agriculture, and Agroeconomics), and two centers (Computer and Remote Sensing). The EWS has a staff of nearly 70. The majority of the staff are engaged in data collection, since the early warning unit carries out its own meteorological, agricultural, market, and food stock surveys.

The Somali EWS has received extensive assistance from donors. The European Economic Commission (EEC) is the primary source of support. It provides approximately $1 million per year. The EEC also is considering establishing a long-term biomass monitoring project based on remote sensing. The FAO is providing modest assistance to establish a Remote Sensing Center in the Early Warning Department. The British Overseas Development Administration (ODA) is providing a METEOSAT Primary Data Users Station (PDUS) and eight automated rain-gauges for rainfall monitoring.

The Early Warning Department has an active publications program that includes three series of reports or bulletins. Publications titled "Food Outlooks" are prepared following the end of each of the two annual growing seasons. A third report summarizing both seasons is published at the end of the calendar year. "Ten Day Early Warning Information Bulletins" are published in both Somali and English throughout the year. Finally, a series of "Technical Reports" have been prepared covering both data and methods. The Somali EWS reports and bulletins are distributed to approximately 50 organizations within the GOS and international donor community.

The Early Warning Department has had major accomplishments since the inception of the program. They have established a viable institution, developed the necessary data collection programs, and started development of computer data bases. There are still several areas that can be improved or enhanced to increase the value of the EWS.

5.1.5 Sudan

The Sudan Early Warning System was started in early 1986 in the Relief and Rehabilitation Commission (RRC) by the U.N. Emergency Operation in Sudan (UNEOS). At the same time, an inter-ministerial steering committee also was established for the EWS. The Sudan EWS tries to be sensitive to abnormalities in the indicators that may be used to target food problem areas. The overall goal of Sudan EWS is to provide advance information on crop production and the country's food supply.

The Sudan EWS staff consists of a Team Leader, Senior Data Base Analyst, and Electronic Data Processing Systems Analyst, Agricultural Meteorologist, two Agriculturalists, and a Statistician.

There is a regular series of reports summarizing the national food security situation, and the activities of the Sudan EWS. The Early Warning Bulletin is published monthly and contains summaries of the most recent data and comparisons of current information with seasonal patterns and long-term trends. In addition, the Early Warning System Status Report is produced each month.

The EWS unit has placed emphasis on using existing data rather than creating new, parallel data systems. The key data used as indicators for famine assessment are:

- Daily rainfall from Department of Meteorology that date back to 1901
- Rainfall estimates based on the TAMSAT METEOSAT PDUS operated by the Department of Meteorology
- Market prices and throughput (quantities sold) from the Ministry of Agriculture
- Pest infestation reports
- Crop forecasts and actual harvest information including data from the Ministry of Agriculture/USAID SERISS agricultural statistics project
- Demography
- Health and nutrition data including data from the Ministry of Health/USAID SERISS nutrition surveillance project

5.1.6 Uganda

There is no defined early warning agency in the Government of Uganda. Two ministries, Agriculture and Environment Protection, claim to have the responsibility to develop a national early warning system. The Ministry of Agriculture claim is based on its statutory responsibility to insure that all people are fed. The Ministry of Environment Protection claim is based in its responsibility to serve as the home of national natural resource and environment data bases.

The FAO is assisting the MOA establish a food early warning system in Uganda based on a project design similar to the FAO/Italy Early Warning Food Information System effort planned for Djibouti. It was impossible to determine the stage of planning of this project due to the withholding of information by MOA. The $1.8 million FAO plan calls for a five-person team (agricultural economist, agricultural meteorology, marketing specialist, nutritionist, and livestock specialist) to be stationed at MOA. However, MOA has requested that only three experts be provided. An agreement apparently was signed between the GOU and FAO authorizing the project. The agreement specifies a five-person team.

Very little data exist in Uganda. Most agencies are developing plans to reestablish data collection programs. Historical data are virtually non-existent. Data collection programs were discontinued in the 1970's and 1980's, and many records prior to this period have been lost or destroyed.

5.2 Sub-Regional EWS

While IGADD currently does not have an operational early warning unit, it has taken action to establish an early warning function. A member of the IGADD Secretariat holds the position of Research and Early Warning Officer and is responsible for monitoring IGADD's EWS initiatives. In addition, the FAO, using a Government of Italy donation, will begin a multi-year project to establish an Early Warning Food Information System (EWFIS) at IGADD headquarters in Djibouti.

The EWFIS project will station four full-time staff at IGADD headquarters for three years. The team will be comprised of a Project Manager, Agricultural Economist, Agricultural Meteorologist, and a Nutritionist. This group plans to produce regular reports on the sub-regional food security situation. In addition, two-person years of consultants will be provided to address specialized problems.

The first year objectives of the EWFIS team involve gaining a detailed understanding of the capabilities of the national EWS, and assisting in strengthening the national programs. The remaining two years of the project will involve developing methods for cooperation between EWFIS and the national EWS. Training of national staff will be a high priority.

IGADD also has remote sensing/early warning project implemented by FAO at the Nairobi Regional Center for Services in Surveying, Mapping, and Remote Sensing (RCSSMRS) using Japanese trust funds. The project is designed to provide satellite imagery to monitor vegetation and rainfall.

6.0 IGADD Role in Early Warning

By definition, IGADD's short- and medium-term goals calling for the establishment and strengthening of early warning systems (see IGADD Plan of Action, Item 13) can only be met when all national EWS reach acceptable levels of capabilities. With this, the key role for the IGADD Secretariat would be to strengthen and support national EWS.

The most important contribution of a sub-regional EWS facility is to strengthen and support the national EWS. Data collection must be carried out at the national level, and analysis conducted based on local context. Sub-regional early warning can, by definition, only be successful if the national EWS are strong. The project document for the FAO/Italian project stresses this orientation. However, assistance will need to come from other groups in addition to the FAO/Italy team. There needs to be a coordinated effort to transfer the lessons learned from other successful early warning systems (AGRHYMET, A.I.D./FEWS). Considerations governing IGADD's national EWS support role include:

1. To be effective in early warning, IGADD must give more than it gets.

2. IGADD must take advantage of existing regional and international technical institutions.

3. IGADD should carefully steer national EWS to standardized methods without removing national autonomy.

Potential functions that may be undertaken by IGADD are:

1. Definition. Help establish realistic goals for both sub-regional and national EWS.

   A. Assist in the establishment of national early warning priorities.

   B. Help countries establish models to implement national EWS, including budget planning procedures.

   C. Help countries define how national EWS can work with other national programs to sustain their programs during non-emergency periods.

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2. Planning and Coordination. Each stage of national EWS development will require planning and coordination. Planning assistance must go beyond identification of goals and objectives, but must include assistance in defining required resources, and developing detailed implementation plans that provide the necessary inputs and outputs.

3. Facilitate communications.

   A. Catalyst for national and regional data sharing. Inter-country sharing of data is highly desirable but difficult to initiate. IGADD can provide the leadership necessary to begin the process of data sharing. IGADD also can help define data content and formats that facilitate data sharing. This effort can begin with agreements to share apolitical data that has sub-regional significance such as hydrological and meteorological statistics. Eventually, sharing other information with sub-regional significance to early warning (refugees, market prices) may follow after the member countries have a chance to realize the benefits gained from data sharing.

   B. Provide neutral forums for idea exchange. IGADD can provide forums for early warning managers, planners, and technicians to gather and discuss common problems and methods. This will allow the IGADD members to benefit from the lessons learned by its neighbors. The forums also can include representation and exchange of ideas with other early warning programs both within and outside the sub-region.

   C. Provide leadership to consolidate studies on similar topics affecting several countries in the sub-region (such as communications).

4. Publish bulletins and technical reports on early warning topics that can be used by personnel in the sub-region involved in food security. A newsletter that describes sources of regional data, descriptions of appropriate technology and methods, and case histories will create an appropriate atmosphere of cooperation to keep national EWS from developing in a vacuum. This is an effective, high-impact use of staff that will provide immediate benefit to national EWS.

5. Coordinator/broker of training and technical inputs. The national EWS periodically will require training, equipment, consultant support, data bases, analysis, and other technical inputs. IGADD can assist to match country needs with donor interest. This can provide logical order to the provision of assistance to national EWS.

6. Coordinate regional and international cooperation among sister groups (such as CILSS, SADCC, and international donors).

7. Plan and support workshops, seminars, and conferences on early warning.

8. Define and coordinate the assistance provided by regional technical institutes (RCSSMRS, Regional Drought Monitoring Center, Regional Forecasting Center).

9. Sponsor arrangements to provide remote sensing data to national programs. Remote sensing can provide data that will permit efficient, objective, regional surveillance of vegetation conditions relating to cropland and pasture production potential. IGADD can boost the level of early warning capabilities throughout the sub-region by insuring that appropriate products derived from remotely sensed data are provided to national EWS.

7.0 Strengthening National Early Warning Systems

The national EWS all are at different stages of development. In the short-term, IGADD can assist national EWS reach a minimum level of capabilities that will allow them to provide basic early warning service to national decision makers. The long-term strategy can be to guide the development of each national system to an advanced level of capabilities that can provide the kinds of information needed by the full range of system users.

The short-term priorities should be to insure that each country has:

1. A national EWS organization designated and recognized by the government. This includes agreements to receive and share needed data from/with ministries.

2. Adequate data covering rainfall, market prices, crop production, population, health and nutrition status.

3. Staff with technical abilities to analyze data and communicate results of vulnerability analysis and at-risk assessments.

4. Capacity to build computerized data bases that permit data entry, query and analysis of famine indicators.

5. Vegetation index data from AVHRR data that can be used to monitor national and regional vegetation conditions.

6. Basic analytic tools to interprete data and produce food situation reports.

When the national programs approach the basic level of capability, efforts should be undertaken to advance all EWS to a higher level that includes:

1. Use of geographic information systems for storage, analysis and presentation of data.

2. Use of computer models for vulnerability and at-risk modelling and monitoring.

7.1 System Inputs

IGADD can assist the six national EWS by providing or coordinating the provision of needed inputs. A major advantage of IGADD advising the national program development effort is the increased likelihood of common ideas and methods used by a majority of member states. This will increase the prospects for sharing of data and experiences. It also will increase the overall economic efficiency of early warning in the sub-region by taking advantage of the successes of each others' programs.

The system inputs needed to achieve the short- and long-term levels of functionality are:

1. Technical Assistance - All programs need assistance to plan, design, develop equipment specifications, and guide new program initiatives. IGADD staff, regional technical centers, and IGADD-sponsored consultants can serve this need.

2. Training - An on-going training program is needed to cover all aspects of early warning - from methodologies to equipment operation and maintenance. Where a limited number of staff per country should be trained, IGADD can facilitate regional instruction and make the training economical.

3. Equipment and Logistics - Computer facilities (hardware and software), data collection, power conditioning, and communications gear will be needed by all programs. IGADD can provide: (1) specifications and guidelines for computer equipment that will insure the long-term operation and maintenance of early warning computer equipment, and (2) sponsor development of software or computer methods needed throughout the sub-region.

4. Data Services IGADD should continue, at an accelerated pace, providing remote sensing data to the members. In addition, it should lead the effort to establish data exchange between members.

7.2 National Priorities

While the status of EWS varies considerably in the six countries, all can be improved. Data services and logistics support are needed in all countries. The following summarizes the other key inputs needed in each IGADD member state:

Djibouti - The IGADD sub-regional EWS effort can provide the limited early warning analytical needs of Djibouti. IGADD can assist Djibouti to strengthen data collection in the country. This can include technical assistance to define new data collection procedures, but also should include training and equipment for computerizing data bases.

Ethiopia - Technical assistance, training, equipment, and logistical support are immediate needs. They should be directed toward building computer data bases, increasing analysis and reporting capabilities, and establishing an early warning GIS.

Kenya - The technical status of Kenya's EWS program is sufficient to meet the countries analytic needs for several years. However, since the Kenya system is multi-purpose with food early warning as a secondary and recent function, training and technical assistance to use vulnerability and at-risk modelling is needed. Efforts are needed to gain organizational commitments on early warning responsibilities, and structure a national system.

Somalia - Technical assistance, training, equipment, and logistical support are immediate needs. As with Ethiopia, assistance should be directed toward building computer data bases, increasing analysis and reporting capabilities, and establishing an early warning GIS.

Sudan - Technical assistance, training, equipment, and logistical support are immediate needs. The Sudan EWS assistance should concentrate on capabilities to build computer data bases and increase analysis and reporting capabilities. Assistance to ministries with data collection responsibilities also is needed.

Uganda - There are two key needs in Uganda. First, planning and design services directed toward creating an early warning institution are needed. Second, technical assistance, training, and equipment to reestablish critical data collection programs should be provided.

8.0 IGADD Sub-Regional Early Warning System Development

As with the national EWS programs, both short- and long-term goals must be met before IGADD's sub-regional early warning objective is satisfied. The short-term goal should be to acquire the technical components and expertise needed to provide leadership and support to the national programs. The long-term objective should be to continue providing support and leadership but add an advanced capacity to carry out sub-regional profiling of the food security situation based on national inputs.

8.1 System Components

IGADD must establish an early warning system and technical staff that can provide the support needed at the national level. To do this, IGADD must obtain comprehensive hardware and software capabilities that are compatible with national needs, and staff with expertise in the major facets of food early warning. The early warning computer system will not be used for operational early warning in the sub-region, but for development and demonstration of early warning procedures needed at the national level. The system components needed are:

1. Staff - The range of staff skills that will be needed is vast. It will not be possible to have staff with expertise in all areas. Consultants can be used when necessary to meet uncovered skills. Highest priority expertise include:

   - Operational food early warning system experience
   - Agricultural meteorology with remote sensing
   - Agricultural economics
   - Nutrition surveillance
   - Remote sensing
   - Statistics/survey design

   In addition, expertise in demography, field survey methods, software development, electronics, communications, and public health is desirable.

2. Training Facilities - IGADD will need access to training facilities to provide the training needed by national staff. The facilities should have environmental controls including a UPS and electrical circuitry adequate to operate computer equipment. Because the use of the training facility will be periodic rather than constant, it is desirable and economical to use the training facilities of other organizations.

3. Equipment - Computer facilities (hardware and software), power and air conditioning, and communications gear compatible with those used by the national programs is needed. Because IGADD will provide leadership to the other countries, it should have comprehensive analytic capabilities including GIS and image processing systems.

4. Data Services - IGADD should continue, at an accelerated pace, to provide remote sensing-based data to the members. In addition, it should lead the effort to establish data exchange between members.

8.2 Sub-Regional Priorities

The immediate priority activities of the IGADD sub-regional EWS should be:

Broker/coordination of inputs - IGADD should help identify available donor assistance and direct the assistance to the priorities of the national members.

Training and technical advice to members - Provide, either through the IGADD EWS staff or through consultants, the training, planning, and design expertise needed in the national EWS.

Sponsor remote sensing data - Provide vegetation index data from AVHRR/LAC to the national programs on a near-real-time schedule.

Data exchange - Initiate the long-term process of establishing data exchange between the national programs and IGADD/Djibouti, and eventually between the individual members.

Communications - Every effort should be taken to participate in programs that may solve the many communications problems facing the sub-region.

9.0 Manpower

The national early warning units will need expertise in many areas to understand the complex famine process and tools used for early warning assessments and monitoring. It will not be possible to have specialists in all areas but instead, permanent staff will need training in the key disciplines. To provide needed skills, the EWS organizations should develop a bureau of national specialists from other ministries, and regional and international experts that can be called on for advice for specialized problems.

The sub-regional EWS staff will require the same skills but with greater depth since the sub-regional staff will serve as consultants to the national programs. They will need a stronger theoretical background and additional practical experience in the specific skills.

All permanent EWS staff should have certain skills to be effective. These include:

- An understanding of the famine process and the objectives of early warning (vulnerability assessments, and monitoring). Since formal educational programs seldom offer training in this area, IGADD will need to arrange training in the principals of early warning. This is an area that A.I.D., through FEWS, can provide practical assistance.

- A general understanding of the tools used in early warning (computer operation, map reading, remote sensing, statistics, report writing). This also is an area that IGADD will need to facilitate training programs. IGADD has expressed interest to have REDSO/ESA sponsor remote sensing training for national EWS staff.

The specific number and skills of staff in each organization depends on funding levels, organization responsibilities, and the nature of national food security problems. Key staff discipline qualifications that likely will be needed by all EWS are:

- <u>Agricultural meteorologist</u> with an understanding of remote sensing. Responsibilities include evaluation of crop growing conditions and determination of the impact of weather on agricultural development. It also is desirable to understand statistical procedures to analyze climate data to determine current probabilities.

- <u>Socio-economic Specialist</u> with an understanding of market prices, market structures, demography, food stocking and consumption patterns, and basic knowledge of health and nutrition data. Responsibilities include analysis of the social aspects of vulnerability and famine progression.

- Computer/Data Base Specialist with an understanding of computer operations, data base design, computer based analysis procedures, and report generation capabilities. Responsibilities include development of applications procedures, administration of early warning data bases, and assistance to staff in computer use.

- Data entry technicians At least two, preferably three, staff members should have training and responsibilities to enter data into computer data bases. Three data entry technicians are desirable to insure continuous data base development.

Depending on the budget and needs of the respective EWS, staff with other qualifications may be necessary. These include:

- Agricultural economist - provide an in-depth understanding of local markets and how their behavior reflects food security.

- Nutritionist - carry out nutrition monitoring and surveillance to determine changes in nutrition status.

- Demographer - understand population structure, migration patterns, and relating these concepts to food balance.

- Statistician - assist EWS staff to interpretate statistical data, implementate analysis strategies, and design statistical surveys.

- Geographic Information System Specialist - guide the development and operation of the EWS geographic information system.

Other skills will be needed on an occasional basis and can be provided through short-term consultants. They include:

- Communications - evaluate, define and implement improved inter- and intra- communications.

- Transportation and infrastructure - assist in understanding transportation requirements of response activities.

- Agronomy - provide a more detailed understanding of local agricultural practices.

- Remote sensing - design and implement practical methods to use remotely sensed data for early warning.

- Geographic information systems - provide in-depth assistance to design and implement GIS capabilities for early warning.

- Technical writing/reporting - assist to develop improved methods to communicate results to decision makers.

10.0 Training Requirements

IGADD should establish an agenda of short-courses that cover the gamut of early warning topics. The agenda should be developed through close cooperation with organizations holding the appropriate expertise (such as FEWS, RCSSMRS, and the World Meteorological Organization - WMO). Training courses should be applied and based on the unique problems of the sub-region. In addition, IGADD should assist to arrange scholarships through ongoing grant programs that will allow selected national early warning staff to attend university-level degree programs. This will allow the gradual building of an early warning "brain-bank" in the sub-region.

The IGADD training calendar should cover a full range of topics that vary from general to specific. IGADD's approach to training should be both formal and informal based on the particular situation. For example, topics that are relevant to the majority should be presented as organized training workshops. Other topics that are specific to a particular EWS should be presented in a more informal one-on-one environment. All technical assistance provided to IGADD members should provide training to build an in-country knowledge base.

IGADD should consider selecting an existing facility as a training center that can demonstrate expertise or have special facilities (such as computer topics, GIS, and remote sensing). For other courses that do not require special facilities, training locales may vary to take advantage of unique conditions or expertise.

Finally, training programs should be designed to assure that on completion of training each participant is provided with adequate support, in both equipment and materials, to carry out the role for which they are trained. For example, training in the use of vegetation index data to monitor agricultural lands is useless if a program to provide the data is not in place. Failure to provide support for trained personnel causes severe morale problems and inefficient use of scarce financial resources.

10.1 Formal Training Programs

The following are potential courses that should accompany a program to strengthen national EWS. The courses are organized in two categories. The first category features courses that are needed to provide a basic EWS capability in each country. The second category includes courses that address topics related to advanced early warning systems.

10.1.1 Basic Courses

The following courses provide the training that corresponds to the basic skills needed by national EWS staff. Both in-country and regional offerings should be provided. The specific topic, size of audience, and status of national capabilities will help determine the best site for each course.

Role of EWS in National Food Security and Development - An awareness course for national decision makers (program managers responsible for data collection, determining food security problems, and providing relief). It should be designed to provide explanations of potential functions and structures within their government. The training course should provide examples of what benefits can be expected from an operational EWS.

Early Warning System Principals and Tools - A basic technical course designed to provide an overview of the full range of functions that are associated with a national early warning system. Specific topics include the famine cycle, famine indicators, data and analysis requirements, and relationship to response mechanisms. Potential audience includes professional staff actively involved in EWS management or analysis of early warning data.

Use of Application Software - Topical course for EWS staff engaged in data entry, analysis, and report preparation. The training should cover use of the specific applications software used in the national warning programs. Each course should cover one or two related software packages -- such as word processing, data base management packages, map analysis, spreadsheets, and presentation graphics. Both basic training for users of new software, and advanced training for experienced staff can be offered.

Data Base Design - This is a specialized course that covers strategies and procedures to create computer data bases. Specific topics include data base structures, data entry, data archiving, and data security. Attenders should be staff responsible for data base administration.

Interpretation of Socio-Economic Data - Topics include methods to interpret price, population, on-farm food stocks, and related data. Course geared to professional staff responsible for famine analysis.

Interpretation of Nutrition Data - Topics include methods to interpret health, nutrition, and related data. Course geared to professional staff responsible for nutrition surveillance and famine analysis.

Interpretation of Agrometeorological Data - Topics include procedures to analyze rainfall data and determine growing season parameters and status. Course geared to professional staff responsible for famine analysis.

Remote Sensing for Early Warning - This course covers methods to interpret vegetation index data from AVHRR, and METEOSAT variables (cold cloud duration, rainfall days) for the purpose of monitoring growing conditions. Course geared to professional staff responsible for famine analysis.

10.1.2 Advanced Topics

The following courses provide training that corresponds to the long-term EWS capabilities defined in Section 6.0. The timing of the advanced training will be different for each country (Ethiopia, Somalia, and Kenya could benefit immediately from the first two advanced courses).

Vulnerability Analysis - Methods to interpret data to determine the countries' structural vulnerability. Course must stress a multi-sectoral approach to data analysis. Attendees should be staff with practical analysis experience in an early warning unit.

Advanced Methods for At-Risk Monitoring - Methods to integrate multi-sectoral data to monitor vulnerable areas and assess at-risk potential. Topics should include convergence of indicators interpretation, and data verification procedures. Attendees should be staff with practical analysis experience in an early warning unit.

Use of GIS for Early Warning - An advanced course for established early warning units that are planning to evolve into full-fledged GIS operations. The course should cover methods to structure a GIS, data display and analysis procedures, and reporting capabilities. Experienced computer users with experience in data base management should attend.

Spatial Analysis Methods - Advanced spatial analysis methods including surface generation, overlay analysis, and pattern analysis using a GIS. Course should be provided to organizations that have established GIS capabilities.

Field Verification of Food Emergencies - Strategies to conduct field surveys to verify and measure the severity of food emergencies. This course should include staff that assess and declare food emergencies.

Effective Communications - Course topics include organization and writing reports, and design and use of business and map graphics to communicate information.

Computer Operation and Maintenance - A technical course for experienced EWS computer users. Topics cover system configuration strategies, software installation, preventative maintenance procedures, and troubleshooting hardware problems. The course should be geared to providing the basic skills needed for staff to independently evaluate day-to-day problems, and determine logical solutions that will allow smooth early warning operations.

10.2 Information Exchange Forums

Information exchange forums (conferences/workshops) should be organized by IGADD to permit EWS staff to exchange experiences and ideas with those of other IGADD countries. They should be used to build awareness at all organizational levels - from top central management to the most remote data collector. They also can used to get decision makers together with technicians under non-emergency settings to discuss expectations and needs. These forums will serve both technical and "public relations" purposes. Through the establishment of networks, seminars, workshops, etc., emphases can be given to the regional nature and commonality of the problems and needs of the IGADD EWS community. Involvement of early warning staff from outside IGADD (i.e., CILSS and SADCC) would allow exposure to ideas that could benefit IGADD.

The forums generally should be planned for sites within IGADD countries but include participants from all IGADD countries where possible. This will allow the sharing of experiences on common problems (and their solution) among IGADD members and also will build regional harmony, cooperation, coordination and communication. An added benefit is that those countries that are advanced further in a given aspect of early warning can provide assistance to their IGADD counterparts thus promoting the concept of sharing experiences from lessons learned. Another reason to use training sites within the IGADD region is the cost savings to be achieved from reduced travel and per diem.

10.3 Degree Programs

IGADD should encourage governments to seek out donor grant programs that allow government staff to attend degree-granting institutions. The future of early warning in the sub-region will be improved if a "brain bank" of early warning professionals is developed. This is a long-term activity. National government officials should work with IGADD and the donor community to identify needs and appropriate staff for training.

The disciplines in which training is needed should be determined on a country-by-country basis. The likely subjects of emphasis will be meteorology, agriculture, geography, public health, and social sciences.

11.0 Communications Requirements

The communication issue is simple. IGADD early warning programs need to move information and data within and between countries in the sub-region. The communications channels must be simple to operate, rapid, reliable, and low cost.

The communications deficiencies of the sub-region is a major technical problem that not only plagues IGADD's early warning efforts, but also slows the economic development of the sub-region.

The specific communications needs of IGADD range from simple to complex. Examples include:

- Inter- and intra-country telephone conversations
- Shipment of texts and reports
- Transmission of small volumes of digital data (text files of interpretation results, rainfall statistics)
- Transmission of large volumes of digital data (satellite imagery)

The options for data communications include mail, telex, SSB radio, telephones, FAX, express courier, microwave links, and satellite transmissions. Currently, only mail, SSB radio, and telephones exist throughout the sub-region. FAX communications will evolve rapidly, but will not be reliable until telephone services improve. While none of these meet the rapid and reliable criteria, they are the only options that immediately can be considered.

In-country communications needs especially are important. Unless data can be moved quickly from the field to the early warning organization, timely food security assessments will be impossible. Unfortunately, implementation of solutions to the in-country communications problems is particularly difficult and costly. Experiences in other programs point to networks of SSB's as the most immediate and cost-effective solution.

Telephones, FAX, telex machines, SSB's, and satellite voice communications have some usefulness for early warning information sharing at the sub-regional level. At the national level, these communications devices often have greater value, since raw and summarized data can be transmitted to the EWS located in the capital city. At the sub-regional level, they become less useful since they have a limited capacity to transmit information directly to computers. At the sub-regional level IGADD should probably focus to establish and operate data communications links that have immediate utility for early warning data transmission.

Ideally, IGADD should work to establish within the sub-region high-speed satellite or microwave data links between each of its member states. This is a long-term goal, perhaps for the next decade or century. The technology is available, but it is costly in terms of procurement and installation, operation, and maintenance.

There are several proposals by multilateral organizations and individual donors or vendors to establish new communications links within the subregion. These vary from high-cost high-volume satellite data links to hybrid high/low speed systems having less utility for early warning needs. One proposal, Data in Africa Now Available (DIANA), envisages a high-speed one-way link from Europe, with low-speed links back to Europe and among the member states. DIANA is of limited utility. The need is for high-speed data links between member states to provide rapid diffusion of data throughout the sub-region.

As noted in the country reports, the Kenya Meteorology Department has established a medium-speed (1200 baud) data link with the Meteorology Service in Addis Ababa. This is microwave-based and relatively low cost, since it takes advantage of an existing telecommunications infrastructure, existing computers, and personnel to operate the link. This new link has the technical capacity to transmit (in both directions) much of the data required for early warning. IGADD should encourage the full utilization of this data link as a prototype for the sharing of EWS information. While political, physical, and infrastructure realities may preclude the establishment of similar microwave-based links with other countries in the sub-region, the principle and practice of information sharing could well be demonstrated with this existing data link.

Clearly, EWS data transmission needs by themselves will not be seen as sufficient to drive the development of sophisticated data communications systems in the sub-region, given the cost and complexity of their establishment. On the other hand, it is conceivable that EWS needs will serve as an important political stimulant within the sub-region to establish better data communications capability -- capability that can serve needs over and above those of EWS.

IGADD will need professional advice to decide which data communications strategy to pursue with the donors. IGADD should participate in communications studies and demonstration projects in the sub-region. Through participation, IGADD can better understand the options for communications improvements in the sub-region. Appendix B contains a brief project profile for a communications requirements study.

12.0 Remote Sensing Strategy

There are well documented scientific reports on the advantages of remote sensing for food early warning applications. IGADD can make an immediate, positive contribution to national EWS by accelerating and improving the provision of remote sensing services.

12.1 Remote Sensing Concepts

Because of the complexity and range of remote sensing programs, it is necessary to understand the many sources and types of data, and the kinds and costs of information they can provide.

Remotely sensed and other data are significant sources of information needed for food early warning. Often they represent the only synoptic data available for a country. Remote sensing provides a means to map or inventory land use/land cover and agro-ecological zones that can be used as a baseline or stratification for resource monitoring. Inventory of crop area also can be accomplished with remote sensing. Perhaps the most important role remote sensing plays in early warning is for monitoring vegetation conditions that relate to relative cropland and pasture productivity. While accurate measurement of yields is not possible with current state-of-the-art remote sensing technology, reliable interpretation of conditions that relate to patterns of rainfall and subsequent vegetation response can be used as a spatial surrogate to relative production patterns.

There are several major sources of remotely sensed data. Each major source has an appropriate role in early warning. Satellite imagery, available from the U.S. National Oceanic and Atmospheric Administration (NOAA) TIROS polar orbiting operational satellites and the geostationary European Space Agency (ESA) METEOSAT program, are cost-effective sources of monitoring data. Higher resolution data from the U.S. LANDSAT and French SPOT series of earth resources satellites are appropriate for baseline inventories.

The NOAA TIROS satellite series that carries the Advanced Very High Resolution Radiometer (AVHRR) sensor has been used extensively for earth resources monitoring. The AVHRR sensor can view areas on the ground as small as 1.1 km on a side (the 1.1 km AVHRR data are named Local Area Coverage - LAC). Also available are Global Area Coverage (GAC) AVHRR data representing ground areas 4 km on a side. Both AVHRR LAC and GAC data can be acquired over an area every day. This especially is advantageous for monitoring vegetation conditions.

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METEOSAT acquires images over Africa every 30 minutes. METEOSAT images view areas as small as 2.5 and 5 km on a side. These data are useful to monitor dynamic weather events such as potential rainfall.

The U.S. LANDSAT satellite series, initiated in July 1972, marked the modern era of land remote sensing satellites. LANDSAT satellites have collected a multitude of images over most of the Earth. From 1972 to 1983, LANDSAT Multispectral Scanner (MSS) imagery were collected every 18 days. MSS data can observe areas on the Earth as small as 79 meters square (0.57 hectares). Each LANDSAT image covers a 185-km square. Since 1982, LANDSAT satellites have carried a second sensor, the thematic mapper (TM) that can observe areas on Earth every 16-days as small as 30 meters on a side (0.09 hectare).

The French remote sensing satellite, named Le Systeme Probatoire l'Observation de la Terre (SPOT), was launched in February 1986. The program was designed by the Centre National d'Etudes Spatiales (CNES). SPOT can image the same area every 26-days (however, the sensor can be pointed to the side which allows, on the average, coverage every 2.5 days - the exact period depends on latitude). The SPOT imaging system can detect objects up to 10 and 20 meters on a side (depending on the specific sensor used) and each image covers an area 60 km by 60 km.

The higher resolution data (smaller objects on the ground can be detected) have a higher cost. Data always should be selected based on information requirements and budget limitations. The following table illustrates approximate data costs and the number of scenes required for one-time image coverage for a country the size of Kenya:

	Spatial Resolution	Number of Scenes	Cost Per Scene	Total Cost
METEOSAT	5.0km	1		
AVHRR	1.1km	1	$92	$92
Landsat MSS	79m	30	$ 660	$ 19,800
Landsat TM	30m	30	$3,200	$ 96,000
SPOT Multispectral	20m	200	$1,700	$340,000
SPOT Panchromatic	10m	200	$2,200	$440,000

The following table summarizes applications and expected information from remotely sensed data:

Product	Geographic Significance	Optimal Map Scale	Potential Data	Typical Project Cost per sq km (in Dollars)
Monitoring dynamic processes	National or Continental	1:2,500,000 to 1:10,000,000	AVHRR METEOSAT	$0.01
Generalized thematic and base-line data	Multi-Nation or National	1:1,000,000 to 1:5,000,000	AVHRR LANDSAT MSS	$0.40-$4.00
Specific thematic baseline maps, inventory maps	National or Provincial	1:100,000 to 1:250,000	LANDSAT MSS, TM SPOT	$0.40-$10.00
Detailed, specialized surveys	Provincial, Local	1:10,000 to 1:100,000	LANDSAT TM, SPOT	$10.00-$100.00

Cost estimates from: Resource Inventory and Baseline Study Methods for Developing Countries, American Association for the Advancement of Science Publication No. 83-3, 1983.

IGADD must follow a logical strategy if remotely sensed data are to provide beneficial inputs to early warning programs. The key consideration is that program requirements must drive the use of remote sensing technology, rather than the technology drive the application. Success follows matching information requirements to the information potential of remote sensing.

The following steps illustrate a logical project development sequence to use remote sensing to survey or monitor natural resources. Each intended application should address the six steps prior to beginning a project.

1. Define User Requirements including: a) geographic area, b) information requirements, c) frequency of information (e.g. one-time inventory versus periodic monitoring), and d) the budget required to conduct the program. This must be coordinated at the policy level to insure availability of resources needed to meet program goals.

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2. Collect Existing Supporting Information that describes the geographic area, application, and phenomena that are to be mapped or monitored. There is no substitute for familiarity with the area or subject when using remote sensing techniques.

3. Select Appropriate Remotely Sensing Data that best can provide the necessary information at the lowest cost. Selection will be based on data availability, mapping scales, spectral data needs, and costs.

4. Define Interpretation Methodologies that will yield the desired information. The methods must consider the information requirements, staff expertise, access to special equipment, and available budget.

5. Conduct the Survey and/or Monitoring by combining appropriate remote sensing data with other available data and field inspections.

6. Present Results to the decision makers in a form easy to understand and use (well-designed maps are frequently the best way to communicate complex resource information).

12.2 IGADD's Remote Sensing Priorities

The most immediate contribution IGADD can make to strengthen national EWS is to move quickly to make remotely sensed data and products available. The data deficiencies that exist throughout much of the IGADD sub-region create a situation in which remote sensing is the only option to obtain recent, objective data of agriculture conditions. The current FAO/IGADD/RCSSMRS remote sensing project is trying to fill an immediate need by providing satellite-derived data (vegetation index, rainfall days, cold cloud duration) to monitor regional vegetation conditions. The project should take additional steps to satisfy the need.

IGADD should concentrate efforts to provide data products and training in their use for early warning applications. IGADD should not dilute its limited resources by sponsoring remote sensing research. There are four areas in that remote sensing can improve early warning capabilities in the sub-region:

1. Provide vegetation index products from AVHRR sensors on a near-real-time basis to monitor rainfall patterns and vegetation conditions.

2. Provide parameter products from METEOSAT sensors on a near-real-time basis to estimate rainfall amounts and determine the spatial distribution of rainfall.

3. Provide higher resolution imagery (LANDSAT or SPOT) to early warning units.

4. Encourage development of agro-ecological zonation studies and integrated resource inventories throughout the sub-region. These types of studies are vital to the proper use of AVHRR and METEOSAT data, and provide a critical link between early warning and development.

In addition to products, training programs should be provided for each of the four priority areas.

12.2.1 Vegetation Index Data

Vegetation index data were requested by every national EWS visited. The data are needed to determine the spatial variability of vegetation conditions related to crop production. The key characteristic the vegetation index data must have is timeliness. The AVHRR LAC data received in Nairobi by the Kenya Meteorological Department, likely will be the most timely data. The LAC data can be delivered to the national programs at least 10 days earlier than the current 8 km data (the 8 km data are produced by generalizing the 4 km AVHRR GAC data) provided by the FAO Africa Real Time Environmental Monitoring Using Imaging Satellites (ARTEMIS) Program. To be most useful to national EWS staff, both digital and hardcopy AVHRR LAC imagery (with up to 1.1 km ground resolution) are required. First priority should be to provide digital AVHRR LAC data to national EWS. The larger scale and resolution of AVHRR LAC will permit localized interpretations by EWS staff and can be used in a broader range of applications.

While the data received by the Kenya Meteorological Department is the logical source of AVHRR LAC data for the IGADD sub-region, it has no formal agreement to distribute either the data or products to IGADD. IGADD must take immediate action to negotiate a program to obtain AVHRR data from the Kenya Meteorological Department. It also must work with RCSSMRS to establish a product generation and training program.

The 8 km ARTEMIS vegetation index data currently distributed through the FAO/IGADD/RCSSMRS remote sensing project should continue until LAC data streams are operational. Once the LAC data are available, they should replace the ARTEMIS data. The LAC products must be processed to be compatible with ARTEMIS data to insure the comparison of LAC to the ARTEMIS historical archive that dates back to mid-1981.

12.2.2 METEOSAT Rainfall Parameters

Several of the IGADD member states have, or are in the process of establishing, Primary Data Users Stations (PDUS) for real-time reception of METEOSAT data through assistance from the British Overseas Development Administration (Somalia, Ethiopia, Kenya, Sudan). These four should soon have the capability to generate their own rainfall parameter data (cold-loud duration, rainfall days, and rainfall amounts) from METEOSAT. Once operational, the national EWS in those countries should receive METEOSAT data from in-country sources. The others (Uganda and Djibouti) will be able to receive METEOSAT data from a PDUS scheduled for implementation at RCSSMRS as part of the FAO/IGADD/RCSSMRS remote sensing project.

The FAO/IGADD/RCSSMRS project can provide an interim source of product until country programs are operational. Initially, this can be done through rapid transfer of ARTEMIS products to national EWS. Once a PDUS is installed at RCSSMRS, the ARTEMIS products produced in Rome will be replaced by those generated at RCSSMRS. RCSSMRS can serve as a regional training and applications assistance facility for the use of METEOSAT products for early warning.

12.2.3 LANDSAT/SPOT Imagery

Higher resolution imagery such as LANDSAT and SPOT are needed by national EWS staff. These imagery can be used for many resource inventory applications. They are an especially useful tool to improve the interpretation of AVHRR vegetation index data. They provide a more detailed view of ground conditions that can be helpful to understand land use and environmental factors influencing vegetation greenness. In addition, they can serve as a frame of reference that can improve interpretation of most other early warning indicators.

IGADD should negotiate with RCSSMRS the purchase of LANDSAT photographic imagery covering the entire sub-region. RCSSMRS has an archive containing nearly complete image coverage of the six IGADD countries. A complete set of imagery should be prepared by RCSSMRS and sent to the national EWS for operational use.

12.2.4 Agro-ecological Mapping and Integrated Resource Inventories

The existence of comprehensive baseline resource data describing land resources is negligible throughout the sub-region. This limitation will effect the use of METEOSAT and AVHRR data since interpretation reliability depends on understanding the local resource characteristics. A reliable vegetation monitoring program must make use of baseline resource data.

IGADD should encourage projects that promise to provide comprehensive, country-wide resource inventory data. Initially, high priority should be placed to establish a project to develop a sub-region agro-ecological zones map. The agro-ecological zonatation effort can take advantage of general, small-scale remote sensing imagery (such as AVHRR). Through an effort involving national experts from all IGADD countries, a classification scheme based on climate, soils, and vegetation should be developed and used to map the entire sub-region into agro-ecological zones.

The resulting agro-ecological maps will provide several important benefits. First, the maps will provide meaningful monitoring units that will improve the reliability of vegetation condition assessments conducted for early warning. Second, they will provide a link to development programs by establishing a common framework from which successful development projects can be extended and used in similar ecological zones in other IGADD countries. Finally, the zones will provide a starting point for larger-scale, detailed resource inventories to be conducted. The zones also will allow development of consistent information that can be used for both early warning assessments and economic development projects.

12.2.5 Training

All products provided to IGADD members should be accompanied by a training program and on-call technical assistance. No data should be provided without training. The training should stress hands-on use of the data using common early warning problems and situations. Specialists should be available for follow-up training and problem solving. The training should be available to both EWS staff and other national staff involved in data collection.

While the majority of training needed for early warning can be provided through RCSSMRS, IGADD should not overlook the importance of strengthening national remote sensing centers in the member countries. Kenya, Sudan, and Somalia have identified national remote sensing programs. Interest also exists to establish centers in Ethiopia and Uganda. The development of national capabilities will allow even greater use of remote sensing in early warning units, and also increase the likelihood that the bridge between early warning and development is established.

12.3 FAO/IGADD/RCSSMRS Remote Sensing Project

The FAO/IGADD/RCSSMRS project was established as a three year project to provide METEOSAT and ARTEMIS 8 km vegetation index data, data calibration studies, and training to IGADD EWS units. The project is in its second year and is just starting to provide data. However, no training has been provided, nor has an assessment of the needs of the users been made. As a result, the data products provided thus far have been of limited value. In addition, the national staff that have received the small-scale data products universally expressed concern over the format and scale.

REDSO/ESA also is providing assistance to the FAO/IGADD/RCSSMRS project. Computer equipment for product generation and applications, training funds, and technical expertise (through a consultant) has been funded. To date, these inputs have yet to arrive. However, plans call for a training course to be held at RCSSMRS in early-1990 for national EWS staff. REDSO/ESA funds will be used to pay trainee expenses.

The FAO/IGADD/RCSSMRS project must regroup quickly and focus its efforts on meeting the immediate needs of IGADD national EWS. The following are suggestions to increase the value of the project for early warning:

1. A project plan should be prepared immediately. The terms of reference are vague and offer little direction. The FAO/IGADD/RCSSMRS project team should clarify its activities and lay out a strategy for the remaining years of the project.

2. The project should minimize efforts to provide the small-scale ARTEMIS products, and instead focus on establishing AVHRR LAC products based on data from the Kenya Meteorological Department. This should include establishing data flows, product characteristics, data communications, and dissemination policies.

3. Develop a training program that is sensitive to the needs of early warning staff. This should include development of reusable training modules, training a RCSSMRS trainer, and offering both regional and national training courses. REDSO/ESA has shown much interest in cooperating with this activity.

4. Reduce emphasis on the calibration aspect of the project. It is unlikely that the project can balance the more important product generation, dissemination, and training needs with the longer-term research associated with a calibration study. A more realistic approach to the calibration study is to provide data to university or technical center researchers so that they can conduct research.

5. Develop a data processing plan. While equipment has been purchased, a decision regarding the image processing software that will be installed on the primary computer system has not been made. This decision should be a high priority.

12.4 RCSSMRS Role in IGADD Early Warning

IGADD needs a technical center that can provide AVHRR-based vegetation index products (both digital and paper) and training in a reliable, timely manner. RCSSMRS should play a significant role to meet these needs. RCSSMRS, working cooperatively with the Kenya Meteorological Department to receive AVHRR data, could provide remote sensing and GIS training, AVHRR products, remote sensing applications support, and LANDSAT/SPOT data products. However, RCSSMRS currently cannot provide the services needed by IGADD due to a lack of equipment and staff with the necessary image processing and GIS expertise.

RCSSMRS is supported by USAID, the French Government, the Japanese Government, and by member states in Africa. It was intended to serve as a center-of-excellence in the use of remote-sensing technologies, oriented towards the development needs of Africa.

Over the past 10 years of its existence the RCSSMRS has developed an impressive capability to produce high-quality photographic products from slides and negatives (generated elsewhere) and a good image analysis capability based on manual photo interpretation techniques. It has improved its record of obtaining pledges from supporting members, and has carried out several large-scale projects on contract, including the FAO/IGADD/RCSSMRS project.

Unfortunately, RCSSMRS presently is not in the technical position to have significant inputs into an operational EWS remote sensing program. To better serve the sub-region and IGADD's early warning initiatives, it needs to:

- Become <u>production</u> oriented
- Develop a capacity to provide custom computer data products
- Improve program and financial management
- Develop a master plan and implementation strategy that includes technology for EWS.
- Resolve the Center's unreliable electrical power problems through installation of a UPS and back-up power supply

- Develop both image processing and GIS capabilities and expertise

- Make arrangements with the Kenya Meteorological Department for the regular receipt and use of AVHRR/LAC data

USAID/Kenya currently is sponsoring an evaluation of the accomplishments, capabilities, and future of RCSSMRS. The evaluation will be used to determine future USAID policy concerning RCSSMRS support. The evaluation report is due in late 1989. While the report will identify several problems at the center, it is also likely to confirm the need for remote sensing expertise in East Africa. IGADD has a strong need for an effective RCSSMRS. It must work with USAID, RCSSMRS, and other donors to see that a modernization program puts into place the capabilities needed for early warning. Appendix C provides a project profile of the establishment of an AVHRR product center, and the functional specifications and progam components for an AVHRR product generation computer system.

13.0 GIS Strategy

Early warning is a geographic problem. Not only is there a need to know how much, but also where the problem is and how to get there. The national and sub-regional EWS should work toward a full-fledged implementation of a geographic information system (GIS). The advantages of a GIS for IGADD's early warning programs include:

1. Improves cataloging and use of existing early warning indicators.

2. Provides an automated mechanism to incorporate remotely sensed data into the monitoring and assessment process.

3. Permits the assembly and analysis of spatial data related to both simple and complex food security problems.

4. Facilitates data exchange because of the inherent data organization.

5. Facilitates the convergence-of-evidence analysis of disparate physical and socio-economic data.

6. Improves efficiency of many reporting tasks by permitting automated mapping and summary of data and analysis results.

7. Allows presentation of results on maps that can be understood easily by decision makers.

8. Provides a single location for an organization's early warning information.

9. Serves as an organization's institutional memory that survives staff changes.

Perhaps the most valuable role of a GIS in early warning is that it provides a relevant means to analyze and display complex information. Maps are an easier format for the mind to assimilate information. Statistical information, in particular, is easier to understand if it is displayed in map rather than tabular form. Maps cut through the confusion of the environment and make spatial patterns easier to see. Area measurements are possible, and spatial relationships and associations can be identified to permit an understanding of a region.

13.1 GIS Concepts

A geographic information system (GIS) can be used to input, manipulate, and analyze geographically referenced data. The GIS is distinguished from other information or data base management systems in that the geographic location (typically expressed in latitude/longitude coordinates) is stored with the statistical or descriptive information. This allows the statistics or descriptions to be displayed or analyzed as maps.

There are three components to a GIS: 1) computer hardware; 2) sets of application software modules; and 3) a proper organizational context. The three components must be integrated into the policies of an organization if the GIS is to provide program benefits through improved decision making.

The computer hardware needed for a GIS consists of a central processing unit and associated magnetic media devices including disk and tape drives. In addition, several graphics-related peripherals are necessary to handle computer map information. These include a coordinate digitizer for map data entry, a plotter for output, and a graphics terminal for displaying and interaction with spatial data. The later devices set a GIS apart from traditional management information systems.

GIS software packages typically include five basic technical modules:

1. Data input and verification - Data input, usually called digitizing, covers all aspects of transforming data captured in the form of existing maps, field observations, and sensors into a compatible computer form.

2. Data storage and database management - Data storage and database management concerns the way in which the data related to geographic elements (points, lines, and areas) are structured and organized.

3. Data analysis - The large array of analysis methods that can be applied to the data to achieve answers to questions asked of the GIS. Transformations can operate on the spatial and non-spatial aspects of the data, either separately or in combination. Methods useful for early warning include overlay analysis, distance analysis, data reclassification, surface generation, and network analysis.

4. Data output and presentation - Data output and presentation concerns the ways the data are displayed and the results of analyses are reported to the users. Data may be presented as tables, maps, figures (graphs and charts) on both hard copy and computer terminals.

While a GIS is a valuable tool for food early warning, it only will be useful if the necessary data are available. In addition, to be used effectively, the GIS needs to be placed in an appropriate organizational context. Just as in all organizations dealing with complex products, new tools only can be used effectively if they are properly integrated into the whole work process and not tackled as an afterthought. This requires not only the investment of hardware and software, but the retraining of personnel and managers to use the new technology in the proper organization context. For these reasons, the implementation of GIS technology in national early warning programs only should be scheduled after the EWS has developed an adequate organization, linked into existing data collection systems, and developed computer data bases. To attempt this prematurely would be counterproductive.

13.2 Modelling

Modelling, or the use of structured analytic procedures, can provide useful information describing complex phenomena relating to early warning. Models are especially appropriate in a GIS because of availability of comprehensive analytic tools. Models can be used in two situations: 1) where relationships are known, they can be used to analyze data, and 2) where relationships exist but are not known, models can be used in an iterative fashion to determine best relationships. Models can be used to analyze many problems including crop phenology, soil moisture, food balance, and market place activities. Through variation of model inputs and assumptions, different scenarios can be tested. Use of proper models allow early warning specialists to evaluate and use information resulting from models. Analytic models should be developed and tailored to local needs by scientists with a strong understanding of the problem.

13.3 IGADD GIS Criteria

The installation of GIS technology for early warning will have a noticeable impact on program activities. A GIS will provide substantial benefits but at a cost. A commitment of additional equipment and staff training must be made. Before investing in a GIS, it is essential that there is an understanding of what it will help accomplish in the EWS. The GIS can be selected once there is an understanding of what and how it will be used. The selection of a GIS should consider the following factors:

1. Desired functionality - This is the critical issue. Can the system do the job? This should address not only analytic capabilities, but the linkages between analysis, data input, and management.

2. Ease of use - The user interface should be easy to use by the occasional system user. Systems with complex syntax should be avoided.

3. Flexibility - The ability to undertake unique, non-typical problems is essential. Systems with comprehensive, integrated sub-systems are best.

4. Customizing Options - Systems that can be modified to have user-specific menus and analytic functions will allow users to carry out complex tasks with a lower risk of failure. Systems with macro languages satisfy this requirement.

5. Data Formats - The system should have tools to allow import and export of data in a variety of formats. This especially is critical since it will allow data sharing and exchange. It also will increase the organization's flexibility to move data to other systems with the appropriate functionality.

6. User Community - In general, a large user community will result in a substantial collection of contributed programs, macros, and data that can be shared at a low cost. Of special importance is the proliferation of particular systems in the geographic vicinity and discipline.

7. Dependability IGADD should avoid new systems. The business of famine early warning is too serious to have to tolerate new, unproven systems, or companies that may go out of business leaving an unsupported system.

8. Multi-level Hardware The national EWS generally will start as a microcomputer-based GIS. However, it may someday grow to the point of requiring a larger computer. Systems that operate on multiple levels of computers offer the greatest growth potential.

9. Cost How much will it cost over the life-time of the program?

The selection of GIS software is typically difficult. None of the GIS systems currently being marketed satisfy all of IGADD's needs. Several factors point to PC-ARC as the current front-runner for use by IGADD. PC-ARC is marketed by Environmental Systems Research Institute (ESRI) of Redlands, California and was released approximately three years ago. The mother system, ARC/INFO, has been the industry standard for nearly eight years. It offers the widest range of functionality, flexibility, dependability, and has been installed at over 1000 sites throughout the world. In addition, UNEP/GRID has initiated a program to distribute 27 PC-ARC installations in Africa -- including one in Uganda. IGADD will be able to benefit immediately from this user group.

The long-standing concern about PC-ARC has been the complexity of the user interface and cost. PC-ARC will cost between $7000 and $8000 depending on the specific configuration and discounts. The interface complexity issue should not go overlooked. PC-ARC uses a tool-box approach in which basic functions with primitive syntax are used. At this level, the system is difficult for the occasional user to operate. However, the system has a powerful macro language that allows building tailored interfaces and functions. This can be used to make a simple-to-operate, yet powerful "IGADD GIS". It also will allow access to the full functionality of the system as users become more familiar and capable. Other programs, including A.I.D./FEWS and UNEP/GRID will be using PC-ARC. This will result in the creation of menu-driven functions that can serve as a starter kit for early warning.

At this time, it is best that IGADD delay the selection of a GIS. There are higher EWS development tasks that first must be addressed. However, it is likely that this issue must be answered with the next three years. At that time, there will be many improvements in GIS software. The decision, at that time, can be made based on an objective evaluation of current technology based on the nine criteria listed previously. Appendix D offers a general description of the GIS workstation components that will eventually be needed.

14.0 Computer Automation

Computers can be a tremendous asset for early warning. The efficiencies afforded through computer automation will reduce the amount of redundant, menial tasks and free resources that can be used for food monitoring, assessment, and improved reporting. The initial step towards automation, however, must be made in a carefully planned fashion. Premature or poorly defined computerization will drain early warning system's resources and negate the achievement of the expected benefits.

There are several factors that should be considered in the automation process.

1. The timing of computerization is important. The infusion of computers should take place when there is an application that requires the use of data processing capabilities, and when sufficient data area available to warrant automation.

2. Some tasks are better done using manual rather than computer procedures. If a task is done efficiently without a computer, it does not need to become a computer job.

3. User needs, rather than available technology, should be the basis for selecting computers and software. No specifications for computer facilities should be prepared until a strong statement of user needs has been prepared.

4. Specifications for computer equipment must be made by specialists with an understanding of both appropriate technology and user needs. Use of consultants to prepare specifications is recommended. However, consultants with a product to sell should be avoided.

5. Commonplace, proven computer hardware and software with broad applications should be used over highly-specialized, little-known, or new products. This will result in lower maintenance costs, access to larger user groups, ability to share data and methods, and increased training opportunities.

6. Life-cycle costs should be considered in the purchase of equipment. Initial purchase costs do not tell the entire story. Frequently, low initial costs are followed by higher-than-normal maintenance and logistics costs.

7. An automation program design must include improvement of site environmental conditions (power supply and cooling) and the long-term logistics support needs. Inadequate environmental controls could result in the destruction of the equipment. Logistics is a reoccurring expense that must be considered in the automation budget. Inadequate access or lack of funds for spares and consumable supplies could also halt computer operations.

8. The availability of local supplies, maintenance, and repair services should be a vital issue in the selection process.

9. Computers must be fully MS-DOS compatible. The inability to run the huge collection of MS-DOS software will result in serious program inefficiencies, reduce data sharing, and prohibit the use of common early warning computer tools.

14.1 Early Warning System Functional Requirements

This study has developed a preliminary definition of computer requirements for IGADD early warning. The IGADD Secretariat EWFIS team plans to conduct detailed country audits in early 1990. Their study will provide a more complete understanding of the program activities of the national early warning units. The computer specifications ultimately developed must be made with an understanding not only of the national EWS needs, but of the early warning computer capabilities developed by other programs (such as FEWS).

The exact number of computer workstations needed in an early warning unit will be based on program activities and staff capabilities. Generally, three workstations are the minimum needed for a comprehensive early warning system. The following briefly describe the functions of the three workstations. Appendix E provides equipment specifications.

1. Data Base Management Workstation - The primary purpose of this workstation is to serve as the host computer system for the organization's early warning data bases. This system is the most critical since early warning relies on timely access to reliable data. Other functional tasks carried out on the data management workstation are data analysis, and less commonly, simple statistical analysis, and communications.

2. Data Analysis Workstation - The data analysis workstation is used to carry out vulnerability assessments, and monitor at-risk populations. Functional tasks carried out on this workstation include statistical analysis, development of graphics and illustrations, preparation of reports, design and display of map information, and display and interpretation of vegetation index data.

3. Report Preparation Workstation The report preparation workstation is used to compose reports. Functional tasks carried out on this workstation include report composition and printing, and preparation of graphics and illustrations.

14.2 Logistics Support

Computers are useful tools for early warning only if they are functional. The IGADD early warning program must recognize the importance of computer maintenance and logistics. Without regular preventative and emergency maintenance, computer operations will fail. Logistics are equally important. If the supply of spare parts, paper, ribbons, and diskettes runs out, it may be months before replacements can be obtained and the equipment made operable. Care must be taken to insure that the equipment purchased can be maintained and repaired locally, and that consumable supplies can be purchased locally.

15.0 Strategy for Improving Early Warning Data

All data used for early warning, including famine indicators and supporting reference data, collectively comprise the early warning data base. EWS are heavily data dependent, that is, they require continuous infusion of data from a variety of sources. They also require a large and well-ordered database containing historical data for comparison with newly-acquired data and the establishment of "normal" trends. Without appropriate, reliable data, identifying food security problems is difficult.

The process of collecting and making full-use of diverse data is complex. There are many steps that must be taken according to a disciplined plan if the result is to be worthwhile. For example, the process involved to utilize a single data stream (e.g., nutritional surveillance data) might involve the following steps:

- Identification of need and specifications for needed data
- Planning for data acquisition (including sampling design, training of staff, needed equipment and transportation, budget requirements, scheduling, analysis plan, etc.)
- Data acquisition (fieldwork, recording of data and transmitting it for analysis)
- Data coding and entry into computers (where appropriate)
- Data cleaning and calibration
- Data storage/archiving/retrieval
- Data analysis and comparisons with other data
- Extraction of inferences from analysis
- Presentation of information needed for decision making (including tables, graphs, deciding on best format)
- Dissemination of information

IGADD faces a major challenge to improve early warning data. There are many examples of current problems. Nutrition data collection does not exist in Somalia, and meteorological data collection is weak in Uganda. Whenever possible, EWS should rely on the data collection activities of the other ministries. Also, deals must be made to receive the needed data. If data collection needs to be improved, IGADD and the national EWS should offer whatever assistance it can. The EWS can offer value-added services back to the original source through reorganization of the data and merge it with other relevant data. Volume 3 provides country summaries of data strengths and weaknesses.

15.1 Data Guidelines

Unquestionably, an EWS is only as useful as its data base. This requires that the data base be organized correctly, documented, and contain timely, complete, reliable data. The early warning data base is the archive from which the data needed for all analysis is drawn. Guidelines must be established that define cataloging and documentation procedures. The establishment and close adherence to data base and archive guidelines will not only insure data integrity over time, but also permit data sharing between users.

IGADD should provide the leadership to get early warning professionals together to discuss data base guidelines that can be followed in the IGADD sub-region. Guidelines should be developed by appropriate early warning and data base professionals and evaluated and modified as needed by national IGADD representatives. There should be incentives to adhere to IGADD guidelines. These can take the form of training, equipment, software, and hopefully data, for the national EWS.

Guidelines should be developed and considered that cover the following areas:

1. Documentation - The most important guidelines should deal with the description of the data. The value of any data base is diminished significantly if it is not properly documented. Documentation should describe the following:

   Classification scheme
   Source
   Data collection/creation procedures
   Data format
   Measurement Units
   Date created or represented
   Resolution
   Geographic location represented

2. Import/Export Formats - IGADD should agree on a set of data import and export formats that can be used for data sharing.

3. Archiving Strategy - Procedures that will insure the security of the data over time should be recommended. This does not mean that data will be housed in a central archive. An archiving strategy must describe practices for each country to guarantee the long-term survival of their data holdings.

4. Geographic Basis - All data used for early warning is geographically specific. Data collection efforts should collect geographic location data in addition to other attributes.

15.2 Data Requirements

Modern early warning systems use diverse data drawn from a variety of sources. Data should encompass both the physical and the social sciences. Sources will include ministries with established data collection programs, and ad hoc sources such as informants, NGO's and PVO's. Based on the experiences of other early warning programs, the following are considered to be the critical data:

- rainfall and temperature
- crop condition
- market prices (grains and livestock)
- political events impacting food supply
- emergency food stocks
- on-farm storage estimates
- demographic information
- remote sensing data

Other data that are considered to be desirable include:

- health and nutrition
- crop area
- crop yield
- soils
- vegetation
- infrastructure (roads, rail, waterways, telecommunications, medical, social, political, etc.)

The effective acquisition and manipulation of these diverse data types is the unique task faced by those operating modern early warning systems. It is no small task. However, it is one which is demonstrably possible, and one which involves continuous improvements in technique and effectiveness.

16.0 Linkages to Other Programs

Early warning programs survive based on their success in tapping into the data and expertise of other programs. At the national level, there must be numerous links established to insure the timely flow of data.

In addition to linkages to programs at the national level, there are a number of programs in the region and sub-region, both technical and non-technical that either overlap in responsibilities, or offer services needed in IGADD's EWS efforts. IGADD must have a posture reflecting the type of relationship it would like to have with each.

16.1 ARTEMIS

The Africa Real Time Environmental Monitoring Information System (ARTEMIS) is an FAO project based in Rome that is designed to provide near-real time vegetation index data and METEOSAT-based rainfall data covering Africa. The data used in the FAO/IGADD remote sensing project currently uses ARTEMIS data.

Currently, ARTEMIS is the only comprehensive source of remote sensing-based vegetation (from AVHRR) and rainfall data (from METEOSAT) over East Africa. However, the value of the data are reduced because of delays in delivery to Nairobi from Rome, and subsequent transfer to the national programs. In addition, the fixed small-scale ARTEMIS product format being provided to IGADD is difficult to use at the national level.

Four of the six IGADD members, and the FAO/IGADD/RCSSMRS remote sensing project, will have METEOSAT PDUS by the end of 1989. The need for ARTEMIS rainfall variables then will be eliminated.

Possibly, AVHRR LAC data from the Kenya Meteorological Department will be available within a year. This will eliminate the need for the ARTEMIS vegetation index data.

ARTEMIS is supposed to migrate from a data services project to a technical assistance project. The exact nature of the planned technical assistance is unknown, but could be useful to the IGADD EWS program.

16.2 DIANA

The Data In Africa Now Available (DIANA) project is just starting. DIANA is a pilot project of the FAO and European Space Agency (ESA) that is designed to provide medium-speed (64 KBPS) data communications from Rome to selected Africa sites, and low-speed return transmission. ARTEMIS data will be available on DIANA. Nairobi and Djibouti have been invited to serve as pilot test cases.

IGADD can benefit greatly from a reliable medium speed data channel. However, its first priority is to communicate between African nations rather than through Europe. It is questionable how valuable DIANA services will be to the national EWS. The services will have somewhat more value for the sub-regional EWS. The technical lessons learned through DIANA are important to IGADD. If the technology provides dependable, reliable data transfer services, and the benefit/cost analysis is favorable, the program may become a candidate for broader implementation. IGADD should participate in DIANA. The severe communications problems in the sub-region must be solved. Any program that offers hope is of value.

16.3 RCSSMRS

See Section 12.4.

16.4 UNEP/GEMS

The United Nations Environmental Program's Global Environmental Monitoring System (UNEP/GEMS) in Nairobi is in the initial stages of implementing a program to create sub-regional and national GIS and geographic data bases in Africa. The program will provide computers, GIS, and image processing software to 15 African countries. The participating countries will receive the equipment, and three months of training in its use. PC-ARC GIS software will be provided.

UNEP/GEMS plans to put three systems in the IGADD sub-region. The Uganda Ministry of Environment already has been selected as a recipient of training and equipment.

Any of the IGADD national EWS in the sub-region would benefit if selected to receive the equipment and training. <u>However, UNEP/GEMS does not have plans for support and technical assistance - this must become IGADD's responsibility</u>. The EWS in Sudan, Somalia, and Ethiopia all should be considered as candidates for the remaining IGADD sub-regional slots. IGADD immediately should begin discussions with UNEP/GEMS to encourage them to select one or more of these programs.

16.5 Kenya Meteorological Department

The Kenya Meteorological Department (KMD) has a High Resolution Picture Transmission (HRPT) system that can provide AVHRR LAC data for the sub-region. However, the KMD is not interested in production responsibilities for other programs. Original plans called for the KMD, with French funding, to have a microwave link to transmit the data to RCSSMRS. Because there is a major need for the data in the sub-region, IGADD must get involved to work out long-term agreements for the data to be provided to RCSSMRS for product generation. If the cost of the microwave link is too expensive, the transfer of images on magnetic tape to RCSSMRS should be used. The Meteorology Department should be compensated for supplying the data.

16.6 French Ministry of Cooperation

The Ministry of Cooperation offered a proposal for a technical assistance project that compliments IGADD's sub-regional EWS program. The two-year project called for the establishment of a study unit in Djibouti that would 1) look at techniques for using remote sensing to evaluate the impact of weather on crops and livestock, and 2) investigate communications improvements.

The original French proposal had merit. The IGADD Secretariat rejected the original proposal, however, and instead asked that it be resubmitted with greater emphasis on communications. In addition, the project would be implemented in Nairobi rather than Djibouti. Both the original project and suggested changes are beneficial to IGADD. The revised project is even more relevant since it addresses areas in which there are major weakness. IGADD should actively pursue implementation of this project.

16.7 A.I.D./FEWS

The A.I.D. Famine Early Warning System (FEWS) covers Sudan and Ethiopia. FEWS in Sudan has maintained a casual relationship with the Sudan EWS in the Relief and Rehabilitation Commission (RRC) and compares findings on food security. However, U.S. policy may force the elimination of these relationships.

FEWS has been innovative in the use of remote sensing and movement towards a full implementation on a GIS. They have developed software and methods for use in early warning. In addition, FEWS plans to continue developing new tools. FEWS has also been innovative in developing analysis strategies based on evaluation of the stress and impact aspects of food security. IGADD should establish a technical relationship with FEWS so that it can take advantage of FEWS's successes.

16.8 AGRHYMET

The AGRHYMET Program in Niamey, Niger has already traveled many of the roads that IGADD will. Their regional emphasis on improving inter-country communications, modernization of data collection, and encouraging of data sharing and standardization are relevant to the IGADD early warning initiatives. IGADD should establish a professional relationship with AGRHYMET staff and share ideas on mutual issues.

16.9 SADCC

SADCC is trying to establish capabilities similar to those needed by IGADD. Since early warning problems are related, coordination would result in the sharing of ideas and solutions.

16.10 Drought Forecasting Center

A Drought Forecasting Center (DFC) has been proposed by WMO and UNDP. DFC will be based in Nairobi and share facilities with KMD. It is supposed to address medium- and long-term drought forecasting in East Africa. IGADD should monitor the development of the DFC and establish a suitable relationship once the program becomes operational.

17.0 Implementation Actions

The following list of implementation activities is based on the recommendations to concurrently strengthen national early warning systems and develop a sub-regional early warning system. This schedule is a combination of planning activities, coordination efforts, technical assistance, training, and physical infrastructure, equipment and supplies which must be planned and implemented.

17.1 Ongoing Actions

There are several actions that must be initiated by IGADD and maintained over the long-term. These include:

1. Provide technical advice to national EWS components. This should be done through a combination of IGADD EWS staff and consultants. Assistance can cover the full range of tasks. Initial assistance, however, should concentrate on providing planning and design expertise needed in the national EWS.

2. Improve early warning data - When possible, national EWS should use data collected by line ministries. Thus, linkages must be established to receive the needed data. In some cases, projects may be needed to improve the data collection practices and capabilities of line ministries.

3. Communications - Every effort should be taken to participate in programs that may solve the many communications problems facing the sub-region. This includes projects dealing with basic data communications from field to central ministries; from ministries to national EWS facilities; from national EWS to IGADD Secretariat; and from IGADD Secretariat or other sub-regional organization (in case of remote sensing) to national EWS. Participation in the DIANA and establishment of a communications project with the French Ministry of Cooperation are important first steps in exploring available options.

4. Cooperate with relevant technical organizations that can help further IGADD's EWS goals. The IGADD EWS effort can benefit by tapping into the data and expertise of other programs. Two important programs include:

   FEWS - IGADD should continue their relationship with REDSO/ESA and A.I.D. FEWS. A technical relationship, particularly in the areas of training and analysis tools sharing, with FEWS will be advantageous to IGADD.

   UNEP/GEMS - IGADD should encourage UNEP/GEMS to select national EWS programs in the sub-region as recipients of GIS systems.

17.2 Immediate Actions

IGADD's immediate actions to strengthen national early warning systems should be to broker/coordinate inputs needed by the EWS components. Initial efforts should be to coordinate inputs that allow the national EWS to achieve a basic level of capabilities (stages 1-3). Specific actions include:

1. Develop an implementation plan that defines the directions for the implementation of IGADD's early warning activities over the next five years.

2. Publish technical bulletins and reports on early warning topics that can be used by personnel involved with food security. This should be one of the first orders of business for the EWFIS team stationed at the IGADD Secretariat.

3. Data and information exchange - The long-term process of establishing data and information exchange between the national programs and the IGADD Secretariat, and eventually between the member countries must be started. This will not only include agreements to share data, but also the establishment of data guidelines and an archiving strategy that will insure data integrity over time. It will also provide a forum for national EWS staff to share experiences and ideas with colleagues in other countries.

4. Sponsor remote sensing data - The need for remote sensing inputs is universal in the sub-region.

   A. Insure that the Regional Center for Services in Surveying, Mapping, and Remote Sensing (RCSSMRS) provide vegetation index products to national EWS from U.S. National Oceanic and Atmospheric Administration polar orbiting satellites (based on the one-kilometer resolution data from the Advanced Very High Resolution Radiometer - AVHRR - sensor).

   B. Distribute METEOSAT (METEOrological SATellite) data from the RCSSMRS Primary Data Users Station (PDUS) to IGADD states that do not have in-country access to a PDUS (Uganda, Djibouti). Note that Sudan, Somalia, Uganda, and Kenya have METEOSAT receiving facilities.

   C. Provide LANDSAT/SPOT imagery to national EWS.

   D. Encourage the initiation of a regional agro-ecological zonation project covering the entire sub-region.

5. Develop curriculum of training courses that cover the gamut of early warning topics. The courses should be applied and based on the unique problems of the sub-region. High priority courses include:

Role of EWS in National Food Security (for managers)
EWS Principles and Tools
Data Base Design
Interpretation of Socio-Economic Data
Interpretation of Agrometeorological Data
Remote Sensing for Early Warning
Vulnerability Modeling and Analysis
Methods for At-Risk Monitoring

17.3 Secondary Actions

As the IGADD EWS components achieve a basic capability level, other actions should be initiated. RCSSMRS is the likely organization to assist in these actions. They include:

1. Offer advanced training courses. Potential topics include:

   Use of GIS for Early Warning
   Spatial Analysis Methods
   Computer Operation and Maintenance
   Rapid Assessment Methods
   Reporting and Communications Techniques

2. Implement geographic information systems. The installation of GIS technology for early warning will have a noticeable impact on program activities. A GIS will provide substantial benefits but at a cost. Before a specific GIS is selected there must be an understanding of what and how it will be used. Efforts should be directed toward use of microcomputer-based GIS tools employed by other organizations with purposes similar to those of IGADD. This will allow several groups to contribute to an "IGADD GIS".

3. Establish a GIS Service Center. This center can provide the technical backstopping in data base development, special products, and analytical procedures not available at the national level.

17.4 Critical Early Warning System Issues

There are three issues common throughout the IGADD sub-region that must be considered in the design of EWS.

1. Will to Communicate and Share Data This is the most critical problem that IGADD can address. Collection of primary data of any kind and assembling it within data bases is a difficult task. Once assembled, the sharing of these data should be both technically and politically possible. However, sharing of data among government entities is often not a common practice. There is an apparent lack of will to share data, and a lack of understanding of the good that comes from

sharing. This phenomenon should be addressed at the highest management levels and arrangements made so that data necessary to support EWS can be made available in a timely manner to both national and sub-regional organizations.

2. Communications Problems Rapid, efficient communications are the lifeblood of early warning. Existing communications systems in the IGADD sub-region are inadequate to support the rapid exchange of early warning information. The problem is much bigger than early warning. Communications deficiencies are a major technical problem that will plague not only IGADD's early warning efforts, but also slow the overall economic development of the sub-region. Clearly, IGADD should strive to stimulate the further development of telecommunications and data communications links within and among member states. IGADD should participate in projects active in the sub-region that address communications.

3. Need for AVHRR Product Center IGADD needs a technical center that can provide AVHRR-based vegetation index products and archiving services in a reliable, timely manner. RCSSMRS, in cooperation with the Kenya Meteorological Department, are the logical elements of this activity. IGADD should facilitate the development of a product center through negotiations with donors interested in provided the needed support.

02

APPENDIX A

LIST OF CONTACTS

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APPENDIX B

COMMUNICATIONS REQUIREMENTS STUDY PROFILE

Introduction

The following text provides illustrative information for the initiation of an IGADD communications requirements study. A refinement of the text, based on inputs from communications professionals, is needed.

Justification

Communication of information is an essential element of an early warning system. Movement of data from the field to the early warning unit, and transfer of information describing food security status to appropriate decision makers must be rapid and reliable. If not, proper actions may not take place in time to mitigate a problem.

For IGADD's early warning initiatives to be effective, data communications both within- and between the member states must be possible. Communications systems throughout the IGADD Sub-Region are underdeveloped. In the short-term, simple, low-cost options for moving information must be defined and tested. Possible methods for moving information include use of single side band radios, telex, telephone, FAX equipment, or low-speed modem transfer of electronic data. In the long-term, high-speed transfer of large volumes of data is needed. This could involve use of microwave and satellite transmission of data.

Communications improvements will not only benefit early warning, but will also permit accelerated economic development throughout the sub-region.

Description of Activities

A study is needed to define the short- and long-term options for early warning communications. This study must evaluate the current status of communications in the sub-region and determine the best options for both inter- and intra-country communications. The communications study must address the following:

- Determine the specific intra- and inter-country communications requirements of the IGADD early warning system.
- Inventory the current state of communications in the sub-region.

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- Determine the likely short-term communications options and conduct field tests to determine their effectiveness for intra- and inter-country communications. Prepare a benefit/cost analysis of the practical short-term communications options for both within and between country communications.

- Develop specifications and cost estimates for equipment that will provide the simplest, lowest-cost, and most-reliable communications. Separate specifications and costs are needed for inter- and intra-country communications.

- Evaluate the current state-of-the-art in communications and determine the potential costs for its implementation in the sub-region.

- Recommend a long-range strategy for implementing modern communications facilities, and suggest possible funding sources.

Expected Results

The communications study will provide the following:

- An understanding of immediate, practical options and their costs for moving early warning information both within and between countries.

- A plan that includes equipment specifications and costs needed to immediately implement an improved communications system for early warning.

- A long-range strategy for modernizing communications throughout the sub-region for the benefit of both early warning and general economic development.

Cost Estimate

The following figures illustrate the potential costs for the communications requirements study. The specific cost figures will vary based on the desired depth.

Requirements study	- $100,000
Testing of communications options	- $100,000
Specification of system	- $ 50,000
Long-range plan	- $ 50,000
Total	$300,000

APPENDIX C

AVHRR PRODUCT GENERATION SYSTEM

Introduction

Section 12.0 describes the need for an AVHRR product generation center that can provide 1-km vegetation index data to national EWS on a near-real-time basis. The following discussion provides a brief profile for a project to establish the system, and specifications for the needed computer system.

Justification

Food early warning systems require timely, objective data on which to base assessments of national food security status. A significant factor that must be taken into consideration in the assessments is the condition of agricultural and pasture lands. Remote sensing images from the AVHRR sensor on board National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites has proven to be a valuable tool for monitoring rainfall patterns and the subsequent condition of agricultural and range resources.

Objectives

The IGADD EWS initiative can benefit greatly from the availability of vegetation index data calculated from NOAA AVHRR imagery. As a result of the installation of an AVHRR receiving station within the Kenya Meteorological Department, IGADD has access to a timely source of data that can be used for food security and drought monitoring. While the data are available, facilities to process the raw satellite imagery into a format appropriate for early warning programs are unavailable.

The Regional Center for Services in Surveying, Mapping, and Remote Sensing (RCSSMRS) is the likely candidate to serve as an AVHRR product center that serves IGADD programs. RCSSMRS has a regional mandate to provide assistance in remote sensing. In addition, it is already the site for IGADD's remote sensing/early warning project. With proper augmentation, RCSSMRS can be developed into an AVHRR product center that provide data and services to IGADD's EWS activities.

Description of Activities

A three year effort is needed to establish computer systems and train staff in the operations and applications of the facilities. The development of an AVHRR product generation capability at RCSSMRS will require a number of inputs, including:

- Consultants to develop the specifications of the required computer equipment and facility improvements.

- Installation of a backup electrical power source and an uninterruptible power supply to insure clean, reliable electricity.

- Installation of computer hardware and image processing software with the capacity to process at data from at least two AVHRR overpasses per day.

- Training for RCSSMRS staff in the operation, maintenance, and application of the computer facilities.

- Develop an annual training program in the application of AVHRR products for early warning and drought monitoring. Courses must be geared to the needs of national early warning system staff.

- Development and financial support of a product distribution system. This will likely initially consist of express courier delivery of products from RCSSMRS to national early warning units, but eventually should use electronic data transfer methods.

Expected Results

The AVHRR product generation center will provide IGADD with:

- Improved assessments of food security throughout the IGADD sub-region.

- Year round supply of timely high resolution vegetation index products that are available to early warning and development programs.

- Computer facilities that can be used to create remote sensing products needed by both early warning and development programs.

- Trained staff capable of using state-of-the-art equipment for early warning and development programs.

Cost Estimate

The following costs illustrate the costs for establishing an AVHRR product center. The establishment of the center is expected to take two-years. Reoccurring costs associated with the operation of the center are not included in the figures.

Site Preparations	- $30,000
Electrical Improvements	- $35,000
Computer Facilities	- $250,000
Installation	- $25,000
RCSSMRS Staffing	- $240,000
RCSSMRS Staff Training	- $100,000
EWS Staff Training	- $240,000
Technical Support	- $150,000
Operational Expenses	- $150,000

Total	$1,210,000

Computer System Specifications

If RCSSMRS is to produce AVHRR products, it will need significant image processing capabilities. The system must be capable of processing data from at least two satellite overpasses each day. The following illustrates the type and complexity of the AVHRR data processing system. Careful attention must be paid to hardware and software compatibility since image processing software typically is dependent on specific brands of hardware.

Hardware

- Super-microcomputer (such as MicroVAX equipment) with:
  - 32-bit CPU
  - 16 megabytes of memory
  - Two gigabytes of disk storage
  - Two tape drives (1600/6250 bpi, 150 ips)
  - Ability to support 10 terminals
  - CRT console
  - Terminals
  - System lineprinter
  - Networking capability (such as Ethernet)
- Large format digitizing tablet
- Large format color raster plotter
- Raster image display
- Vector graphics display

- Color film recorder

- Communications equipment

Software

- AVHRR image processing system with the following capabilities:

    - Unlimited line, sample arrays
    - Ingest Level 1-B and Sharp AVHRR data formats
    - Geometric registration capabilities including AVHRR system corrections, image to map, and image to image correlation
    - Data transformations including NDVI, albedo, principal components, and ratios
    - Contrast enhancement
    - Spatial filtering
    - Mapping and renumbering of data
    - Primitive processes (arithmetic, maximum, minimum)
    - Logical processes
    - Statistical summaries by polygon, area, scene
    - Classification using supervised or unsupervised methods
    - Interactive display system
    - Interface to vector GIS
    - Plotting of merged raster/vector data

- Geographic Information System software for vector data processing

- Plotting software for raster and vector data

APPENDIX D

GIS WORKSTATION SPECIFICATIONS

The GIS configuration requires a careful determination of functional requirements, and matching of computer hardware and software. A GIS can operate on computers ranging in size from microcomputers to large, mainframe systems. The IGADD GIS likely will be resident on microcomputers. A typical microcomputer GIS configuration would include the following hardware and software:

Hardware

- Microcomputer capable of operating both MS-DOS and OS/2
- 386 CPU with 1 megabyte of RAM, expandable to 16 megabytes
- 1.2 megabyte 5 1/4 inch floppy disk drive
- VGA Color graphics and monitor
- 300 megabyte hard disk
- Dot matrix printer (24-pin)
- Large format pen plotter or color printer
- Large format electronic digitizing tablet
- Uninterruptible power supply

Software

- GIS software - see discussion in Section 13.4
- Operating system compatible with GIS software
- Text Editor (such as Norton Editor, Edix, PC-Write)
- Disk Utilities (such as Norton Advanced Utilities, PC Tools)
- Hard disk backup software (such as Fastback, PC-FullBak)

APPENDIX E

EARLY WARNING SYSTEM WORKSTATION SPECIFICATIONS

Data Base Management Workstation

The potential hardware specifications for the data base management workstation include:

- Capable of operating both MS-DOS and OS/2
- 386 CPU with 1 megabyte of RAM, expandable to 16 megabytes
- 1.2 megabyte 5 1/4 inch floppy disk drive
- VGA Color graphics and Monitor
- Minimum hard disk capacity of 120 megabytes
- Dot matrix printer (24-pin)
- Uninterruptible power supply

Software needed for data base management include:

- MS-DOS (Version 3.3 minimum)
- Data base management system (such as DBASE IV, RBASE, DATAEASE, Condor, Lotus 1-2-3)
- Text Editor (such as Norton Editor, Edix, PC-Write)
- Disk Utilities (such as Norton Advanced Utilities, PC Tools)
- Hard disk backup software (such as Fastback, PC-FullBak)
- Word processor (optional)

Data Analysis Workstation

The potential hardware specifications for the data analysis workstation include:

- Capable of operating both MS-DOS and OS/2
- 386 CPU with 1 megabyte of RAM, expandable to 16 megabytes.
- 1.2 megabyte 5 1/4 inch floppy disk drive

- VGA Color graphics and monitor
- Minimum hard disk capacity of 120 megabytes
- Dot matrix printer (24-pin)
- Uninterruptible power supply

Software needed for data analysis include:

- MS-DOS (Version 3.3 minimum)
- Spreadsheet (such as Lotus 1-2-3, SuperCalc)
- Word processor (such as WordPerfect, Word, WordStar)
- Presentation Graphics (such as Freelance, Harvard Presentation Graphics)
- Map graphics (such as ATLAS*GRAPHICS, Map Info)
- Image display and analysis (such as IDA from FEWS/USAID)
- Disk Utilities (such as Norton Advanced Utilities, PC Tools)
- Hard disk backup software (such as Fastback, PC-FullBak)
- Data base management (same as used on data base management system)
- Statistical software (such as SPSS-PC, STAT*Graphics)

Report Preparation Workstation

The potential hardware specifications for the report preparation workstation include:

- Capable of operating both MS-DOS and OS/2
- Minimum of 286/12 hz or 386 CPU with 1 megabyte of RAM, expandable to 16 megabytes
- 1.2 megabyte 5 1/4 inch floppy disk drive
- Minimum hard disk capacity of 40 megabytes
- Dot matrix printer (24-pin)
- Uninterruptible power supply

Software needed for preparation of reports include:

- MS-DOS (Version 3.3 minimum)
- Word processor (such as WordPerfect, Word, WordStar)
- Presentation Graphics (such as Freelance, Harvard Presentation Graphics)
- Printer utilities (such as Print-Q)
- Disk Utilities (such as Norton Advanced Utilities, PC Tools)
- Hard disk backup software (such as Fastback, PC-FullBak)
- Desktop publishing (optional)

Other Equipment Options

In addition to the computer equipment mentioned, several other components are optional. They include:

- Laser printer
- Pen plotter or color ink-jet plotter
- 1.44 megabyte 3 1/2 inch floppy disk drive
- Tape backup system
- Modem (2400 baud) and communications software
- Networking hardware and software

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Establishing the Structure of an IGADD National and Sub-Regional Early Warning System

Volume 3
Country Reports

EROS Data Center
National Mapping Division
U.S. Geological Survey
Sioux Falls, South Dakota USA

December 1989

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VOLUME 3 - COUNTRY REPORTS

ESTABLISHING THE STRUCTURE OF AN IGADD NATIONAL AND SUB-REGIONAL EARLY WARNING SYSTEM

Prepared under AID PASA No. AFR-0510-P-IC-7022-22

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REDSO/ESA
Nairobi, Kenya

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FOREWORD

The Final Report on Establishing the Structure of an IGADD National and Sub-Regional Early Warning System consists of three volumes. Collectively, they provide a complete treatment of the findings, conclusions, and recommendations suggested by the USGS team. The three volumes are:

Volume 1 - Executive Summary

Contents include a brief summary of a strategic plan for an IGADD sub-regional early warning system (EWS). Topics include (1) a suggested EWS model, (2) IGADD's role in early warning, (3) priorities and actions, and (4) critical issues.

Volume 2 - Main Report

This volume provides a detailed discussion of the overall findings, conclusions and recommendations for an IGADD sub-regional EWS.

Volume 3 - Country Reports

Contents include reports detailing the status and needs for early warning systems in the six IGADD member states. The country reports are the working documents prepared by the USGS team to develop the overall conclusions and recommendations.

The country reports were prepared following team visits to Ethiopia, Kenya, Somalia, Uganda, and Djibouti. It was not possible for the team to travel to Sudan to visit their early warning system.

The country reports are not in a standardized format but instead are presented as rough working documents. They focus dicussions on the national situation and needs, rather than serve as polished expositions on early warning.

LIST OF ACRONYMS

Acronym	Definition
A.I.D.	Agency for International Development
ACMAD	African Center for Meteorological Applications for Development
ADP	Automatic Data Processing
AGRHYMET	Agriculture, Hydrology, Meteorology
AISC	Assessment and Information Services Center, NOAA
AMCEN	American Ministerial Council
ARC	AGRHYMET Regional Center
ARTEMIS	Africa Real Time Environmental Monitoring Using Imaging Satellites
AVHRR	Advanced Very High Resolution Radiometer (NOAA)
BPI	Bits Per Inch
CAC	Climate Analysis Center, NOAA
CAC	Coordinating and Advisory Committee of AGRHYMET
CBS	Central Bureau of Statistics
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CLICOM	Climate Computing System
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTO	Regional Remote Sensing Center of Ouagadougou
DCP	Data Collection Platform
DIANA	Data in Africa Now Available
DLCO	Desert Locust Control Organization
DRSRS	Department of Resource Surveys and Remote Sensing
ECA	Economic Commission for Africa
EEC	European Economic Community
EGA	Extended Graphics Adapter
EOSAT	Earth Observation Satellite Company (LANDSAT)
ERDAS	Earth Resources Display and Analysis System
EROS	Earth Resources Observation Systems
ESA	European Space Agency
EWFIS	Early Warning Food Information System
EWS	Early Warning System
FAO	Food and Agriculture Organization (U.N.)
FAX	Facsimile Transmission
FCCAD	Foreign Crop Conditions Assessment Division
FEWS	Famine Early Warning System (USAID)
FEWS	Food Early Warning System (Somalia)
GAC	Global Area Coverage (AVHRR)
GEMS	Global Environmental Monitoring System
GIEWS	FAO Global Information and Early Warning System
GIS	Geographic Information System
GMS	Global Monitoring System
GNS	Global Navigation System
GOES	Geostationary Operational Environmental Satellite
GOS	Government of Sudan

Acronym	Definition
GOU	Government of Uganda
GPS	Global Positioning System
GRID	Global Resources Information Database (UNEP)
GSFC	Goddard Space Flight Center (NASA)
GTS	Global Telecommunications System
HRPT	High Resolution Picture Transmitter
IBM	International Business Machines
IDA	Image Display and Analysis
IGADD	Intergovernmental Authority for Drought and Development
IPS	Image Processing System
IPS	Inches Per Second
ITCZ	Intertropical Convergence Zone
KBPS	Kilobits Per Second
KMD	Kenya Meteorological Department
LAC	Local Area Coverage (AVHRR)
LANDSAT	Land Satellite of NASA, NOAA, EOSAT
LAS	Land Analysis System
METEOSAT	Meteorological Geostationary Observation Satellite (ESA)
MOA	Ministry of Agriculture
MOH	Ministry of Health
MSS	Multispectral Scanner (LANDSAT)
NAC	National AGRHYMET Centers
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data and Information Service (NOAA)
NEWS	National Early Warning System
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRMS	Natural Resources Management Systems
OAU	Organization for African Unity
OECD	Organization for Economic Cooperation and Development
PDUS	Primary Data Users Station
PTT	Post and Telecommunications Office
PVO	Private Voluntary Organization
RAFC	Regional Area Forecasting Center
RAM	Random Access Memory
RCSSMRS	Regional Center for Services in Surveying, Mapping, and Remote Sensing
RDMC	Regional Drought Monitoring Center
RNA	Requirements Needs Analysis
RRC	Relief and Rehabilitation Commission
SADCC	South African Development Coordination Conference
SAP	Systeme d'Alerte Precoce
SDUS	Secondary Data Users Station
SERISS	Sudan Emergency and Recovery Information and Surveillance System

Acronym	Definition
SHARE	Software Help in Applications Research and Education
SPOT	Systeme Probatoire d'Observation de la Terre
SWD&M	Sahel Water Data and Management Project
TAMSAT	Tropical Agricultural Meteorology Using Satellites
TIROS	Operational Orbiting Weather Satellite (NOAA)
TM	Thematic Mapper (LANDSAT)
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
UNEOS	United Nations Emergency Office for Sudan
UNEP	United Nations Environment Program
UNITAR	United Nations Institute for Training and Research
UNSO	United Nations Sahelian Office
UPS	Uninterruptible Power Supply
USAID	United States Agency for International Development (Bilateral Missions)
USDA	United States Department of Agriculture
USG	United States Government
USGS	United States Geological Survey
VGA	Video Graphics Array
WFP	World Food Program
WHARF	World Hunger Alleviation Through Response Farming
WHO	World Health Organization
WMO	World Meteorological Organization

APPENDIX A

REPUBLIC OF DJIBOUTI
COUNTRY REPORT

Status of Early Warning

There is not an established early warning system in the Government of the Republic of Djibouti (GRD), although discussions with IGADD on the need for an EWS have been held with Office National Affairs for Cereals (ONAC). ONAC is an autonomous management and finance group in the Ministry of Commerce charged with providing adequate food stocks to avoid shortages. To ONAC, early warning means having knowledge of world calamities that would effect prices and availability of imported food. The government food security strategy calls for a 90 day supply of food stuffs.

The Mayor of Djibouti is the head of the National Disaster Office. The most recent disaster was an unusual flooding of the city caused by the heaviest rains in 100 years (507 mm in 6 days). Lack of adequate drainage in the city led to displacement of the poorer population in low-lying areas, and pollution of the water supply with subsequent epidemics. The mayor had authority from the chief of the state to mobilize whatever assistance was needed from government agencies during this period. This was a unique situation because the problems were not those of food deficiency normally dealt with by an early warning system.

Available Data

Agricultural Data

There is virtually no agriculture in Djibouti other than small irrigated areas adjacent to the city that provide vegetables. What little data there are comes from the Ministry of Agriculture and agricultural cooperatives. Livestock are moved across all borders but no quantitative data are available.

Meteorological Data

The Meteorological Services Department is located at the airport and concentrates on aviation needs. All meteorological records collected in Djibouti are kept by the Climatological Department of the Ministry of Transportation.

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Records from 1934 to 1977 are stored at the Climatological Department. Data from 1900 to 1933 are stored in Paris. All climatological observations by the French military were stopped in 1977. By 1986, 24 rainfall stations had been reestablished with data recorded at military posts through cooperation between the military and the Climatological Department. The accuracy of the data is unknown.

Population Data

There are no reliable data on population. Estimates (1987 - 483,000; 1988 - 500,000) do not include refugee populations. The foreign population in Djibouti City is unknown but is estimated to be 12,000. Government officials desire an agricultural census and a household consumption survey.

Price Data

ONAC is the focal point for price data. The Statistics Department retains historical data on prices.

Nutrition and Health Data

Health data are not regularly collected. The Ministry of Health (MOH) states that malnutrition exists and birth weights are low. A government policy of free health services for all citizens, plus the presence of large refugee groups strain the MOH capabilities. Rural dispensaries have been established to discourage urban migration.

During 1987-1988, The Harvard Institute for International Development provided training to MOH in a range of topics including surveillance methods and use use of microcomputers for records management. Implementation of new practices based on the training did not take place.

Data Gaps

Little data are available for early warning. However, given Djibouti's lack of agriculture and its absolute necessity to import foodstuffs, there is no apparent need for a food security based early warning system.

Related Activities

Port Facilities

Because of Djibouti and Ethiopia's food import and export needs, the Port of Djibouti is large and efficiently operated. Storage deficiencies for both regular and relief food stuffs rapidly are being solved.

World Food Programme

The World Food Programme (WFP) moves relief food through the MOH to promote monitoring of Tuberculosis.

Meteorological Services Department

The Meteorological Services Department is charged with synoptic observations, air navigation control, and marine forecasting. The Department believes it can provide early warning services to Djibouti if given training and equipment.

Climatological Department

The Climatological Department is part of the Ministry of Transportation. It suffers from insufficient funding, staff, and training. Discussions with the French have resulted in a study of needs but, to date, funding has not been arranged.

Statistics Department

The Statistics Department is hampered by a lack of hard data on population and other facets of the economy.

ONAC

ONAC was established in 1978 as an autonomous management and finance organization under the Ministry of Commerce. ONAC's mission is to assure an adequate supply of foodstuffs through private sector initiatives. Procurement is made through numerous private sector sources to regulate stock levels. There is no government food strategy other than the goal of at least 90-day food stocks. Efforts are underway to subsidize supplies of sugar, rice, flour, and cooking oils.

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ISERST

This government research organization has meteorological stations which are not integrated with those in the Meteorological Services Department.

Ministry of Agriculture

The Ministry of Agriculture also has meteorological stations which do not share data with ISERST or the Meteorological Services Department.

Recommendations

1. A food security-based early warning system is not a high priority for Djibouti. The lack of agricultural production has led to the currently established import-based food supply system.

2. Cooperation with IGADD's early warning activities, especially those related to strengthening government data collection skills, is recommended.

3. The sharing of meteorological data among ISERST, the Meteorological Services Department and the Ministry of Agriculture should be established.

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APPENDIX B

ETHIOPIA COUNTRY REPORT

Description of National Early Warning System

The Ethiopian early warning system (EEWS) is part of the Relief and Rehabilitation Commission (RRC) that was established in 1976. The EEWS was begun in 1977 and has functioned since that time. The RRC Commissioner reports to the Council of Ministers. This post, and two of the three Deputy Commissioner posts, are currently vacant. The EEWS presently is guided by Melaku Ayalew, Acting Head.

The RRC is the oldest and likely the most mature EWS in the IGADD sub-region. Its structure and conceptual framework include a sophisticated understanding of EWS needs and processes. The RRC has gained much experience over the past 12 years, both in field operations and in analytic processes needed for an effective EWS. The RRC is responsible within the Ethiopian government for early warning and disaster relief and rehabilitation activities.

In carrying out EWS tasks, the RRC collaborates with other government ministries and many NGO's operating in the country. As a result, most of these agencies find the RRC to be their primary contact with the Ethiopian government.

Facilities

The RRC has extensive transportation facilities, with more than 1,000 vehicles. The RRC also has its own communications network as well as emergency food storage facilities. The food security reserve is operated by the RRC.

The RRC is equipped with modest data processing capabilities (four monochrome IBM XTs with hard disks, and an inoperable IBM-AT clone). It is using standard software (Word Perfect, dBase, Lotus, Quattro, and Condor), including some tailored programs in dBase III+ for data entry. Printing capabilities consist of Epson dot matrix printers (a Hewlett-Packard 7475A plotter is on order). Most data processing equipment was provided by CIDA under a project executed by UNICEF. Data processing staff consists of one recently added programmer and four data entry persons. An expatriate staff member provides part-time assistance in computer graphing and mapping. The staff is housed in the RRC's main office near the center of the capital city.

Analytic Capabilities

Data analysis in the RRC is done principally by the three section heads and the head of EWS, using intermediate analyses generated by computer as well as other non-quantitative information. The RRC makes effective use of non-quantitative information that it collects from other ministries, its own surveys, and paid informants.

Products

The RRC publishes periodic reports, typically quarterly, and monthly bulletins during the key growing seasons. An end-of-year synoptic report is issued usually in January. These are distributed widely within the Government and among donor agencies (over 250 copies distributed to central and local government entities, NGO's, foreign donors, libraries, etc.). They contain analyses of food stocks, weather/rainfall, crop situation and outlook, nutritional status and trends, and commodity prices. Data used in the reports are gleaned from a multitude of sources: other government ministries, NGO's, RRC's own surveys, and informants.

At times the government has been reluctant to release nutritional status information -- including data collected by the NGO's. This is understandable since nutritional status is not an early warning indicator but rather a sign that a crisis is already in progress. The policy, however, does not forward the spirit of free information exchange.

At present, products derived from satellite imagery are not integrated into the RRC's analysis or reporting. This is an obvious area for strengthening, particularly in view of Ethiopia's excellent new data communications line with Nairobi.

Staffing

Staffing of the RRC's EWS consists of the acting head, three section heads, 21 professionals and sub-professionals (including 16 nutritional field workers employed under a UNICEF project), plus clerical staff. Additional staff capability is contained in other non-EWS sections of the RRC that have a close relationship to early warning activities. For example, six former data entry persons in the EWS now are assigned to the Disaster Area Assessment Section. This 16 person unit carries out targeted field assessments whenever additional detailed information is required on a suspected problem area.

The RRC presently lacks a Commissioner (head of RRC) and two of the three Deputy Commissioners. These posts are important, especially with the RRC in competition with other parts of the government which would like to split-off all, or part, of the RRC's early warning responsibility.

Recently, the RRC has lost some of its professional and support staff, with shifts in personnel being made on very short notice. However, for the first time, the RRC is included in the Capital Budget (development budget), as well as the Recurring Budget. Current drafts of the overall national disaster strategy all imply a strengthening of the RRC and its EWS.

Communications

Communications within Ethiopia are good when compared to other countries in the sub-region. Microwave links make telephone service efficient within the capital city, and throughout much of the country. Single-side-band radio (SSB) links operated by the government and certain NGO's offer another means of communicating with remote locations. International phone service is excellent. In addition, Ethiopia has direct METEOSAT satellite reception and analysis facilities located at the Meteorology Department, as well as a new medium-speed (1200 baud) microwave data link with the Kenya Meteorological Department in Nairobi. This capability has the potential to receive LAC and GAC data from the AVHRR HRPT installation at the Kenya Meteorological Department. In theory, it could handle other data communications as well.

The Ethiopia National Meteorological Services Authority (NMSA) operates its own SSB net (3.2 and 5.2 mHz) that presently involves about 42 stations, with approximately 20 others to be installed soon. The equipment, provided by CIDA under its early warning assistance project, is providing daily two-way communications with these stations.

NATIONAL EWS USERS

Identification of Users

The RRC, with its dual responsibilities for disaster relief/ rehabilitation and early warning, is a primary user of the early warning information it generates. EWS data are used to target relief assistance to those most in need, assist with logistics planning, and aid in the formulation or modification of government disaster strategies. EWS data also are used by researchers and planners interested in famine-related phenomena.

EWS data produced by the RRC are distributed widely and used by branches of the government, NGO's, and foreign donor agencies to help make decisions on relief, rehabilitation and development activities.

At the senior government level, a principal consumer of RRC's EWS data will be the proposed inter-ministerial council (IMC) on disaster preparedness and planning (the RRC will likely serve as the secretariat to the IMC). This council, to be chaired by the Prime Minister, is the body with responsibility for formulating strategies and programs that address Ethiopia's disaster needs, as well as coordinating all line ministries involved in disaster preparedness and planning.

Information Needs of Key Users

The key users in Ethiopia need the earliest possible warning of developing food security crises resulting from either natural or man-made causes. Information is needed both for new and ongoing crises related to Ethiopia's large structural food deficit. Also important is early warning information on medical and public health crises, such as the recent meningitis outbreak.

The RRC is responsible for conducting and coordinating relief activities and needs information on a scale sufficient to carry out directed feeding programs (operating transportation networks, food storage locations and amounts available, operating communications networks, weather forecasts, non-food relief supply locations and quantities). These needs must consider the capabilities and resources of the many NGO's operating in Ethiopia, those of the major donor nations, and those of the Ethiopian government.

AVAILABLE DATA

Types of Data

Because of its relatively long experience in early warning, Ethiopia has developed a diversity of data bases. These include:

- Meteorological data from an extensive network of stations
- METEOSAT satellite data
- Meteorological data received from the Regional Forecast Center of the Kenya Meteorological Department and from Darmstadt, West Germany
- Crop area estimates received from the Ministry of Agriculture (MOA)
- Crop outlook estimates from MOA and RRC surveys
- Water balance data derived from computer modeling (NMSA)

- Nutrition surveillance data from NGO's and RRC surveys
- Market price and quantity information from CSA, RRC - food stock situation reports, donors, and NGO's
- Migration, health, family purchasing power and related information from RRC surveys (qualitative information)
- AVHRR/GAC-derived photo products from Nairobi (FAO/IGADD via regional remote sensing facility)

In addition, experimental use of water balance models is underway, with estimates being made by crop and by station.

The scale and coverage of data available for early warning analysis in Ethiopia varies widely. Satellite data from METEOSAT and AVHRR provide the only synoptic time-series information. However, the AVHRR products are not integrated into the early warning assessment process, and there are no digital processing or GIS capabilities to use these products.

Rainfall and other meteorological observations covers most of the country. Also available are market prices (including livestock), nutrition, health, migration, food stocks, and similar data. However, the coverage is never national in scope, and is often concentrated on areas believed (from historical analysis) to be most vulnerable. Current political realities prohibit the acquisition of detailed information for large areas in the northern part of the country that are traditionally food-deficit, and consequently, vulnerable areas.

The RRC and other parts of government have made efforts to expand their data coverage, both by stimulating new activities (such as the RRC's nutrition surveillance program) and modifying old programs (such as using existing networks of civil servants to gather needed information). These efforts have resulted in some improvement, but as yet are judged insufficient to the need. As a result, the newly proposed national disaster prevention and preparedness strategy, it seems likely that data acquisition systems will be further strengthened.

A particular problem for the RRC's EWS has been a lack of cooperation received from other ministries. This problem stems from both institutional rivalries and the traditional lack of information sharing among separate organizational entities in the country. The problem is recognized by the Office of National Coordination and Central Planning (ONCCP) and is being specifically addressed by the proposed new strategy and associated administrative structures.

Reliability

The reliability of data available for early warning analysis varies considerably. Steps have been and are being taken to improve reliability (such as RRC's establishment of guidelines for the collection of nutritional surveillance data). Much of the RRC's information is qualitative in nature. They believe, however, that this information is of key importance in their convergence-of-evidence approach to early warning assessment and prediction.

Data Gaps

The most evident data gap is the absence of AVHRR data for routine surveillance and analysis. AVHRR LAC data soon may be available regularly in Nairobi and could be made available in Addis via the new medium-speed microwave data link between these two capitals. Effective use of the data by the RRC, the FIS, and the NMSA would depend on the acquisition of appropriate facilities, training in AVHRR data analysis, and on GIS techniques for integrating this information with other important data streams for early warning.

Gaps occur in virtually all existing data streams because of incomplete geographic coverage. This is a problem to be addressed incrementally as experience accumulates and as additional resources are made available.

COMPLEMENTARY PROGRAMS AND ACTIVITIES

Early warning analysis also is carried out by a temporary activity located in the Central Statistical Authority. This is the Food Information System (FIS) supported by FAO, under which one Dutch national and a staff of 2-3 persons analyze available data and generate food situation reports and bulletins. This year-old activity in some ways duplicates the RRC EWS, but with important exceptions:

1. FIS attempts to take a more quantitative approach to data analysis; as a result its detailed reports are somewhat less timely than those of the RRC but appear to be high quality;

2. FIS reports are not now as widely available as RRC reports; and

3. At present the FIS does not appear to be an institution-building activity.

FIS computer data bases are not shared easily since they are processed on an old Hewlett-Packard computer that is not IBM-compatible. This problem could be overcome by moving the analysis to an IBM compatible machine and through the use of standard software packages. Despite the evident tensions between the FIS and the RRC, the FIS may constitute, for the moment, healthy competition.

FAO has put forward a draft proposal that would extend the current FIS activity (with UNDP funding) and would set up a food information unit within the Central Statistical Authority (CSA). FIS uses essentially the same data sources as the RRC. The FAO proposal has elicited some consternation on the part of the Ethiopian government. The government is in the process of deciding definitively who is to have early warning responsibilities in the future. As of July 1, 1989, it appears that RRC will retain the primary responsibility for early warning, but that the establishment of a Food Information Unit in CSA may go ahead.

The National Meteorological Service Agency (NMSA) has a full range of activities important to early warning, including the computation of soil-water balance by crop type.

Many of the NGO's operate their own "early warning systems" by virtue of their surveillance and operational activities in the field. Their information is shared with the RRC through the Christian Relief and Development Association (CRDA) and direct contact. Of these, perhaps the nutrition surveillance program of Save the Children (UK) is the most important in view of its geographic coverage.

The Ethiopian Nutrition Institute (ENI) of the Ministry of Health, provides technical assistance to the RRC and others in the collection of nutritional information.

The major donor agencies sometimes conduct their own analyses. FAO performs an annual food assessment. USAID makes a similar assessment using a food balance sheet technique. A.I.D.'s Famine Early Warning System (FEWS) activity covers Ethiopia and uses information obtained from sources including routine AVHRR coverage.

RECOMMENDATIONS

IGADD Initiatives

The foremost need for strengthening Ethiopia's early warning system is a definitive decision by the government on an overall strategy, roles, responsibilities, resources, and necessary administrative arrangements.

IGADD can play an important role to strengthen the existing early warning apparatus in Ethiopia. Six areas appear to be appropriate:

1. Augment available data for EWS by building an indigenous capability to analyze and integrate AVHRR/LAC data.

2. Strengthen RRC's computer data storage, processing and analysis capability, both at the national and regional (provincial) level.

3. Foster the standardization of methods of data collection and analysis among the several Ethiopian agencies involved in EWS, and within the IGADD sub-region.

4. Arrange for appropriate technical assistance and training needed to improve the capabilities of the RRC: use of computer methods (including GIS), report preparation, and graphics.

5. Working with the NMSA and other government entities to improve information and data exchange capabilities internationally, using modern computer and telecommunications methods.

6. Sponsor a detailed vulnerability assessment geared to resource-based monitoring and famine early warning.

Each of these recommended areas of assistance is discussed in more detail in the following sections.

Recommendation #1 : AVHRR Satellite Data

The RRC and the CSA/FIS have begun recently to receive photo products from the FAO/IGADD remote sensing project in Nairobi. At present, staff in both organizations lack training to use these data. Interpretation is particularly difficult because of: (1) Ethiopia's many micro-climates, (2) the present small-scale character of the photos being received, and (3) the absence of historical records for baseline comparisons.

The NMSA already has an image analysis capability for METEOSAT images that it directly receives. One analyst has been trained by NOAA in Missouri. The NMSA also has a new medium-speed (1200 baud) microwave data link with the Kenya Meteorological Department that could be used to receive vegetation index data once its HRPT is in full operation. NMSA has a Vax 730 computer. In anticipation of this event, appropriate hardware (microcomputers and UPS units), software (such as IDA and Atlas*Graphics), and training should begin immediately. This initiative is important to upgrade analysis and reporting capabilities of the RRC.

Recommendation #2: Strengthening Data Processing Capability

The efficient operation of an early warning system depends on the timely receipt and expeditious processing of needed information. Microcomputers offer an inexpensive means to speed up the acquisition and processing of such information. They also invoke a discipline that is useful to the overall analysis system.

The RRC is making use of computer processing but there is much room for improvement. Computers are not used routinely at the regional level for the collation of field data and transmission to Addis. With a modest investment in hardware, software, and training, they could make a strong contribution toward improving EWS capability in the country.

IGADD can help locate a donor for 80286- and 80386-based computers, together with associated uninterruptible power supplies (UPS), software, supplies, and training. Computers of this nature are needed at the regional level to collate and analyze regional data. Computers also are needed in Addis to strengthen RRC's analytical capabilities, including AVHRR analysis and GIS technology.

Supplies for data processing are extremely important, since Ethiopia has little ability for direct acquisition. An inventory of computer paper, diskettes, plotter-pens and ribbons, printer-ribbons, and all associated computer peripherals should be provided.

Special attention should be paid to the UPS units, since power outages and line contamination are a problem. The units should be on-line continuously and run from large batteries -- recharged whenever line current is available.

IGADD should sponsor inter-regional workshops on the use of computers for early warning data analysis. National EWS staff should be trained to use software packages selected for their suitability to early warning work.

Recommendation #3: Standardization

IGADD could foster the development of early warning systems in Ethiopia and across the region by sponsoring seminars and workshops concerned with technical aspects of EWS development. These could cover:

- Indicators - selection, import, interpretation. In this topic, the Ethiopia EWS can help the other IGADD countries understand their strategy for indicator use.
- Surveillance methodologies - low-cost approaches. This is also an area where Ethiopia can provide leadership to the other countries in the sub-region.
- Use of satellite data - processing, interpretation.
- GIS (geographic information systems) - approaches, hardware, software, training.
- Computer methods - including data base management and selection of hardware and software useful for EWS.

The purpose of these seminars and workshops would be to promote sharing of data, methodologies, and experiences between Ethiopia and other member countries.

Recommendation #4: Reporting

The development of succinct, attractive, substantive reports that communicate the desired messages is not an easy task. It is especially difficult when working with limited resources and very short deadlines. Yet if early warning systems are to be effective, they must convey the results of their analyses in a most efficient fashion to stimulate the desired responses of interested organizations. Recent advances in computer graphics, mapping, and GIS offer powerful tools to enhance EWS products.

In Ethiopia, progress has been made by the RRC to improve the information-transmittal capability of its periodic reports. However, there remains substantial room for further improvement. IGADD could, through the sponsorship of national or intra-regional workshops, contribute to the strengthening of analysis and reporting capabilities. The content of these workshops might include:

- the convergence-of-evidence approach: working with "hard" and "soft" data
- computer-assisted analytical methods
- computer-assisted graphics and desktop publishing for early warning
- integration of satellite surveillance information

Workshops could be held in-country (to maximize the number of persons who might benefit), or regionally (to benefit those who have the most immediate need). These workshops could be developed immediately, since the hardware/software needs to improve reporting will require only a modest upgrading.

Recommendation #5: Sub-regional and Inter-regional Data Exchange

Ethiopia may already have the necessary technical ability to facilitate data exchange within the sub-region. The NMSA has a medium-speed microwave data link with the Kenya Meteorological Department. This is a high-grade computer-controlled system capable of two-way data transfer. At present, it is used only for meteorological data. It has the potential, however, to receive and transmit other data useful to early warning, including:

- NDVI values derived from AVHRR/LAC data
- non-satellite derived data (i.e., rainfall)
- documents, bulletins, worksheet data

IGADD could encourage the use of this facility to enhance Ethiopia's early warning capability and to demonstrate to other IGADD member states the viability and utility of such transfers.

Recommendation #6: Vulnerability Study

Ethiopia's EWS is probably the most sophisticated and experienced in the region in terms of longevity and testing in actual small- and large-scale famine situations. The RRC can increase their capabilities even more by undertaking a detailed vulnerability analysis that could serve as a baseline for both early warning needs and natural resource monitoring. A number of data already exist, some as yet unexploited. High-resolution satellite imagery could be used to establish baseline information on soils, land use, crop area, and other geographic characteristics. A sampling-frame could then be drawn from the imagery which would be appropriate for continuous monitoring of vegetation and cropping trends via low-cost AVHRR imagery. As a result, continuous synoptic coverage of the country could be provided. Using GIS technology, the physical data could be merged with socio-economic, nutritional, infrastructure, and other data, helping to improve the quality of early warning analyses and providing a basis for development planning by other ministries.

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Attachment 1 - Brief Note on Non-Governmental Agencies in Ethiopia

CRDA (Christian Relief and Development Association)

CRDA is an indigenous Ethiopian institution that serves as the coordinating body for 64 NGO's operating in the country. Its Executive Director, Brother Augustine O'Keeffe -- an Irish national -- has been in Ethiopia for 17 years. His organization is very important to the many NGO's since, through CRDA, they are able to speak with the government as one powerful voice.

CRDA believes that the RRC is doing a good job, both with early warning and in relief/rehabilitation activities. They were effective in the 1987-88 famine crisis, helping to avoid the formation of camps of displaced persons seeking food (as they did in the 1984-85 famine). This was because of the timely warning, the prompt response by indigenous institutions, NGO's, and foreign donors, and an in-country emergency stock of 92 tons of food for immediate distribution to the most needy. Roughly five million persons were at-risk in the most recent crisis, compared with seven to ten million during the 1984-85 famine.

CRDA coordinates the work of 64 NGO's active in the country. All of these NGO's are represented on CRDA's board, which holds monthly meetings. An Executive Committee, consisting of 12 persons elected from the NGO members, provides overall guidance.

CRDA also runs a small grants program, using resources donated from charities that do not have direct representation in Ethiopia. The NGO's submit project proposals for review and approval by CRDA.

NGO's in Ethiopia carry-out a wide array of relief and development activities ranging from feeding programs to community development activities, primary education, medical service provision, public health action programs (key players in the recent meningitis epidemic), transportion, and agriculture.

Communications with the NGO's is effected through their offices in Addis. A few (World Vision, Japan International Development Agency, KHCDP, Norwegian Church Aid) have their own SSB radio links, but most rely on the telephone service or travelers to Addis.

Attachment 2 - List of Publications Reviewed

RRC

"The Early Warning System - Ethiopia (Description of its Major Activities and Technical Basis), May 1985.

"Early Warning System Report: 1985 Meher (Main) Crop Season Synoptic and 1986 Food Supply Prospect Final Report", Jan 1986.

"Early Warning System Report: Food Supply Situation of the Pastoral Areas of Sidamo and Gamo Gofa Regions", February 1985.

"Early Warning System Report: 1987 Belg Production", July 1987.

"Early Warning System Monthly Report", May 1989.

"Early Warning System Monthly Report", August 1988.

"The Famine Early Warning System", Melaku Ayalew, December 1988.

Numerous statistical reports, questionnaires, and computer programs of the RRC also were reviewed.

CSA/Food Information System

"Report on 1988/89 Crops, Weather, and Food Situation (Food Information System Project)", Central Statistical Authority, March 1989.

Christian Relief and Development Association (CRDA)

"Directory of Member Churches and Agencies", CRDA, 1989. This is a helpful volume that details the programs and structure of each of the 64 NGO's.

A.I.D. - Office of Foreign Disaster Assistance

Chapter on Ethiopia (65pp of excellent background data).

Office of the National Committee for Central Planning (ONCCP)

"A National Disaster Prevention and Preparedness Strategy for Ethiopia", (Revised First Draft), ONCCP, June 1989.

United Nations Development Program (UNDP)

"Brief on the National Disaster Prevention and Preparedness Strategy for Ethiopia", UNDP, undated.

International Development Support Center

"Evaluation of the Food and Nutrition Surveillance Project - Ethiopia", a draft report prepared for the Canadian International Development Agency (CIDA), May 1989.

Food and Agriculture Organization

A mid-term report on the Food Information System was reviewed. It contains recommendations for an extension of the FIS and the establishment of a Food Information Unit within the Central Statistical Authority (UNDP funding).

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APPENDIX C

KENYA COUNTRY REPORT

Overview of Kenya's Early Warning System

Kenya's technical capabilities for early warning is in many ways the most advanced of any of the member states in the IGADD region. Data collection methodologies, data archiving, analysis, and reporting systems are relatively advanced. In the use of geographic information systems (GIS), Kenya is the most sophisticated, especially concerning natural resource monitoring and the integration of remote sensing data, including aerial photography.

However, there is no central authority ordained to perform the early warning task and the overall EWS approach in Kenya suffers from an unbalanced emphasis on physical data, with little attention given to the human side of early warning: socio-economic, demographic, and health information.

In most years, Kenya produces sufficient food to meet internal needs and could, with appropriate policy incentives, produce a healthy surplus. Yet there remain substantial numbers of disadvantaged people in the country who are potentially at-risk of famine. These are the landless laborers, herders, and small-scale subsistence farmers who are without substantial resources to weather extended periods of drought and unemployment. These vulnerable populations have been identified as a result of past experiences in lean years. No systematic vulnerability studies have been done yet for Kenya, though much of the groundwork has been laid. Included are: the delineation of agro-climatic zones; soils mapping; high resolution satellite imagery covering the central highlands and substantial portions of the rangelands; sustained aerial photography to estimate cropped area and yield; and livestock numbers and locations. Much of these data is presently being captured in a GIS operated by the Department of Resource Surveys and Remote Sensing (DRSRS). This work is excellent preparation for a full vulnerability study, and for analysis needed to identify data gaps.

On the matter of a central authority for EWS, Kenya apparently prefers to continue the present system of a decentralized approach, i.e., with several ministries responsible for data collection, analysis, and estimates within their particular domains. The results of these separate operations are then compared and debated in a series of inter-ministerial meetings chaired by the Office of the President, ultimately deciding on the "official" figures. While this process offers opportunity for political judgments to cloud "objective" assessments, the facts -- as seen by the several ministries -- are made known to the highest level of government.

Description of National Early Warning System

Institutional Structure

Kenya has no single organization responsible for famine early warning activities. Rather, several ministries and governmental bodies each collect and process information needed for early warning. Whenever it appears that a serious problem is unfolding, these ministries and bodies are brought together under the chairmanship of the Office of the President to compare information and decide both the nature and extent of the problem, and possible corrective actions. Because of Kenya's favorable food supply position, good infrastructure and communications networks, and good access to foreign credits and foreign markets, this ad hoc approach to food security and early warning may be appropriate. For purposes of the following discussion, Kenya's national EWS will be considered to be a composite of all the different organizations that contribute to early warning knowledge in the country.

Facilities

Together, Kenya's EWS facilities are extensive. At least seven national organizations play a key role:

- DRSRS Department of Resource Surveys and Remote Sensing, (formerly Kenya Rangeland Ecological Monitoring Unit)
- CBS Central Bureau of Statistics
- MOA Ministry of Agriculture
- NCPB National Cereals and Produce Board
- KMD Kenya Meteorological Department
- OP Office of the President
- MOH Ministry of Health

At least four regional and international organizations are carrying out work related to early warning. These organizations also are both generating and using early warning products:

- RCSSMRS Regional Remote Sensing Center
- DLCO Desert Locust Control Organization

- UNEP United Nations Environmental Program

- ICIPE International Insect Center

Products

The specified organizations produce a full range of products appropriate to early warning, including:

- estimates of crop area, crop yield, and production
- crop monitoring products
- long-range, short-range weather predictions
- current and historical meteorological data
- grain stocks and availability
- nutrition surveillance reports
- market price analyses
- livestock monitoring analyses
- population estimates
- remote sensing products from METEOSAT, AVHRR, LANDSAT, and SPOT
- natural resources monitoring analyses

Staffing

Total staffing of those engaged in early warning and data collection likely exceeds 1,000 people. DRSRS, alone, has a staff of approximately 350 persons. The quality of professional staff is very good with numerous professionals of high caliber engaged in the planning and management of data collection, analysis, and reporting activities.

Communications

Kenya has a good communications infrastructure. There is a good road and rail network, excellent international air, sea, and telecommunications networks, good internal telephone, telex, and radio networks, including a good microwave-based voice and data capability.

National EWS Users

Identification of Users

The primary user of Kenya's EWS information in an emergency is the Office of the President. Other primary users are ministries that are assigned responsibility for disaster mitigation and rehabilitation work by the Office of the President. Each government unit responsible for data collection uses the collected information for its programs and activities, as well as contribute to the larger early warning knowledge pool.

Information Needs of Key Users

Kenya's EWS users need up-to-date information on emerging food security problems covering the usual range of indicators:

- drought, floods, pests, other natural threats
- unstable food and livestock prices
- extent of crop damage
- depletion of on-farm stocks
- unusual population movements (refugees, displaced persons)

Because of Kenya's good crop production capacity for export, it should be cognizant of developing food security problems in surrounding countries. Early identification of specific commodity needs would permit Kenyan farmers to grow additional food specifically to meet a future external demand.

Description of Relevant Data

Types of Available Data

Crop Yield, Crop Area, Crop Production - Four organizations estimate crop parameters: NCPB, CBS, MOA, and DRSRS, according to the following protocols.

NCPB carries out maize yield surveys annually. The country is divided into nine ecological zones; 30-40 primary sampling units (PSI) are selected in each zone. From each of these PSI's, four farms are selected randomly. Cob counts are done along diagonals in the each sampled field. Cob measurements (total cob size) and cob population data are collected to estimate cob population per hectare and, therefore, cob volume/weight. The entire country is covered over a 6-7 month period (due to climate diversity). Information is collected only for the long rains. NCPB's produce yield estimates to plug into the production equation (MOA, CBS, and DRSRS each provide area estimates).

CBS has carried out crop surveys four times per year (Dec-Jan, Mar-Apr, July-Aug, Sept-Oct) since 1976. A total of 24 clusters in each of 32 districts, each involving 10-15 respondents serves as the sampling population. Data are processed on microcomputers and are not released. Each quarter, basis, six organizations meet through the Office of the President to decide on figures (CBS, KMD, NCPB, OP, DRSRS, MOA). Problems become the responsibility of OP, Treasury, and Ministry of Planning. After the Kenya census is completed this year, 130 microcomputers will be installed in the districts to assist in data analysis.

MOA Crops Division estimates crop area and yield using its extensive network of field staff. Protocols for data collection were not identified.

DRSRS estimates crop area and yield (hence, crop production) through remote sensing techniques, using mostly aerial photography transects flown over an identified sampling frame. Airborne radiometers are employed to collect data used in a regression model to estimate maize yield. This equation was developed experimentally by DRSRS.

Market Price Data - CBS and MOA collect market price data. MOA collects marketing data monthly, using a network of agriculture marketing officers located at the district level. All crops are included, as are all inputs: fertilizer, implements, and seed. CBS uses a staff of 70 to collect market data, the quality of which is judged to be excellent. A key difficulty in handling market data is the variance in measurements used throughout the country. CBS attempts to circumvent the problem by using hand scales to measure the weight of items purchased and asking people leaving markets how much they paid for the item being sampled. The MOA has had computerized data on weekly market prices since 1982. The CBS approach is judged to be more scientific (use of sample surveys) while the MOA approach is more qualitative but meets MOA needs.

Food Stocks - The NCPB and MOA each provide data on food stocks. NCPB is responsible for purchasing food in country and marketing it. MOA is responsible for monitoring NCPB's stock levels around the country, as well as estimating on-farm storage.

Nutrition Data - The MOH and CBS, working through an inter-ministerial committee, carry out national nutrition surveys every four years. The most recent survey was taken in 1987. These studies include weight-for-height measurements of children under five, education level of mothers, household food and water supply, migration, and other socio-economic information. A Child Health and Nutrition Information System has been in operation since 1985, assisted by Tulane University (New Orleans, Lousiana) and Thunder and Associates (Nairobi). This system covers people attending health clinics. Data come from all districts in the country on all children under five attending clinics. In two districts, pilot community-based growth monitoring activities are underway. These activities involve local health committees that have taken an active part in the work, even to the point of developing and printing their own data collection forms. The MOH also is working with the Ministry of Education on a child weight program in the schools. Scales and simple equipment are needed by cooperating NGO's and other organizations to improve the value of this work.

Meteorological and Climatic Data - These are the province of the Kenya Meteorological Department (KMD). The KMD has an excellent national and regional capability, the latter because of Kenya's regional responsibility for marine and aircraft weather information. The KMD has a METEOSAT PDUS capability for real time data reception. The KMD also has a new HRPT for reception of AVHRR LAC data. This is now in a test mode; additional software is required to make the installation fully functional. A 1200-baud microwave data link with Addis recently has been made operational. It presently is used to exchange rainfall and other meteorological data.

The KMD has numerous telecommunications links with countries in the region and with Europe. These links are needed to fulfill its regional responsibility for air and sea navigation (with weather forecasts covering from 55 north to 30 south latitude.

The KMD has been issuing long-range crop forecasts for the base four years. These forecasts, issued in November or December, thus far have proven to be accurate.

The KMD has an archive of historical rainfall data, some in machine readable form. It is unclear whether daily rainfall data are available prior to 1950, though 10-day and monthly aggregates apparently are available. It is not easy to obtain these data from KMD.

Natural Resource Monitoring - DRSRS (formerly KREMU) was established following the 1973-74 drought, with financing by CIDA, World Bank, and GOK. It has an ambitious aerial photography program, satellite data program, and is beginning to use a geographic information system (GIS). Livestock and wildlife have been monitored annually since 1977, using a 5% national sample. Transects are flown every 5km, with the sample consisting of a strip about 300 meters wide. Counts are made by two observers using a tape recorder. Whenever more than 10 animals are sighted, photographs are taken for later counting. These surveys are completed for every wet and dry season. DRSRS's Ground Survey Section is responsible for field verification for aerial and satellite remote sensing, mainly for rangeland species, density, height, soil conditions, and moisture. In addition, a national vegetation map will be interpreted from SPOT imagery. It is hoped that this can be completed in 3-4 years and can be used as a base to calibrate AVHRR data.

Other GOK ministries are beginning to ask DRSRS for special analyses and GIS products (e.g., a recent request to identify appropriate areas in Kenya's national parks for relocation of threatened rhino populations).

Scale and Coverage

Scale and coverage vary widely according to type of data being collected. Inferences may be drawn from the above discussion.

Reliability

Kenya's EWS data appear to be reasonably complete and reliable, particularly when compared to other data in the region. Demographic data, including both human and animal populations, are unmatched in Africa. Market price data, crop, and meteorological data also are judged to be excellent.

Data Gaps

The most evident gap in Kenya's early warning data flow is the absence of AVHRR data. The potential for filling this gap is good, given the recent installation of an HRPT at the KMD. The addition of the ARTEMIS historical AVHRR-based vegetation index data would be advantageous.

Complementary Programs and Activities

RCSSMRS - The Regional Center for Services in Surveying, Mapping and Remote Sensing, supported by USAID, the French Government, the Japanese Government, and by member states in Africa, is located near Nairobi. It is intended to serve as a center-of-excellence in the use of remote-sensing technologies, oriented towards the development needs of Africa.

Over the past 10 years of its existence the RCSSMRS has developed an impressive capability to produce high-quality photographic products from slides and negatives (generated elsewhere) and a good image analysis capability based on manual photo interpretation techniques. It has improved its record of obtaining pledges from supporting members, and has carried out several large-scale projects on contract. The center also has an agreement with IGADD to assist in the area of famine early warning.

Nevertheless, it appears that the center is presently not in the technical position to have significant input for an operational IGADD EWS. To better serve the sub-region and IGADD's early warning initiatives, it needs to:

- Become production oriented
- Develop a capacity to provide custom computer data products
- Improve program and financial management
- Develop a master plan and implementation strategy that includes technology for EWS
- Resolve the Center's unreliable electrical power problems through installation of a UPS and back-up power supply
- Develop both image processing and GIS capabilities and expertise
- Make arrangements with the Kenya Meteorological Department for the regular receipt and use of AVHRR/LAC data

UNEP - The United Nations Environment Program is pursuing an Africa regional program of seeding GIS technology, using equipment donated by IBM. Individuals are to be trained and equipped at RCSSMRS under UNEP sponsorship. Following the training, the participants will return to their organizations with microcomputer-based GIS equipment and software.

Recommendations

IGADD Initiatives

Kenya's EWS needs are relatively modest compared to other countries in the sub-region. They consist chiefly of:

- Define organizational responsibilities for early warning
- Additional microcomputer equipment, software, and training for the MOA
- Additional technical support and software for the Kenya Meteorological Department and DRSRS in the use of AVHRR data.
- Provide direction to establish a convergence-of-evidence analysis capability at the data level rather than the analysis level.

Kenya has a significant role to play in assisting other countries in the IGADD region in such areas as GIS applications and remote sensing techniques using aircraft platforms (DRSRS has both capabilities, although its mandate is not regional).

IGADD potentially has a larger role to play with RCSSMRS. This center is a logical regional organization to become the AVHRR center-of-excellence, i.e., to provide training, software, and products to IGADD member states. Achieving this status will require substantial inputs of technical assistance, equipment, software, and training for the RCSSMRS itself. Also needed will be political maneuvering within the region and vis-a-vis the bilateral and multilateral organizations active in early warning and remote sensing.

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APPENDIX D

Somali Democratic Republic
Country Report

Description of Somalia Food Early Warning System

The Somalia Food Early Warning System (FEWS) was established within the Ministry of Agriculture (MOA) in the late-1970's. The goal was to improve food security in Somalia. The purpose of the Somalia FEWS is to determine if food assistance is needed. In FEWS, "food security" means assuring that there is enough food to cover the requirements of the population for a reasonable time ahead. "Food Early Warning" means the continuous assessment of the food balance and predicting its components for several months ahead. Somali food components consist of existing stocks, exports, imports, indigenous production and consumption.

Institutional Structure

The Early Warning Department is a Directorate within the Ministry of Agriculture. The Early Warning Department Director also serves as the FEWS Project co-manager. The Department is made up of three technical services and two centers. The departments and their responsibilities include:

Agroclimatological Service
Responsible for all meteorology matters within the MOA
Provides meteorological/climatological inputs into the Food Outlook reports
Responsible for national network of 23 meteorological stations

Agricultural Service
Monitor crop development in the country
Estimate crop area for each agricultural season
Estimate total food crop production
Maintain network of observers in the agricultural areas of Somalia

Agroeconomic Service
Responsible for the assessment of the food balance situation
Cooperate with appropriate agencies to provide continuous monitoring of food imports and exports
Monitor Somali food stocks

Computer Center
Responsible for the processing of meteorological data
Supervise and maintain the Department's computer facilities

Remote Sensing Center

This group is planned but is not yet operational. Planned tasks include:

- Estimate crop areas for each agricultural season
- Use AVHRR-NDVI imagery to monitor biomass
- Operate METEOSAT station

Donor Inputs

The "Food Early Warning System" project was started in 1980 with support from the Federal Republic of Germany. Funding was provided from 1980 to 1984.

The European Economic Commission (EEC) is providing funding for the project for the 1985-1990 period. The goal of the EEC project is to allow the Somali Government to have advance information on basic food crop production, the rangeland situation, and the distribution, marketing and consumption of food-stuffs to take suitable and timely remedial action in the event of imbalance.

The EEC assistance is approximately $1 million per year. The assistance includes technical assistance staff, computers, vehicles, radios, and supplies. In addition to the main FEWS financial and technical support, several related projects are either underway or planned that will further expand the capabilities of FEWS.

Discussions are underway with the EEC to establish a long-term biomass monitoring project. The project will have a remote sensing component using both Landsat and AVHRR imagery. The original project document recommended use of a geographic information system. However, FEWS and MOA decided it was premature to incorporate GIS technology.

FAO is providing modest assistance for establishing a Remote Sensing Center in the Early Warning Department. The assistance is short-term and limited to basic remote sensing training and provision of basic equipment.

The British Overseas Development Administration (ODA), through the University of Reading (Reading, England), is providing a METEOSAT Primary Data Users Station (PDUS) and eight automated rain gauges for rainfall monitoring. The station is expected to be operational by November, 1989. The ODA also provided a Book Grant to allow FEWS to gather historical meteorological records.

Computer Hardware and Software

Hardware

IBM AT Personal Computers (2) with:
- EGA color displays
- 20 MB hard drives

Tape backup system
Dot matrix printers (2)
Power conditioning
- Transformer
- Voltage regulator
- Uninterruptible power supply

Software

PC-DOS, Version 3.2
CLICOM (climate data management)
DATAEASE data base management system - used for CLICOM
GRAFMATIC - comprehensive graphics system used for CLICOM
Norton Editor - used for CLICOM
Fortran - programming
Fortran Utilities - programming
Basic - programming
Norton Utilities - system and disk utilities
Microsoft Word, Version 3 - word processing
Lotus 1-2-3 - spreadsheet
Paradox - data base management
INSTAT - statistical analysis (University of Reading)
SPSS-PC Plus - statistical analysis
SPSS-PC Trends - time series analysis
Microsoft Chart - presentation graphics
3-D Graphics - presentation graphics for Lotus 1-2-2
Graph-in-the-Box - presentation graphics for SPSS-PC

Analytic Models

Frere-Popov Water Balance Model - uses the INSTAT software package developed by the University of Reading.
Food Requirements Model
Food Balance Sheets

Other Facilities

Single Side Band Radios - approximately 16 were installed in 1987. Many are experiencing maintenance problems. For example, in the northern part of Somalia, only one of five works.

Remote Sensing Analysis Equipment
- Mirror stereoscopes (2)
- Light table
- Reflecting projection system
- Diazo reproduction machine

Vehicles
- Land Rovers (5)
- Volkswagen Sedan

Planned Equipment

Meteosat Primary Data Users Station (PDUS)
- Antenna
- Receiver
- Microcomputers (2)

Automatic Rainfall Stations (8)

Products

FEWS has an active publications program that includes three series of reports or bulletins.

"Food Outlooks" are prepared following the end of each of the two annual growing seasons. A third report summarizing both seasons is published at the end of the calendar year. They provide detailed information on climatological, agricultural and food balance situation, predictions of future trends, and advise on any corrective action necessary in the case of imbalance. While the reports are comprehensive, they contain little cross-sectoral analysis. Contents include:

- Summary for assessment period
- Crop Situation
  - General summary of production
  - Region-by-region summary of previous season(s)
- Food Balance Situation
  - Imports
  - Stocks
  - Food balance for assessment period
- Market conditions
- Rainfall Situation

FEWS publishes a "Ten Day Early Warning Information Bulletin" in both Somali and English throughout the year. It provides information on rainfall, river flow, agricultural situation (crop condition, pests, and rangeland conditions), and prices. Once a month, it contains retail prices, imports, and a food balance report. Bulletins are sent to over 50 addresses (all GOS ministries, international donors, embassies, and others). Typically, bulletins are distributed approximately four days following the end of the reporting period. The bulletins, as with the Food Outlook reports, lack cross-sectoral analysis.

A series of "Technical Reports" have been prepared covering both data and methods used in FEWS.

Numbers 1-10 provide all daily, monthly, and annual rainfall data for the entire country.
Number 11 - topic unknown
Number 12 - 200-page study titled "The Agroclimatology of Somalia"
Number 13 - "Manual on Methodology and Work Organization of the Agricultural Service"
Number 14 - "Agrometeorological Crop Yield Assessment in Somalia"

Staffing

There are approximately 64 MOA staff members plus 3 expatriate experts provided by the EEC. One additional expert assisted FEWS until late 1988.

Headquarters Staff in Mogadishu
- Administration - 10 people (includes support staff)
- Agricultural Service - 3 people
- Agrometeorological Service - 8 people
- Agroeconomic Service - 3 people
- Computer Center - 2 people

Expert Staff - originally, four experts were with the department
- Team Leader (agricultural economist)
- Agriculturalist
- Agricultural Economist - will lose this position this year
- Agroclimatologist - left program in late-1988

Field Observers
- Agrometeorolgy Observers - 44 people (two at each station
- Part-time Micro Rainfall Station Observers - part time people at each of 57 stations.

National EWS Users

The FEWS reports and bulletins are distributed to approximately 50 organizations within the GOS and international donor community. The extent to which this group uses the information received is unknown. The organizations contacted stated that the reports were useful.

The key user in Somalia should be the Ministry of Interior (MOI). Somalia national emergencies are declared by the MOI and it is supposed to lead relief efforts. However, according to those interviewed, it has not been active.

The Drought Emergency Group is an ad hoc body comprised of representatives from the World Food Programme, UNDP, and the Ministries of Interior, Health, Transportation, and Agriculture. It convenes during declared emergencies to activate appropriate relief efforts.

The U.N. World Food Programme (WFP) chairs a monthly donors meeting to discuss food situation and determine if food assistance is needed. Generally, WFP does not get involved in local emergencies. The director of WFP believes the information published by FEWS is a valuable source of agricultural and rainfall information.

Information Needs of Key Users

Simply, there is a need for advanced warning of the location and magnitude of populations at risk to a food emergency.

Description of Relevant Data

Available Data

FEWS has established both primary and secondary data collection programs to satisfy their real-time data requirements. The network of field observers are responsible for primary data collection while the headquarters staff gather data from local sources and carry out data base development and analysis activities. While FEWS intends to computerize all data, it appears that only the agrometeorological data are consistently entered into computer data bases.

Meteorological Data

The Agroclimatological Service operates a two-level meteorological observation network.

The primary network consists of 23 agrometeorological stations equipped with rain gauges, dry- and wet-bulb psychrometers, min/max temperature thermometers, soil thermometers, anemometer, sunshine recorders, thermohydrographs, and in a few cases, evaporation pans and Piche atomometers. Instrument readings, plus observations of cloud amount and weather phenomena are taken three times a day (0800, 1200, and 1800 hours). Sixteen of 23 stations are equipped with single side band radios. The mean and totals data from these stations are radioed to Mogadishu every 10 days. Recent equipment problems have reduced the number of functioning radios.

A network of 56 rain gauge stations provide data on daily rainfall amounts. Five of the stations have radios and transmit rainfall data every day. The remaining stations send data every 10 days on printed postcards.

Other rainfall data are collected from 21 additional stations that belong to other projects.

Historical data have been collected from all available sources. Records date back to 1912 but there are gaps. The data have been checked for consistency or errors.

All meteorological data received by FEWS staff in Mogadishu are entered into a computer data base using the CLICOM system. CLICOM provides a means for standardization, verification, management, and reporting of climate data.

Hydrological Data

Stream flow and level data are collected for the Juba and Shabelle rivers at the point where they enter Somalia from Ethiopia. Data are transferred by radio to Mogadishu where 10-day means, comparison to previous year, and percentage of normal are determined.

Crop Development Data

Crop data are gathered by the network of field observers attached to the Early Warning Department. Data on crop development, crop condition, observed adverse effects and expected production are sent to Mogadishu every 10 days. Fifteen of the observations are sent by radio and the remainder by printed postcards.

Crop Area Estimates

Crop area estimates are produced based on sampling during FEWS field missions. Area estimates are limited to the important agricultural areas of the country. Estimates are based on agroecological zone stratification (uniform soils, climate, cropping patterns) and extrapolation of the sample data. The sampling methods vary depending on the zone characteristics. The crop area estimates are summarized by administrative units (regions and districts) rather than by zones.

Crop Yield Estimates

Crop yield estimates are provided by two groups - the Early Warning Department's agricultural observers, and Ministry of Agriculture district representatives. In addition, yield calculations are made based on the Frere and Popov (FAO) water balance methods that have been adapted to Somalia agriculture. Model inputs are rainfall data, soil water holding capacity, potential evapotranspiration, and adequate crop coefficients. The results of the modelling are indices that relate to yields.

Crop yields for maize and sorghum are measured directly using random sampling procedures. In the samples, grain heads are cut and sent to Mogadishu for measurement. Final crop yield estimates are calculated by comparing the information obtained from both the field and water balance model, and adjusting estimates based on rainfall patterns.

Crop Production Estimates

Production estimates are calculated using the crop area and yield data with adjustments made based on consideration of the part of the crops used for livestock feed. Estimates for some regions are reliable while others are not. Access to fields is the determining factor.

Historical Agricultural Data

Data bases are kept on historical crop area, crop yields, and crop production. Data are stored by Region, District, and country.

Food Imports

The Agroeconomics Service collects data on both commercial imports and food aid. Data on the type, amount, food origin, port of origin, and donor are collected.

Food Stocks

Categories of food stocks considered by FEWS are governmental stocks, private stocks and on-farm stocks. The major weakness is on-farm stocks. A detailed survey has never been conducted in Somalia. The Agroeconomic Service tries to trace gross evolution patterns of commodities through the use of small surveys executed during field missions.

Government stocks consist of the grain stored in government procurement centers distributed throughout the country.

Food Requirements

Food requirements information are produced using a modelling process. Model results describe the average per capita food requirements for Somalia. The model uses data on:

- Population structure estimates of social groups by age
- Nutritional pattern estimates by social group (nomads, urban, rural, mixed)
- Cereal consumption by social group and age
- Composition of the cereals food basket by social group

Crop Prices

The Agroeconomic Service has a network of price observers. The network partially overlaps the agricultural and agroclimatological network. Retail prices are collected for maize, sorghum, rice, wheat, cowpeas, groundnuts, imported oil, sesame seed, sesame oil, and sugar.

Prices are collected daily from 23 markets covering districts and regional capitals. The data are sent daily to Mogadishu. The data are analyzed every 10-days to calculate percent change from the previous decade.

Decadal price data are collected for 36 markets. The information are sent by postcard to Mogadishu. These markets are located in small villages.

The weakness of the price data is that units of measurement vary throughout Somalia. To deal with this, surveys of volume measurements are regularly conducted and used to develop conversion procedures.

Population Census

The last Somalia census was conducted by the Ministry of Planning in 1986. The census data are used in FEWS food balance analysis.

Topographic Maps

Somalia was mapped at scales of 1:200,000 and 1:100,000 by Soviet Union cartographers. When the Soviets left the country, they took the map printing plates. Only a limited number of maps are still in circulation. They can be rented from the Topographic Department in the Ministry of Defense.

Data Gaps - Remotely Sensed Data

FEWS has a keen interest in using remote sensing to improve their data collection and monitoring activities. In the mid-1980's, NOAA provided NDVI images and telex data (1- by 1/2- degree block statistics) to FEWS. When the program was dissolved, FEWS contacted AID and asked that continuation of the program be reconsidered. FEWS staff require a reliable and timely source of AVHRR NDVI data. They hope to use NDVI to monitor vegetation conditions and calculate the length of the growing season.

Rainfall distribution data, interpreted from METEOSAT imagery, are also needed by FEWS. This need is expected to be satisfied in fall-1989 through the installation of a METEOSAT PDUS in the Early Warning Department.

FEWS staff also are interested in using LANDSAT and Spot imagery to improve data collection - particularly crop area. The FAO provided training in the basic interpretation of remotely sensed data but did not provide a collection of imagery that could be used for FEWS functions. A land use inventory also is needed to improve the current agroecological stratification that was developed in 1975. FEWS lacks the high resolution satellite imagery for use in daily activities.

Data Gaps - Nutritional Data

There are no nutritional surveillance programs in Somalia. The Ministry of Health has been encouraged to begin a cross-sectoral program but to date, nothing has been initiated.

Related Programs/Activities

Ministry of Livestock, National Range Agency

The Central Rangeland Development Project (CRDP) was established in 1980 with a goal to improve pastoralists' income through increased rangeland and livestock production. The project is entering a new phase that will concentrate on the use of remote sensing and geographic information systems to carry out rangeland monitoring. Plans include:

Development of a geographic information system (GIS) to consolidate data processing and cartographic functions.

Use remote sensing to increase data collection and monitoring functions. Examples include:

Landsat MSS or TM for creating base maps describing major ecological zones, production systems, roads, cut lines, cultivated areas, sand dunes, and settlements.
NOAA AVHRR for estimation of biomass production.
Aerial photography for animal census and sampling.

Implementation of a Systems Investigation and Monitoring Program (SIMP) designed to optimize data collection, analysis, and subsequent use of survey and study findings. This will include:

Gathering demographic and socio-economic data.
Determination of baseline environmental conditions.

Eight automated meteorological stations were established during Phase I and eight more are scheduled to be installed in Phase II. The stations use automated instruments to collect data on temperature, rainfall (amount and intensity), wind velocity and direction, and evapotranspiration. These data are not shared with FEWS.

There is definitely overlap between the CRDP and FEWS. Redundant data collection plans, and data that have common value exist.

Ministry of Agriculture, Land and Water Department

FAO is sponsoring the Land Resources Survey for Land Use Planning Project. The goal is to increase institutional capabilities for conducting land resource surveys for land use planning that will result in increased food production (crop and livestock) while preserving land resources for future generations. The budget is $1,127,560 over three years.

The project has a strong remote sensing component. Plans call for the completion of 1:250,000-scale land use and soils inventories based on LANDSAT imagery. FEWS staff have begun discussions with the project staff and it appears that cooperation is possible.

Civil Aviation Agency

The Civil Aviation Agency also collects meteorological data for aviation purposes. However, the data are not used in FEWS.

Recommendations

General

The Early Warning Department has had major accomplishments since the inception of the program. It has established a viable institution, developed the necessary data collection programs, and started development of computer data bases. There are still several areas that can be improved, or enhanced, to increase the value of FEWS.

1. Work closely with the user community to insure proper understanding and use of FEWS products.

2. Develop a strategy for incorporation of remote sensing into the early warning program. This should include immediate adoption of AVHRR NDVI for vegetation and rainfall monitoring.

3. Improve in-country communications by increasing the number of radios, and establishing a maintenance program for existing radios.

4. Provide staff training in data base development and computer analysis methods.

5. Establish communications and data exchange with other ministries.

6. Increase attention to livestock and nutrition/health sectors.

7. Upgrade computers through the installation of larger hard disks. Increased storage capacity is necessary for continued expansion of the CLICOM system.

8. Begin gradual transition to use GIS for data management and analysis. Food surplus and deficit summaries are not regional but rather are presented in aggregate form. This does not allow proper targeting of areas with populations at risk.

9. Obtain funding for a generator. Power outages are currently disabling the Department for significant periods. This will be even more critical when the METEOSAT PDUS is installed.

IGADD Initiatives

1. IGADD should facilitate the establishment of a link for data exchange between Somalia's neighbors, particularly with Ethiopia and Kenya. Somalia has a strong need for Ethiopia and Kenya hydrology and meteorology data.

2. Provide AVHRR vegetation index products.

3. Provide, through RCSSMRS, LANDSAT imagery for Somalia. Coordinate remote sensing assistance through RCSSMRS.

4. Serve as catalyst to deal with both national and regional telecommunications problems.

5. Organize training in remote sensing, computerization, and data analysis methods.

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APPENDIX E

Sudan Country Report

NOTE: The sudden change in the leadership of the Sudanese government that occurred in early-July 1989, forced the IGADD EWS study team to cancel its scheduled trip to Khartoum. The following report was summarized from materials collected by USGS staff on previous trips to Sudan, and from Progress Report of the Sudan Early Warning System prepared by A.M. Zahran for IGADD.

Description of Sudan Early Warning System

The Sudan Early Warning System was started in early 1986 in the Relief and Rehabilitation Commission (RRC) by the U.N. Emergency Operation in Sudan (UNEOS). At the same time, an inter-ministerial steering committee also was established for the EWS. Funding for the first years of the project have come from Norway, Sweden, and Denmark (total funding was approximately $751,800). UNDP is currently implementing a training program to improve the skills of the EWS staff.

The Sudan EWS tries to be sensitive to abnormalities in the indicators that may be used to target food problem areas. The overall goal of the Sudan EWS is to provide advance information on crop production and the country's food supply. The information should be used to alert all concerned, well in advance, of an impending food shortage, surplus, or pest attack so that timely and preventative action can be administered.

Facilities

The EWS is housed in RRC facilities. For data base management and analysis, the Sudan EWS has two IBM XT microcomputers. In addition, it has the following types of computer software:

- Spread sheet
- Word processing
- Data base
- Mapping
- Statistical packages
- Project management

The computers are used primarily for computerization of data bases. In addition there are established analytic procedures for financial accounting, mission review, and project planning.

Staffing

The Sudan EWS originally was established with a staff of three professionals. They included a Team Leader, Senior Data Base Analyst, and Electronic Data Processing Systems Analyst. The RRC is expected to approve additional staff. They are:

Agricultural Meteorologist
Agriculturalists (two)
Statistician

Products

There is a regular series of reports summarizing the national food security situation, and the activities of the Sudan EWS. The Early Warning Bulletin is published monthly and contains summaries of the most recent data and comparisons of current information with seasonal patterns and long term trends, but not analysis and interpretations of multi-sectoral data. In addition, the Early Warning System Status Report is produced each month. The reports are distributed to nearly 400 people from Sudanese Ministries, co-operating NGO's, international aid agencies, and U.N. and donor communities.

National EWS Users

The Sudan EWS has a constituency at several levels. As stated in the previous section, nearly 400 people receive the Early Warning Bulletins. This group is comprised largely of decision makers that require concise information that signals the approach of food emergencies.

In addition, EWS staff have established a close working relationship with relevant technical ministries, NGO's with EWS systems, international aid agencies, and international EWS to keep abreast of relevant developments and procedures.

The Sudan EWS also has made arrangements to share data and knowledge on a cost-free basis with other African national, regional, and international EWS.

Description of Relevant Data

The EWS unit has placed emphasis on using existing data rather than creating new, parallel data systems. The key data used as indicators for famine assessment are:

- Daily rainfall from Department of Meteorology that date back to 1901

- Rainfall estimates based on the TAMSAT METEOSAT PDUS operated by the Department of Meteorology
- Market prices and throughput (quantities sold) from the Ministry of Agriculture
- Pest infestation reports
- Crop forecasts and actual harvest information including data from the Ministry of Agriculture/USAID SERISS agricultural statistics project
- Demography
- Health and nutrition data including data from the Ministry of Health/USAID SERISS nutrition surveillance project

EWS staff would like to see improvement of several data sources. They would like to add more rainfall stations and are trying to locate funding to establish 1000 rain gauge stations throughout the country.

Recommendations

It is not possible to develop a definitive list of program recommendations due to the teams' inability to visit the RRC in Khartoum. However, based on review of available documentation, the following program improvements appear necessary:

1. Establish a dependable power supply for computer facilities. This should include UPS equipment and a back-up generator.

2. Increase sophistication of computer data analysis. This could include expanded computerization of data that will permit vulnerability assessments.

3. Increase use of remote sensing for monitoring seasonal vegetation.

4. Strengthen existing ministry data collection programs on as needed basis.

5. Operating expenses to supplement the funds provided by RRC.

6. Additional staff including Nutritionist, Agricultural Economist, and Agrometeorologist.

7. Staff training programs.

8. Logistics support for computer equipment.

Finally, the Sudan EWS hopes to create a Disaster Area Assessment Survey (DAAS) team that can travel to potential problem areas and verify the presence and magnitude of problems.

APPENDIX F

Republic of Uganda
Country Report

Description of National Early Warning System

The Government of Uganda (GOU) has not established formally an early warning function. However, two ministries, Agriculture and Environment Protection, claim to have the responsibility to develop a national early warning system. The Ministry of Agriculture (MOA) claim is based on it's statutory responsibility to insure that all people are fed. The Ministry of Environment Protection (MEP) claim is based on its responsibility to serve as the home of national natural resource and environment data bases. It appears that the GOU will endorse the MOA as the national food early warning organization.

Uganda has the potential not only to be food self-sufficient, but to produce enough food to feed its neighbors. The need for food early warning in Uganda is one of knowing the spatial distribution of both surpluses and deficits and having the tools to determine redistribution strategies.

Historically, the Karamoja District in the northeast corner of Uganda has experienced the climate related food shortages. Food shortages in southwest Uganda have occurred because of overpopulation and land tenure problems. The northern part of the country has had shortages cause by refugees.

National EWS Users

The question of who makes food aid decisions was asked at several levels of the Ministry of Agriculture. No response was provided leading to the conclusion that there is not an official body to make food aid and early warning decisions in Uganda.

Description of Data

Very little data exist in Uganda. Most agencies are developing plans to reestablish data collection programs. Historical data are virtually non-existent. Data collection programs were discontinued in the 1970's and 1980's, and many records prior to this period have been lost or destroyed.

Agricultural Statistics

A national agricultural census is underway and will take two-three years to complete. The MOA is conducting the survey. Statisticians from other ministries question the potential value of census results because of perceived flaws in its design.

Field agents gather data on food crop areas, cash crops, prices, and production. Their data collection is very informal and, according to the FAO, based on extrapolation and conjecture. Historical records go back to 1963.

Meteorological Data

The Meteorology Department is responsible for agrometeorological data. The Civil Aviation Service collects meteorological data needed for aviation. The Hydromet Department also has meteorological stations.

The Meteorology Department has a network of almost 1000 rain stations. However, only 100-150 are reporting. These stations provide monthly reports. Five synoptic stations report every hour. These stations were established to provide aviation weather.

Little historical data are available. At the time of the split of the East Africa Community, Uganda meteorological records representing 60 years were stored in Nairobi. Uganda has not been able to retrieve their data. Meteorological Department staff estimate that $14,000 is needed to obtain the data.

The Organization for African Unity (OAU) provided a $1 million grant to the Meteorology Department for use in rehabilitating the meteorological network. The rehabilitation had two components. The local component provided funds for local construction of rain gauges. Unfortunately, the quality of the gauges were low and they were not used. The agrometeorology component provided funds for additional gauges, computers, radios, and vehicles. Eighteen semi-automatic stations (automatic recording without transmission), three automatic stations (both recording and transmission), and five manual stations are being purchased. The automatic stations will communicate through METEOSAT to a receiver in Entebbe. The Entebbe station is supposed to communicate data to a Wang VS-171 minicomputer obtained with the OAU funds. However, the necessary communications hardware was not included in the purchase and funds (estimated at $20,000) are no longer available. The Wang computer has been delivered to the Meteorology Department. However, the OAU grant funds are exhausted and the Meteorology Department does not have funds to pay for staff training. Staff training is needed prior to installation. An additional problem with the new computer system is that too few data entry stations were purchased. More stations are needed if the Department is to automate their records.

Population Census

The last Uganda census was conducted in 1980. However, civil unrest disrupted the census process and the results are not reliable. The next census is scheduled for August, 1990. The Ministry of Planning is responsible for population statistics.

Price Data

The Ministry of Planning is the focal point for price data. However, current data are limited and historical data do not exist.

Nutrition and Health Data

Routine national nutrition surveillance programs do not exist, nor do programs for the systematic collection and standardization of existing statistics. Two small, local, health surveys have been recently conducted. Nutrition questions were a minor component of the survey.

Topographic Maps

Topographic maps have been produced for all of Uganda. Four scales of maps are available - 1:50,000, 1:250,000, 1:500,000, and 1:1,000,000.

Data Gaps

All data needed for early warning is missing in one form or another. Establishment of primary data collection systems in the appropriate ministries will be necessary.

Related Programs/Activities

FAO/Italian Early Warning Project

The FAO is assisting the MOA to establish a food early warning system in Uganda based on a design similar to the FAO/Italy EWFIS effort planned for Djibouti. It was impossible to determine the stage of planning of this project. The $1.8 million FAO plan calls for a five person team (agricultural economist, agricultural meteorology, marketing specialist, nutritionist, and livestock specialist) to be stationed at the MOA. However, MOA has requested that only three experts be provided.

FAO Nile Basin Project

A project currently is being designed that calls for Nile riparian nations to develop plans to cooperate and develop Nile Basin water. It emphasizes collection and analysis of data that can be used to monitor and simulate hydrological conditions. Water data, including stream statistics and meteorology, are likely to be important elements of the project. The project is in a planning phase and specific activities are not yet defined.

Ministry of Planning

The Ministry of Planning (MOP) is responsible for all statistics programs. Distribution of all GOU statistics is by the National Statistics Center (NSC) of MOP. The NSC assists other ministries in the design of statistical surveys. In addition, they carry out their own projects. They currently are involved in projects to strengthen data collection, conduct household budget surveys, and complete a population census.

Ministry of Health

The Ministry of Health is responsible for health and nutrition surveillance. While it does not have surveillance programs, it intends to pursue projects that will regularize health and nutrition surveys. It hopes to establish nutrition units in each District that will have responsibility for both data gathering and nutrition services. The MOH Health Planning Unit publishes a quarterly bulletin that contains reports on health, nutrition and methodology.

Environmental Protection Department

The Environmental Protection Department of the Ministry of Environmental Protection deals with day-to-day environmental issues. The Data Base Division was established to compile natural resources and environmental data from all ministries. Their priority is to monitor the state of the environment. The Division, with UNEP/GEMS assistance, has digitized 167 data layers from the 1967 Atlas of Uganda. The data were updated, where possible, and entered into the ARC/Info GIS. The EEC has made overtures to provide microcomputers, ERDAS image processing software, and ARC/Info GIS software. The assistance has yet to be formalized. Staff from the Data Base Division have taken respective training in both remote sensing and GIS from RCSSMRS and UNEP. The division has sed LANDSAT data to complete a forest inventory of Uganda. It is now planning to initiate additional resource inventories using LANDSAT TM and SPOT imagery.

It is are also conducting a National Biomass Survey with NORAD. The Norwegian effort is using aerial photography and satellite imagery to quantify the amount and distribution of biomass in Uganda.

UNSO is interested in the establishment of an early warning system in the Environmental Protection Department that deals exclusively with the Karamoja District.

Recommendations

General

Uganda is starting from scratch and will need to address every aspect of early warning systems. Institutional development and strengthening of primary data collection systems must take the highest priority. However, unless an atmosphere of openness and cooperation is created, a Uganda early warning system will fail. Specific recommendations include:

1. Establish inter-ministerial working group on resource information systems to discuss data needs, computer experiences, and other technical topics related to early warning and resource monitoring. Group should not be a policy board but a forum for exchange of technical experiences.

2. Improve communications. Communications within Uganda are poor. Telephone communication is unreliable within the Kampala-Entebbe area and almost impossible throughout the rest of Uganda.

3. Data sharing is uncommon. Sharing of information between agencies is incidental rather than planned.

4. Provide logistics support and training.

5. Arrange assistance to map agroecological zones.

IGADD Initiatives

1. Assist in the negotiation and retrieval of Uganda meteorological data currently stored in Nairobi.

2. Provide leadership and assistance to plan the proposed EWS.

3. Coordinate RCSSMRS assistance.

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