See Appendix B Market Assmt.

USE OF CLIMATIC IMPACT ASSESSMENTS BY THE SAHEL COUNTRIES FOR OPERATIONAL CROP MONITORING AND RANGELAND MANAGEMENT

Submitted to: International Development Cooperation Agency
Agency for International Development
Bureau for Africa
Office of Sahel and West Africa Affairs
Washington, D.C. 20523

Submitted by: U.S. Department of Commerce, NOAA
National Environmental Satellite, Data, and Information Service
Assessment and Information Services Center
Climatic Impact Assessment Division
Page Building #2
3300 Whitehaven Street, N.W.
Washington, D.C. 20235

Co-Principal Investigators: Russell A. Ambroziak
Sharon K. LeDuc
Louis T. Steyaert
Climatic Impact Assessment Division
NOAA/NESDIS/AISC

Proposed Starting Date: May 1, 1985

Proposed Duration: 36 months

Proposed Ending Date: April 30, 1988

Amount Requested: $3,223,644.00

Dr. Louis T. Steyaert
Program Manager
Models Branch, AISC/CIAD

Russell A. Ambroziak
Chief, AISC/CIAD

Dr. Sharon K. LeDuc
Senior Statistican
Models Branch, AISC/CIAD

Dr. Joan C. Hock
Director, AISC

Dr. Clarence M. Sakamoto
Chief, Models Branch,
AISC/CIAD

Margaret E. Courain
Deputy Assistant
Administrator for Information
Services, NESDIS

USE OF CLIMATIC IMPACT ASSESSMENTS BY THE SAHEL COUNTRIES FOR OPERATIONAL CROP MONITORING AND RANGELAND MANAGEMENT
(Proposed Technical Assistance)

SUMMARY

Technical assistance for the Sahel countries is proposed by the NOAA/NESDIS Assessment Information Services Center (AISC) to substantially improve each country's capability for drought impact early warning, agricultural crop monitoring, crop production forecasting, and rangelands management. This capability will be based on climatic impact assessment technology developed by NOAA/NESDIS/AISC. This technology has been used operationally in the Sahel for monitoring food security since 1979 and technical assistance has been provided since 1983. AISC will assist each participating country in designing an organizational structure and implementing a plan for using climatic impact assessments. Host countries will learn to prepare and use assessments based on available weather data. These data are processed through agroclimatic assessment models developed and tested by AISC. AISC will also prepare special assessments (meteorological satellite and weather data) for distribution to each country. Host countries will be trained to properly use AISC assessments and shown how assessment information can significantly improve crop production forecasting and agricultural policymaking. AISC will improve assessment models to upgrade the existing technology. This technical assistance will be accomplished by:

- providing each participating country with detailed, monthly special assessment reports based on all available meteorological satellite and weather data,

- assisting each participating country in developing, testing and operationally implementing a National Climatic Impact Assessment System. This will enable each country to use special assessments provided by AISC and to develop assessments based on rainfall-derived agroclimatic crop condition index models,

- conducting professional training courses, sponsoring decision maker seminars and providing in-country technical assistance to ensure that: host-countries understand the technology; can properly use the assessments; and have the appropriate organizational structure necessary for a successful operational system, and

- upgrading AISC's assessment models to improve the timeliness, spatial resolution, and quantification of AISC and participating country assessments of crop production and rangeland conditions.

This proposed technical assistance, based on AISC's operational assessment capability, builds on current efforts to initiate technology transfer in the Sahel (NOAA/AID-OFDA PASA BOF-0000-P-CC-3062-02, completion date May 1985). AISC has routinely prepared monthly crop condition/drought food shortage assessments for each country since 1979. These assessments are based on agroclimatic index models, estimates of regional rainfall, and vegetation biomass conditions. Daily rainfall gauge data and meteorological satellite data

(AVHRR) are used as inputs. Requests from assessment users (e.g., USAID Missions, AID/W and AID/Food for Peace), has led AISC to develop a special assessment capability that provides detailed information regarding ongoing and expected drought impacts. AISC's assessment technology can become more timely and quantitative for routine and special assessments. Appendix A describes the preliminary implementation plan developed in September 1984. As part of this OFDA-sponsored activity, a professional training course will be conducted in Niamey during early May 1985.

AISC will begin providing special assessments to each country during June 1985, and monthly thereafter through the end of the rainfall/crop season during each project year. Assessments will include decadal (10 day) and monthly analysis. Maps and tables will supplement analysis of climatic impacts. Drought areas will be identified and tracked. Agroclimatic index and meteorological satellite models will be used to assess conditions of major food crops. Meteorological satellite data will be used to improve rainfall estimates and to assess vegetation/biomass conditions. The assessment will include detailed analysis of rangeland conditions in terms of grazing potential, quantitative crop production forecasts, and color displays of satellite imagery (Appendix C). These assessments will resemble a 1984 assessment of Mali (Appendix B).

AISC's technical assistance will focus on institutional development and training. With the assistance of USAID Missions and host countries, individual country plans will be prepared to effectively develop, test and implement operational climatic impact assessment systems. High level government policymaker support will be obtained to develop the plan and coordinate the assessment activity. The appropriate participating agencies (meteorology, agricultural statistics, agricultural economics, food security, land use, rural development and extension) will be identified. Agency responsibilities for assessment preparation, distribution, and use will be determined. The country plan will include provisions for professional training courses and decision maker seminars. Training courses will be designed to teach trainees to develop agroclimatic impact assessment models, interpret and use host country and AISC assessments, and design appropriate assessment reports.

AISC will upgrade the existing assessment technology by improving agroclimatic crop index models and meteorological satellite imagery analyses. Historical rainfall data bases will be expanded to include additional weather stations. Models to provide analysis every 10 days will be developed. Statistical crop yield forecast models, based on regional data provided by the countries, will be developed. Agroclimatic regions used for meteorological satellite vegetation index analysis will be redefined. Ground truth information will be used to improve satellite assessment of drought and vegetative/biomass conditions. The spatial resolution of meteorological satellite analysis will be increased from 20 to 4 kilometers. Procedures for using meteorological and satellite information to forecast crop production (30-60 days before harvesting begins in October) will be improved.

The schedule for AISC special assessments, training, in-country technical assistance, and host-country assessment applications for each project year is provided in the attached table. During the first project year, each country will develop the organizational structure and procedures necessary to begin quasi-operational test assessments during 1985. Emphasis will be on drought

detection, crop monitoring, potential food shortage alerts, initial rangeland management and preliminary input of assessment information for agricultural policymaking. In the second project year, the activities would be expanded to include crop production forecasting and increased use of information for rangeland management and agricultural policymaking. In the third project year, host-countries will make further refinements on their assessment system and make it operational. Emphasis will also be placed on food availability assessments to project deficits and estimate relief requirements. Such analysis can be performed during September and updated during October.

Climate impact assessment technology can be realistically absorbed by each Sahelian country and operational systems will provide significant socio-economic benefit. The crop condition index models are based on existing rainfall data resources. These models are very simple, easy to learn, and inexpensive to use. NO computer capability of any kind is required by the countries to do these assessments. (If computer systems are avilable, they will facilitate assessment product development and application). All countries can use these rainfall index models to detect drought, qualitatively assess drought impacts on crop production (30-60 days before crop harvesting begins) and issue drought/food shortage alerts with a lead-time of 3-6 months. Most countries can use their own assessments in conjunction with the AISC assessments to significantly improve the accuracy of crop production forecasts (to be made during August and September), and management of rangelands. This information will enhance agricultural policy decision making (i.e., imports/exports, pricing, food needs, population migration, road conditions, etc.). All of the Sahel countries can benefit from meteorological satellite products to be provided by AISC but none are expected to develop a satellite data processing capability. During the second project year, recommendations will be made on how to ensure that satellite information is available after the end of the project.

Agencies within the U.S. Government will benefit from this project. In particular, AISC will provide crop production forecasts to AID and USDA. These will improve U.S. analysis of food-assistance needs; quantified information for administrative zones in each country will be provided during August and September of each crop year. In addition, detailed weather assessments will help determine road conditions.

Attachment
NOAA/NESDIS/AISC

SCHEDULE FOR ASSESSMENTS, TECHNICAL ASSISTANCE AND PARTICIPATING COUNTRY APPLICATIONS
(by Project Year)

1. Assessments & Technical Assistance:

Activity (Project Years 1,2,3)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	No. of Persons
Prof. Training Course	X												M,E,S
AISC Special Assessment		X	X	X	X	X							
Host-Country Assessments		X	X	X	X	X							M,E,S
AISC In-Country Visits			X			X				X			
Decision Maker Seminar							X						
U.S.A. Training											X	X	M,E,S
Annual Project Review							X						
Update Country Plan							X						

Professional discipline codes are agro-meteorologist (M), agric. economist (E) and agric. statistician (S)

2. Host Country Applications:

a) Project Years 1, 2 & 3

													Gov't. Agencies
Drought Detection/Alerts		X	X	X	X								M,A
Crop Monitoring/Reports		X	X	X	X								M,A
Food Shortage Alerts				X	X								A,F
Initial Rangeland Mgt.		X	X	X	X								M,A
Prelim. Agric. Policy			X	X	X								A

b) Project Years 2 & 3

Crop Prod. Forecasts					X	X							A
Rangeland Advisories		X	X	X	X	X							A
Crop Advisories		X	X	X	X	X							M,A
Agric. Policy Inputs		X	X	X	X	X							A

c) Project Year 3

Food Needs Analysis						X							A,F
Determine METSAT Needs						X							M,A,F
Crop Systems Analysis						X							M,A

Government agency codes are Nat'l. Met. Svc. (M), Min. of Agric. (A) and Food Security (F)

I. INTRODUCTION

The purpose of this proposed project is to assist each participating Sahel Country in significantly improving their operational capability for drought impact early warning, agricultural crop monitoring, crop production forecasting and rangelands management. These improvements can be made through the appropriate use of available weather and meteorological satellite data. The NOAA/NESDIS Assessment and Information Services Center will accomplish this by: 1) providing each country with special AISC assessments during the growing season of each project year, 2) assisting each participating country in the operational implementation of a national climatic impact assessment system, 3) conducting professional training courses, coordinating decision maker seminars and providing in-country technical assistance on assessment preparation and interpretation for decision making, and 4) improving AISC assessment technology (i.e., greater timeliness, higher spatial resolution and quantitative crop production forecasts).

Drought is a continuing problem affecting the people, food security, and economic development of the Sahel countries: Burkina Faso, Cape Verde, Chad, Gambia, Mali, Mauritania, Niger, and Senegal. These countries have agriculturally based economies. For the past decade, drought has caused crop failures which have resulted in malnutrition, food shortages, rural population dislocations, and disruptions throughout the economy of each country. Emergency international food relief assistance has been necessary on many occasions. Their foreign exhange has been depleted by the need for increased food imports while their income from export crops has been sharply reduced. Drought strains the whole economic system, compounding the impact of other economic problems such as energy costs or debt servicing. The net effect of a drought is lost time in the economic development process which all of these countries need so desperately.

The fight against the drought requires a combination of long and short-term actions. One long-term solution is to minimize the risk of drought by improving agricultural practices and increasing conservation of environmental resources. In the short-term, this process can be accel-erated through improved use of meteorological information resources. For example, upgraded weather data collection and communication facilities are available at the National Meteorological Services as result of the AGRHYMET Project. These weather resources can be used to develop applications for users, particularly involving short-term economic decision making. The economic and social benefits from these applications can be most rapidly realized if each country implements a management information system based on Climatic Impact Assessment Technology.

With support from the USAID Office of Foreign Disaster Assistance (OFDA), Climatic Impact Assessment Technology was developed by the U.S. NOAA/NESDIS Assessment and Information Services Center (AISC) over the past seven years. During this period NOAA/NESDIS/AISC has developed and is now operating a drought/crop condition and food shortage alert assessment program that provides weekly and monthly analysis for more than 90 countries. These assessments are based on a combination of daily rainfall reports from weather stations and meteorological satellite data used in "simple" models which help assess weather impacts on crops and rangeland.

The system has been verified with "ground truth" data and it has proven to be reliable, timely and cost effective. For example, NOAA/NESDIS has been assessing climatic impacts in the Sahel since 1979. More recently, the OFDA program has included assistance to countries in the development, testing and operational implementation of assessment programs (Asia, Latin America, and Caribbean Basin).

To illustrate, a Climatic Impact Assessment System can be used to operationally monitor daily weather, reliably detect drought, and determine the impacts of weather on agricultural crops during the crop growing season. If drought is a serious problem, then by the end of August the assessment system can provide government decision makers with a reliable 30-60 day forecast on relative crop yields including crop failure, a 60-90 day forecast on major food price instability and at least a 3-6 month early warning alert on the potential for drought-caused food shortages. Because rainfall variability accounts for 80 percent of the annual changes in crop yields within the Sahel countries, the assessment system can be used to forecast crop production. More recently, advances in the development of meteorological satellite applications have significantly upgraded AISC's assessment capability, particularly in the Sahel Region. These significantly contribute to crop production forecasting and rangeland management applications.

The Sahel countries can develop, test and operationally implement National Climatic Impact Assessment Systems to help government policymakers and planners fight drought impact. Such a system can provide early warning of potential problems involving crop production losses. Improved agricultural crop forecasts can strengthen agricultural policy analysis. The 3-6 month alert of potential drought caused food shortages can enhance emergency relief planning. Information from the system can also help management of rangelands for livestock grazing.

The resources to implement Climatic Impact Assessment Systems already exist within the Sahel Countries. However, several requirements are necessary to make the system work. Some of these include the need for strong leadership from high government policymakers and planners. Their support is necessary to coordinate the development of National Plans to implement the technology. This will include designating the participating agencies, determining their mission and coordinating how assessment reports will be distributed.

The purpose of this proposed project is to provide each Sahel Country with the capability to assess and act on its drought problems with an increased measure of technical accuracy. The results will be National not Regional in nature. However, regional resources available from the National AGRHYMET Center could help accelerate national program development and testing and fine-tuning through applied research results.

II. OBJECTIVES

The overall goal is to improve each Sahel country's capability to operationally assess the impact of weather on agriculture (food crops and rangelands) and to use these assessments for agricultural production forecasting, agricultural policymaking and farmers' advisories. This will be accomplished by completing four objectives which focus on AISC special assessments for each participating country, technical assistance for assessment system implementation, training on how to use assessment technology for decision making and development of improved assessment tools. Specific objectives include:

A. To provide timely special assessment reports at the end of each month during the crop growing season (May-October) of each project year. The content and analysis included in these assessments would be continually enhanced during the three year plan as follows:

First Crop Year (1985)

AISC Special Assessments will be similar to the 1984 assessment for Mali (Appendix B) except that high quality color photographs will also be provided for each country (Appendix C). AISC will assess rangeland conditions and make crop yield and crop production forecasts (beginning in August 1985) for administrative regions in each country.

Second Crop Year (1986)

Assessments will be improved by increasing the spatial resolution of satellite data from 20 kilometer pixels to 4 kilometer pixels. The quality of satellite derived color photographs will be improved. Crop indices will be used every 10 days - not just once a month. Crop production forecasts will be improved.

Third Crop Year (1987)

AISC will make further refinements on the interpretation of satellite data products and crop production forecasts will be improved. AISC will also examine high resolution SPOT satellite data. The total assessment package will be incorporated into a Geographic Information System for decision making.

B. To assist participating countries in the development, testing and operational implementation of a National Climatic Impact Assessment System by:

First Crop Year (1985)

- obtaining policymaker support for coordination of the activity
- developing country plans for organizing and implementing the system
- preparing monthly test assessments to include drought early warning, crop condition monitoring, and drought/food shortage alerts

- using a combination of AISC special assessments and in-country agroclimatic assessments for preliminary rangeland monitoring/management and crop production forecasting
- identifying how assessment information can contribute to agricultural policy analysis.

Second Crop Year (1986)

- improving assessment methods and assessment distribution procedures used in project year one
- upgrading timeliness and application of rangeland management advisories for nomadic herders
- incorporating assessment information into agricultural policymaking
- determining how assessments can be used as a basis for crop advisories for farmers

Third Crop Year (1987)

- improving assessment products and applications
- expanding the national system to include other government agencies

C. To conduct professional training courses, sponsor decision maker seminars and provide in-country technical assistance so host-countries have the capability for:

- developing agroclimatic/crop condition assessment models
- preparing assessments of weather impacts on crops and rangelands
- designing assessment reports and a system for distribution of reports to decision makers
- understanding how to interpret assessments, in particular AISC special assessments based on meteorological satellite data
- most importantly, learning how to use the assessment reports as a stand-alone product or in combination with other information systems to improve crop production forecasting, early warning of potential drought/food shortage conditions, agricultural policymaking, and in-season advisories to farmers and herders.

D. To improve the timeliness, spatial resolution and quantification of AISC assessment technology by:

- o expanding the AISC resource base for preparing high quality, detailed special assessments for each participating country
- o improving spatial resolution of meteorological satellite derived assessment models (4 kilometer analysis and detailed vegetative/ biomass indices)
- o processing high quality color-coded photographs of satellite imagery
- o providing reliable crop production forecasts (30-60 days before crop harvest)
- o developing a Geographic Information System for integrating agroclimatic models and satellite models for decision making

III. PROCEDURES

This section outlines procedures for preparing and distributing AISC special assessments, implementing national climatic impact assessment systems, training activities, and upgrading AISC assessment models. A summary of AISC's assessment methodology is provided.

A. Preparation and Distribution of AISC Special Assessments

AISC will prepare special assessments which will be provided to each participating country on a monthly basis during the crop growing season. All available weather and meteorological satellite data will be used to prepare these assessment reports. Reports will resemble AISC's analysis for Mali made at the end of the 1984 crop growing season (Appendix B), except that high quality color photographs will be included (Appendix C).

Each assessment will provide a detailed analysis of weather impacts on agricultural crops and rangelands. A narrative statement will summarize weather impacts, the regional scope and severity of ongoing or potential impacts, and analysis of rainfall patterns and crop conditions. This analysis will be supported by various maps, tables and color photographs based on meteorological satellite data.

AISC special assessments will be provided to USAID Missions and participating countries by two methods. Five copies of each written report will be sent by the most expeditious express air mail services. The narrative summary with each assessment will be sent by NOAA communications cable for distribution to USAID and participating host-country government agencies. The suggested distribution for assessments is USAID (1), Ministry of Agriculture (2, economics and statistics), National Meteorological Service (1), and food security management/relief agency (1).

These assessments will be expanded and improved as AISC upgrades assessment models. The technical assistance activities (Section III.C) include provisions to train host-country professionals in interpreting and using AISC special assessment products.

<u>First Year Contents</u>

Narrative analysis supported by maps and tables based on:

- Agroclimatic indices for weather stations
- Meteorological satellite vegetation indices: Time series plots showing previous 3 years plus current year biomass indications for areas 1° of latitude by 2° longitude
- Meteorological satellite color photographs showing satellite derived biomass indications
- Display of existing land use patterns

Photographs of satellite derived biomass indications will be provided along with time series for the small areas (Appendices B and C). Existing land use will be displayed. The condition of crops will be initially determined from agroclimatic indices at weather stations which report precipitation. This station specific information will be extrapolated to other areas based on the relationship between the agroclimatic indices and the satellite information.

Combining satellite information with earth observations requires careful analysis. Two independent and simultaneous assessments will be made by AISC (Columbia, Missouri and Washington, D.C.). These will be compared and merged for the final assessment to be released by the Climatic Assessment Branch. This will help ensure that all available information and expertise are used. The confidence limits for assessment information will be included in each assessment. The use of crop condition indices will allow decision makers to evaluate the condition of crops and pastures at specific points and to compare them to past years. The time series of satellite vegetation indices for small (1°latitude x 2°longitude) areas will include within season conditions and year-to-year differences for the past three years. If vegetation in an area appears to be poor, a decision maker can determine location with better vegetation. This information will help improve rangeland management.

Second Year Contents

The special assessment will be based on:

- Satellite derived biomass indicators based on 4 kilometer resolution data
- Agroclimatic indices for additional weather stations
- Satellite-derived precipitation estimates for remote areas
- Ten-day agroclimatic analysis
- Simulatanoous display of crop condition indices and satellite indices

Assessments will include more geographic resolution from an increased number of precipitation stations and use of higher resolution satellite data. The reflectance of ground vegetation at 4 km resolution will permit detailed analysis. The lower resolution (20 km) data will be used to establish a reference level based on the previous four years. Satellite information on clouds will also be used to estimate precipitation for defined regions which will be determined at the training course in the spring of 1986. These estimates will be adjusted based on observed precipitation. Agroclimatic indices will then be available for those remote regions with no precipitation stations. The mixture of crops in the defined regions will also need to be determined at the training course as well as area planted and yield in those regions.

Assessments will be available at time intervals of 10 days for both satellite and agroclimatic indications. Providing regular ten-day assessments is not planned but would be available upon special request.

Methods for improved interpretation of color photographs (4 km resolution vegetation patterns) will be developed by the Rochester Institute of Technology. RIT will also recommend methods for simultaneously displaying satellite vegetation at two resolutions (4 and 20 km).

A geographic information system will display all products on the same geographic coordinate system.

Third Year Contents

- o Analysis of Spot data for selected small areas
- o Test results from statistical plant process models
- o Detailed ground truth information for test sites will be available

Spot coverage of pre-selected areas will be simultaneously displayed with GAC resolution data. These areas will be selected to contain as much ground truth information as possible. Statistical plant process models requiring daily temperature and precipitation at these locations will be used.

B. Implementation of National Climatic Impact Assessment Systems

AISC will assist each participating country in designing, developing, testing and implementing a national climatic impact assessment system. The purpose of the system is to provide a framework so that the weather/environmental information (host-country and AISC generated) can be effectively used as input for decision making by the appropriate government agency. The process for assisting in Sahel national system implementation is based on AISC's previous assistance efforts in Latin America (Peru and Ecuador USAID Mission projects which are underway) and regional projects in South and Southeast Asia. The process model for national assessment system implementation includes components such as obtaining policymaker support to coordinate the country program, developing individual country plans which describe how the system will function, conducting training on how to develop and effectively use the technology, and providing technical assistance on all of these activities. Technical assistance will emphasize applications: identification, model development, assessment preparation, assessment use and incorporating other information sources for an improved product (e.g., combining weather/satellite based crop forecasts with survey results to forecast crop production).

Policymaker Support

During the first project year, AISC proposes to work with the USAID Mission in determining the key government policy agencies which would be responsible for coordinating the proposed technical assistance and effectively managing the national assessment system. The strong leadership and continuing support from the appropriate policy level agency is essential to coordinate the design of the system and its eventual operation. The country plans, described in the following subsection, would be developed for use by the policy agency.

Country Plans

AISC proposes to assist each country in preparing Country Plans which specify the system design, how it will be developed and tested and how it will be effectively used. Country plans define the involved policy level agencies and their responsibilities. The names and missions of other government agencies are also included. The channels for flow of assessment information will be described. What type of assessment report is prepared by each agency, how is it distributed and when, and who are the users of the report.

Country plans will define key milestones for model development, test and operation. The technical assistance requirements should be specified. The country inputs (e.g., resource commitments) should be defined. AISC also proposes that these plans specify the milestone for data to be provided to AISC (e.g., decadal rainfall reports each month, historical crop statistics for administrative regions, crop distribution maps, ground truth reports for satellite model calibration, etc.)

One of the primary objectives of these country plans is to ensure the appropriate interagency coordination for preparation, distribution and use of assessments. Assessment distribution can be achieved through either formal or informal interagency agreements. AISC suggests that the most straight-forward method of interagency coordination is through a system of regular assessments reports. This can be facilitated by ensuring that the country plan clearly defines the role of each agency (consistent with their mission), the type of information and data to be included in the assessment report and the agencies which will be provided the report.

National assessment plans could also institutionalize policy and technical level coordination committees which could meet regularly to discuss system operation and application.

Participating agencies should include the National Meteorological Service, Ministry of Agriculture and Rural Development (agricultural statistics, agricultural economics, agricultural policy and extension), the national agency responsible for drought disaster management (preparedness and relief operations), the national planning agency and others.

Another function of the country plan is to define how climatic impact assessment information can be effectively coupled with information generated by other systems (e.g., crop surveys).

Training

AISC proposes four types of training. These include annual professional training courses held in the region, an annual seminar for decision makers, 6-8 week short-term training courses in the United States, and various types of on-the-job and informal training to be held during AISC's in-country technical assistance visits. Details on the scheduling and goals of these training activities are provided in Section III.B (Procedures) and Section V (Milestones).

The primary purpose of these training activities is to develop a solid human resource base for developing models, preparing assessments and using these assessments as input for improved decision making. Trainees and managers within each participating country will learn how to effectively use special assessements provided by AISC.

Technical Assistance

AISC's technical assistance will emphasize institutional development and training on how to effectively develop and use climatic impact assessment system products. Technical assistance will be directed towards helping each participating country develop the capability to assess and act on its drought problems with an increased measure of technical accuracy. Assistance will be provided to each participating government agency so that officials understand and can use assessment information to improve decision making. Assistance will be provided in each of the major project objectives: Use of AISC special assessments, development of national climatic impact assessment plans, provision of broad based training and feedback of improved AISC models into AISC special assessments and host-country assessment models.

AISC's technical assistance capability will be "entirely stand-alone, self-contained and adequately sufficient" to accomplish the objectives of this project. AISC will not place additional burdens on USAID Missions. However, it is believed that as meaningful project results/benefits become evident, USAID Missions may wish to learn more about AISC's special assessments, become involved in national assessment plan implementation and participate in the identification and use of assessment applications (e.g., agricultural policy analysis, rangeland advisories, food shortage projections, etc.).

To ensure this "stand-alone" technical assistance capability and to meet diverse assessment application needs within each government, AISC will hire a highly skilled agricultural meteorologist and agricultural economist. Each individual will be at the Ph.D. level (or M.S.), be fluent in written and spoken French, and have a strong background in weather/agricultural problems including in-country experience in Africa.

Two technical assistance teams will be formed for in-country visits. The first will consist of the Ph.D. agro-meteorologist, a Ph.D. level statistician (familiar with satellites and computers) and an M.S. level agricultural economist. The second team will consist of the Ph.D. level agricultural economist, a Ph.D. level agro-meteorologist (AISC African Assessor) and computer programmer. Teams will be capable of performing simultaneous technical assistance missions and conducting scheduled training.

AISC has written several user's guides: assessment model development, METSAT training assessment, assessment preparation, etc. These will be revised and translated into French for distribution within each country.

If computers are available in-country, AISC will provide needed technical assistance relating to assessment applications. AISC has also developed extensive micro-computer software applications which will be available on request.

Applications

Technical assistance will be oriented towards the use of assessment models which meet applications required by users. Assessments to meet these needs will be generated by the participating country and by AISC in the special monthly assessments. Host-country decision makers will be shown how to use each type of assessment. The basic assessment information will be progressively expanded during each project year.

Information to be provided during all three project years include assessment of drought affected areas (regional scope, duration and intensity), assessment of weather impacts on crops (qualitative crop condition analysis), qualitative assessment of potential drought/food shortage conditions (regional extent and historical severity), and preliminary assessment of rangeland conditions (where are biomass/grazing conditions likely to be good or poor for use by livestock herders), and the preliminary use of assessments as input for agricultural policymaking (e.g., where are there drought problems, what is being affected and how does this relate to food availability, trade and market prices).

Beginning in the second project year, these basic assessments will be improved and new assessment information will be generated. AISC will assist host-countries in improving quantitative agricultural production forecasts, upgrading of rangeland/pasture advisories for livestock grazing, determining how information on drought can be used by grain crop farmers, and using quantified agricultural production forecasts as input for improved agricultural policy making.

During project year three, these applications will be further improved and quantitative analysis techniques will be determined to estimate potential food deficits and food assistance needs. At this time, decisions will be made on the future role of meteorological satellite information for each country - who will process and distribute METSAT data after the project is completed.

Finally, AISC will help determine how other agencies could be brought into the national climatic impact assessment to incorporate land use studies and crop system analysis for increased agricultural production.

The schedule for host-country applications is included in Section V, Milestones, Part II.

C. Provision of In-country Assistance, Training Courses and Decision Maker Seminars

The schedule for in-country technical assistance, professional training courses and decision maker seminars to be conducted during each project year is summarized in Section V, Milestones, Part II. These technical assistance activities are linked with each project component (AISC special assessments, institutional development, training and improved assessment models) and will be directed towards successful host-country applications of the assessment technology.

During each project year, there will be a professional training course during May, a major in-country visit during the middle of the crop growing season (one week in each participating country during July), a major end-of-season in-country visit (October), a decision maker seminar in November, a minor in-country visit for selected countries during February, and U.S. based 8 week training courses to be conducted during March and April of each project year. Procedures for conducting each of these technical assistance activities are summarized below.

Professional Training Course in the Region

The professional training course will be conducted during May of each project year. It is recommended that this course be conducted in Niamey at the Regional AGRHYMET Center. (Note: The course for May 1985 has been funded by AID/OFDA and will be two weeks in duration. An agro-meteorologist and an agricultural economist from each participating country will be invited to attend this initial course). Courses to be held during May 1986 and May 1987 would be one week in duration. This proposed project has provisions for training three qualified professionals from each country. These should include an agro-meteorologist and an agricultural economist plus an additional person (policy level staff, extension or statistics). The course lectures and all relevant instructional material (lesson plans, user's guides, practical exercises, etc.) will be in French.

The purpose of each professional training course during May is to train those key in-country personnel who would be directly responsible for preparing and using host-country and AISC assessments during the following growing season. Trainees would learn how to interprete and use AISC special assessments. They would learn how to develop agroclimatic impact assessment models based on their data, design assessment reports, prepare timely assessment reports and make recommendations for updating each national assessment plan.

The training course agenda would reflect the aforementioned course objectives. Significant time will be spent on practical exercises. The agro-meteorologist (attached to the National Meteorological Service) would focus on weather data collection (and quality control) and the use of the data to identify drought problems and to make qualitative impact assessments. The trainees from the Ministry of Agriculture would learn some of these techniques plus methods for making quantitative assessments of

weather impacts in crops. They would learn how to use this information for improving crop production forecasts and as input for policy analysis. Training will be provided to professionals involved with drought/disaster management and determination of food assistance needs. A trainee from the appropriate agency will be identified to focus on preparing and communicating advisories for farmers and herders.

Professional trainees must be adequately qualified. For example, they should be permanently assigned to the participating agency and in working level positions. They would be designated in the country plan as participants in the training course and subsequent in-country assessment activity. Trainees should have at least two years of professional experience, preferably with at least a B.S. degree and a thorough knowledge of agricultural practices in their country. Each trainee should be skilled in basic statistical concepts and capable of preparing high quality written assessment reports.

U.S. Based Training Course

Two professionals from each participating country will be invited to attend an intensive eight week technical training course which will be held in the United States. The trainee will spend six weeks in Columbia, Missouri and two weeks in Washington, D.C. The course will be held during March and April of each project year. The purpose of the course is to provide exceptionally qualified persons with more extensive training than can be presented during the regional training course. The subject matter would be essentially the same except more instruction will be provided on meteorological satellite analyses and strong emphasis will be placed on user application of assessments. User application will focus on the needs of the trainee's agency. Trainees will prepare a written report. The training reports will be similar to that of Massamba Gueye, "Proposed Agroclimatic Assessments for Policy Decision Making, Economic Planning and Rural Development in Senegal" completed in 1982. AISC has conducted such short-term training courses for more than 25 developing countries. This training opportunity will help AISC improve assessment models and develop new applications.

Training provided in project year three will focus on forecasting food shortages (quantitative), estimating food assistance needs and expanding the assessment activity to other government agencies involved with land use and food production systems.

Decision Maker Seminar

A five day seminar for participating country decision makers will be conducted during November of each project year. It is proposed that these seminars be held in Niamey (1985), Dakar (1986) and Washington, D.C. (1987). Decision makers to participate would include the Director General of the National Meteorological Service, the Minister of Agriculture or a high level assistant involved in agricultural policy analysis and a senior

official from the national agency responsible for management of drought/disaster situations, determination of food shortage conditions and needs, and coórdination of relief operations.

The purpose of these annual meetings will be to review in-country progress in developing their assessment system, present results on the previous crop/weather season, update country plans for the coming season and present new methods and applications for use during the following season.

The decision maker seminar would be used to conduct an annual project review. USAID Mission officials would be invited to participate.

AISC would conduct these seminars in a fashion similar to those previously conducted for South and Southeast Asia (see Background, Section VI).

In-Country Visits

AISC will conduct in-country technical assistance missions to each country during July, October and February of each project year. The overall purpose of these visits will be to brief USAID Mission and host-country officials, provide additional training, update country plans, identify needed assessment applications, and assist in assessment preparations.

Three AISC representatives will participate in the July and October visits. The visit during July will focus on mid-season assessment preparation and use of AISC and host-country assessments. At this time, AISC will also assist country officials in the analysis of rangeland conditions. The visit during October will focus on end-of-season analyses, final crop condition assessment and preliminary crop production forecasts.

One AISC representative will visit selected countries during February of each project year. The purpose will be to follow-up on any special problems relating to the previous assessment season, to help prepare candidates for U.S. based training and to collect needed data and ground-truth information for satellite assessment verification.

D. Upgrade of AISC Assessment Models

The timeliness, reliability, spatial resolution and quantification of AISC assessment models will be upgraded. These tools provide information needed to prepare a written assessment. AISC's models can be classified as follows: agroclimatic index models, meteorological satellite models (precipitation estimates and vegetation reflectance), and various types of statistical crop yield models. The operational implementation of assessment models will be done cautiously and only following thorough test and evaluation.

The agroclimatic index models will be improved by updating crop coefficients and incorporating crop water requirements into the analysis. Additional weather stations will be used. In the second year, analysis for every 10 days will be available to supplement monthly index analysis.

Satellite derived precipitation estimates for selected regions will be available during the second year. This methodology will be tested for use in remote areas where precipitation reports are not available. These satellite derived estimates will lead to interpolated agroclimatic indexes.

Analysis of vegetation reflectance measured by the satellite will be improved through the work at the Rochester Institute of Technology (RIT). They will recommend a color display method which will permit maximum differentiation of vegetative conditions. They will also recommend an optimum color display for the different satellite resolutions: 20 km (PSG), 4 km (GAC) and SPOT (20 meters). Their methodology will be transferred for use by AISC. The simultaneous display of vegetative reflectance and cumulative precipitation in stereographic form will be developed. The third dimension, i.e. height, will be determined by cumulative precipitation for a geographic area. The color overlay will be determined by the vegetative reflectance.

Elimination of cloud contaminated pixels will be accomplished by using the thermal IR channel with GAC data and compositing the daily data over a 10 day period.

The index of vegetation reflectance which indicates biomass conditions will be calculated for smaller, more homogeneous areas. These will be defined by the trainees as part of their program. This analysis will be incorporated into a Geographic Information System (GIS).

National level statistical crop yield models for Senegal and Niger were developed during 1979 and 1982. Statistical models for other countries can be developed depending on availability of yield data. Yield models for administrative regions can be developed, depending on data.

Models to estimate acreage will be based on both statistical models and inputs from the satellite. Because a threshold amount of moisture is needed to plant, emergence, or lack thereof, of the crop can be determined. Discrimination between crop and pasture areas will require input from analysts within each country. The method of using these various inputs is addressed in Section IIIE.

In addition to these statistical models, existing plant process models (i.e., plant physiologic processes) will be tested for selected locations. These locations will be determined by the availability of data: several years of daily temperatures and daily precipitation, phenologic stages of crop development and yield. The daily temperature and precipitation for the current year will also be required. A model for maize will be examined first. A sorghum model will also be used. The results of these models will be used to determine their potential role in production forecasting, crop/weather advisories for farmers and scenario analysis for decision making.

All of the above models and their improvements will become part of a Geographic Information System. This system will display the information in map format. The following types of information will be included: existing land use; pasture and rangeland; distribution of crops (millet and sorghum); human population; livestock (type and population); roads; rivers; topography; soils; land forms; crop production zones (based on wet scenerio of early 1960's as well as a dry scenerio of the early 1980's); agroclimatic indices; vegetation reflectance indices; other climatic indices; and drought impact indices.

E. AISC Assessment Methodology

AISC assessment methodology is based on agroclimatic crop condition index models, meteorological satellite models and statistical climate/crop yield forecast models. The agroclimatic models are based on historical rainfall data. Rainfall estimates for use in these models are obtained either from weather reporting stations or determined from meteorological satellite analysis. Meteorological satellite models are of two types. The first involves using satellite data to estimate daily rainfall for agroclimatically homogeneous regions. The second type of model is used to assess vegetative and biomass conditions. The statistical climate/crop yield forecast models are based on multiple linear regression analysis using historical yield and meteorological data. All of these models are used in combination to make quantitative crop production forecasts. Additional information on each assessment model is provided in the following discussion on assessment model applications: Drought Detection, Crop Condition Monitoring, Food Shortage Alerts, Crop Production Forecasting, Rangeland Management and Others.

Drought Detection, Crop Condition Assessment and Food Shortage Alerts

AISC's Global Early Warning Program focuses on daily weather impact monitoring, drought detection, crop condition assessment and drought/food shortage alerts. Qualitative assessment information is provided. The program is based on agroclimatic models and meteorological satellite models. The agroclimatic models have been successfully operated in the Sahel since 1979. These have been reliably verified with ground truth information (USAID, FAO, WFP, and PVO's). They will consistently provide government decision makers with a sufficient early warning (30 days before crop harvesting begins representing 30-60 days before food prices increase and at least 90-180 days before potential food shortages) to help mitigate the potential drought crises. Since 1983, the meteorological satellite models have been used to substantially upgrade the spatial resolution for detecting drought and assessment of vegetative/biomass conditions in Africa.

Agroclimatic/crop condition indices are based on derived climatic variables (e.g., soil moisture, plant water deficit and moisture stress) which directly determine the plant's response to environmental conditions, hence productivity. The selection of the regionally appropriate indices is in part determined through the use of episodic event data. For example, candidate indices are qualitatively compared to the historic occurrences of crop failure, food shortages, drought, flooding and other anomalous weather/non-weather events as determined from reports, newspapers, and computerized data bases. Episodic data are also used to "calibrate" the index by establishing a critical threshold which is associated with crop failure and/or drought-related food shortages. The strengths and limitations of all available indices and models are collectively considered in the assessment process.

Meteorological satellite models are based on the European Geostationary Satellite which provides coverage for Africa and the NOAA polar orbiting satellites which provide daily global coverage. AISC uses cloud photographs (Geostationary and polar orbiting) to estimate regional rainfall. AISC also uses AVHRR data (Advanced Very High Resolution Radiometer) from the NOAA satellites to assess vegetative biomass conditions. These data are observed by the satellite at a 1 kilometer spatial resolution and then converted b the satellite to 4 kilometer resolution data for internal storage and transmission to NOAA/NESDIS in Washington, D.C. The 4 kilometer data (called GAC for Global Area Coverage) is further sampled by NESDIS to provide essentially 20 kilometer resolution data, called PSG for "Polar Stereographic" projection. The daily PSG data are sampled to select cloud free pixels and composited to provide a weekly PSG analysis. AISC uses the 20 kilometer PSG data and, as previously discussed, will begin using GAC 4 kilometer data during 1986.

AISC is using the weekly composited PSG analysis in two ways. These involve visible and near infrared solar radiation signals which are reflected from the ground and received by the NOAA satellite. First, these reflected solar radiation signals are converted into color displays using the Ambroziak Color Coordinated System (ACCS). Color photographs are produced and show vegetative/biomass conditions on the ground. These color photographs can be used to identify ground conditions ranging from desert, drought stressed vegetation to dense tropical forest coverage. A series of photographs can be used to examine the progress of vegetation growth during the rainy season. In the second type of model, the reflected solar radiation signals are converted to a vegetation index for each 20 kilometer pixel. All vegetation index values within an agroclimatically homogeneous region are averaged to provide a mean vegetation index. This regional vegetation index is available each week and can be plotted as a time series. Time series for each year are overlayed. These show the progress of vegetation/biomass conditions ranging from "green-up" at the beginning of the rainy season, peak vegetative buildup at mid-season, and drying out of vegetation at the end of the rainy season. Equally as important, the difference between "wet" and "dry" crop seasons can be detected.

These NOAA satellite models (color photographs and vegetation indexes) significantly improve AISC's ability to detect drought, determine its regional extent between rainfall reporting stations and assess relative vegetative/biomass conditions. Drought conditions throughout the Sahel were effectively monitored during the growing seasons of 1982-84. AISC also demonstrated that there is a strong correspondence between drought affected biomass patterns and cumulative rainfall patterns observed during the growing season.

These improved assessment techniques were effectively used to provide AID with special impact assessments of 1984 drought conditions in Mali, Niger and Sudan. The assessment for Mali is included as Appendix B. Sample color photographs used in the assessment procedure are shown in Appendix C.

Crop Production Forecasts

AISC will provide each participating country and AID with monthly crop production forecasts to be made during the crop growing season. Forecasts will be made for administrative regions (or political zones) in each country. These will be aggregated to the national level. Production forecasts will be based on crop yield forecasts and crop acreage estimates. Production forecasts will reflect deficit and surpluses which result from weather impact each year, not necessarily losses due to non-weather factors such as pests and diseases. Production forecasts made during August and updated during September will be the most indicative of harvest conditions. In the first project year, AISC will focus on sorghum and millet crops grown within each country. One to two other major food crops will be included beginning in project year two. The methodology for making these crop production forecasts will be systematically upgraded during the course of the project. Participating countries will be taught the methodology.

The crop yield forecasts and acreage estimates used to make crop production forecasts will be based on analysis of agroclimatic, meteorological satellite and statistical models. Forecasts made during the early growing season will primarily indicate the conditions at crop planting during June. Forecasts made during August and updated during September will represent the most reliable information on crop conditions at harvest. This is true because, by mid-August, the availability of seasonal rains to meet the crop's water requirement, hence grain production, can be reliably determined.

Production forecasts will be made for each administrative region as follows:

1) Maps showing drought impacted areas will be prepared each month from analysis of rainfall data and satellite models (color photographs and vegetative indices). The rainfall data (station reports and satellite derived estimates) will be used to determine the availability of soil moisture necessary to grow the particular crop. Satellite color-coded photoraphs will be used to identify drought areas. Drought affected areas will be categorized according to extreme drought impact (little to no vegetation indicating crop failure), severe drought/impact (well below normal vegetative conditions and major crop yield losses), significant drought impact (below normal vegetative conditons and below normal yields) and moderate drought impact (some drought stress evident in vegetation and crops). Vegetative and crop conditions which are normal to above normal will also be assessed.

2) Maps showing the agroclimatic crop index expressed in percentiles for the crop growing areas in each administrative region will be prepared from agroclimatic and satellite model analysis. For example the condition of the millet crop will be displayed on a map showing index percentiles ranging on a scale from 0 to 100. This relative crop yield information (based on agroclimatic models) will be first determined at rainfall reporting stations. This station analysis will be interpolated to other crop growing areas by using the satellite color photographs and vegetation indexes and available satellite derived rainfall estimates.

3) Statistical analysis of crop yield data for the administrative region will be used to determine the expected yield for each drought category in the drought impact map (1 above) and crop index percentile range (2 above). In some cases, useful quantitative statistical crop yield forecast models can be developed to provide an absolute yield forecast.

4) Yield Forecast. The Drought Impact Map, the Crop Index Map and the Crop Yield Statistics will be simultaneously analyzed to make a regional yield forecast.

5) Crop Area Forecast. The "normal" crop area for each region will be determined from available crop statistics and other information obtained from each country. This normal crop area will be adjusted according to the satellite analysis used for development of the drought impact and crop index maps. AISC will also investigate statistical relationships between crop area and weather impacts.

6) Production Forecast. The forecasted yield will be combined with the crop area estimate to provide a production forecast for the administrative zone. As a check, production data for previous years will be compared to determine the consistency of the current year's forecast. AISC will also investigate statistical relationships that may exist between total production and seasonal rainfall. Forecasts of crop area, crop yield and production will be provided to AID.

7) Production Forecast Reliability. AISC has previously determined that approximately 80 percent of the variability in Sahel country crop yields is directly due to year-to-year changes in rainfall totals. Because yields are highly related to weather information, very useful yield forecasts can be made. The estimated reliability of yield forecasts is illustrated as follows: Subsistence yields for millet, sorghum and maize grown in the Sahel usually range from about 0.8 to 1.0 metric tons per hectare in a "good weather year" down to 0.0 to 0.2 metric tons per hectare in an extreme drought year. AISC believes that yield forecasts can be made to the nearest $\pm$ 0.2 metric tons per hectare. During the first project year, AISC will determine the quality of crop area estimates. AID will also be provided with confidence levels on production forecasts.

Rangeland Assessment Methodology

The meteorological satellite models will represent the primary tools for assessing rangeland conditions. Color-coded photographs showing biomass and vegetative indexes will be calibrated for interpretation by using the agroclimatic index models. The goal is to provide a fine scale analysis indicating various classes for rangeland conditions, very poor to above normal. Preliminary findings suggest that high resolution satellite data (1 to 4 kilometers) will provide very useful information which can be used to assist in management decisions (see Appendix C).

AISC will map rangeland conditions during each month of the growing season. These will be included in the special assessments. These assessments will be upgraded each year through the use of higher resolution data and by incorporating reliable ground truth information.

Other Methodologies

Beginning in project year two, AISC will also focus on developing crop advisories for farmers and using assessments plus crop production forecasts as input for improved agricultural policy analysis. Policy decisions and farming practices which are sensitive to weather variability will be identified. Climatic impact assessments can directly benefit the policy decision maker by providing an early warning alert plus quantitative information on the nature of the drought impact. Crop production forecast deficits can be used to analyze questions involving imports, exports, prices, etc. AISC will help in the total process. The rangeland condition assessments can help the herder find good grazing conditions, but using assessment information to help the farmer is not so straight-forward. AISC will investigate how weather information made available during the growing season and coupled with recommendations (i.e., advisories) can be used to help the farmer. Analysis of early season rainfall patterns may assist on the decision to plant. If farmers have planted their crops and the rains fail, it may be possible to provide information that contributes to the replanting decisions.

During project year three, AISC will make recommendations on how the assessments can be used to estimate quantitative food shortage needs. AISC will also encourage research facilities to become involved in the assessment activity. The assessment methodology can contribute to land/water resource management studies and cropping systems analysis.

IV. DELIVERABLES

A. Quarterly reports will be submitted to AID. These will provide results on each project component: AISC special assessments, technology transfer and national program implementation, training, and AISC assessment model improvement.

B. Special monthly assessment reports will be provided by AISC to each participating country, USAID Mission, AID/W and others as requested by AID.

C. Detailed Reports containing results of all technical assistance visits including training courses and seminars will be prepared for AID.

D. Individual trainee reports will be prepared by each participant attending U.S. based orientation programs. These would be similar to the report for Senegal by Massamba Gueye, "Proposed Agroclimatic Assessments for Policy Decision Making, Economic Planning and Rural Development in Senegal". Included in these reports would be a summary of available country data, examples of agroclimatic methodologies, assessment techniques, assessment report design, follow-up recommendations, as well as discussion of potential problems relative to implementation of the program in the specific country.

E. Annual progress reports and the final project report will be provided to AID.

V. MILESTONES (PART I)

Year	Tasks	Date
1985	Incorporate revised crop coefficients and crop water requirement into agroclimatic models	May
	Conduct OFDA funded training course in in Niamey on assessment technology, host-country test assessments and AISC special assessments	May
	Develop initial country plans Brief USAID Missions on project Begin GRC contract to support assessments	May
	Develop time series plots of satellite vegetation indices for all 1° latitude x 2° longitude areas	May
	Begin delivery of AISC special assessments to each country (monthly) Begin host-country test assessments	June
	Design geographic information system Visit each country to assist on assessments	July
	Define detailed pasture areas, crop areas and irrigated areas to allow aggregation of indices and use in GIS	August
	Submit initial Quarterly Report and every 3 months thereafter	August
	Make preliminary crop production forecast	August
	Begin precipitation estimation from clouds for 1° latitude x 2° longitude areas	September
	Complete GRC contract to provided assessment products	October
	Visit each country to forecast production and to discuss use and improvements for next year, collect ground truth data and crop statistics for admin. regions	October
	Begin RIT contract to improve color display	October
	Revise crop production estimates	November

Year	Tasks	Date
1985	Define country specific areas for time series plots of satellite biomass/ vegetative indices	November
	Conduct decision maker seminar (3 participants per country)	November
	Update country plans and conduct host country project review (at seminar)	November
	Process full GAC resolution data for Sahelian Region	December
1986	Display geometrically corrected and registered GAC data at AISC	January
	Conduct in-country visits to collect information for this year's assessment products	February
	Determine time period for composite of GAC data	February
	Conduct 8 week training course in US (2 participants/country)	March
	Incorporate historic precipitation data assembled at Clark University	March
	Implement RIT recommended color display for use with GAC and PSG display	April
	Submit Annual Progress Report to AID and provide program review in Washington	April
	Calculate percentiles for decadal agro-climatic index analysis (smooth and interpolate decadal precip from monthly precip; then use to calculate percentiles)	May
	Conduct regional training to introduce new capabilities and products to be included for assessments, emphasis on use of satellite information	May
	Update country plans	May
	Resume regular assessments Test Geographic Information System	June

Year	Tasks	Date
1986	Interpolate station crop indices to other locations and display in geographic information system	June
	Overlay crop condition indices and satellite vegetation reflectance indices	July
	Conduct In-country visits	July
	Make preliminary crop production forecasts	August
	Make radiometric corrections to GAC data for display and time series use	September
	Review RIT annual report	October
	Conduct in-country visits	October
	Conduct host country project review and update country plans	November
	Conduct decision maker seminar	November
1987	Conduct in-country visit to plan products for growing season	February
	Conduct US training with emphasis on crop production forecasts	March
	Submit Annual Progress Report and provide AID with program review in Washington	April
	Implement RIT recommended color display system for Spot data	April
	Conduct Training Course	May
	Resume assessments	May
	Incorporate Spot data	July
	Incorporate process model yield estimates	July
	Conduct in-country visit	July

Year	Tasks	Date
1987	Fine-tune and document system, make preliminary production estimates	August
	Conduct in-country visit concerning food needs analysis, meteorological satellite data needs and crop system analysis	October
	Conduct evaluation seminar in Washington D.C.	November
	Revise production estimates	November
1988	Conduct in-country visit	February
	Provide US training on future needs	March
	Submit Final Report	April

V. MILESTONES (PART II)

SCHEDULE FOR ASSESSMENTS, TECHNICAL ASSISTANCE AND PARTICIPATING COUNTRY APPLICATIONS
(by Project Year)

1. Assessments & Technical Assistance:

Activity (Project Years 1,2,3)	May	Jun	Jul	Aug	Sep	Oct.	Nov	Dec	Jan	Feb	Mar	Apr	No. of Persons
Prof. Training Course	X												M,E,S
AISC Special Assessment		X	X	X	X	X							
Host-Country Assessments		X	X	X	X	X							M,E,S
AISC In-Country Visits			X			X				X			
Decision Maker Seminar							X						
U.S.A. Training											X	X	M,E,S
Annual Project Review							X						
Update Country Plan							X						

Professional discipline codes are agro-meteorologist (M), agric. economist (E) and agric. statistician (S)

2. Host Country Applications:

a) Project Years 1, 2 & 3

													Gov't. Agencies
Drought Detection/Alerts		X	X	X	X								M,A
Crop Monitoring/Reports		X	X	X	X								M,A
Food Shortage Alerts				X	X								A,F
Initial Rangeland Mgt.		X	X	X	X								M,A
Prelim. Agric. Policy			X	X	X								A

b) Project Years 2 & 3

Crop Prod. Forecasts					X	X							A
Rangeland Advisories		X	X	X	X	X							A
Crop Advisories		X	X	X	X	X							M,A
Agric. Policy Inputs		X	X	X	X	X							A

c) Project Year 3

Food Needs Analysis						X							A,F
Determine METSAT Needs						X							M,A,F
Crop Systems Analysis						X							M,A

Government agency codes are Nat'l. Met. Svc. (M), Min. of Agric. (A) and Food Security (F)

VI. BACKGROUND

The NOAA/NESDIS Assessment and Information Services Center (AISC) with its Climatic Assessment Branch (CAB) in Washington, D.C., and its Models Branch (MB) in Columbia, Missouri, has developed procedures to assess climatic impacts on food security of developed countries. The Climatic Assessment and Models Branches include a multidisciplinary team, addressing not only the meteorological aspect of the problem, but also the agronomic and economic impact of climate on food production as well. Since 1979, AISC has participated in a multiagency project termed AGRISTARS (Agricultural Resources Inventory Surveys Through Aerospace Remote Sensing) which is designed to improve methods of crop forecasting. As part of this effort, a Joint Modeling Center for Crop Model Development has been established in Columbia, Missouri, with participation among representatives of NOAA, USDA, and the University of Missouri-Columbia. In 1984, NOAA/NESDIS and the University of Missouri-Columbia were successful in creating the Cooperative Institute of Applied Meteorology also located in Columbia, Missouri.

AISC with support from the AID Office of U.S. Foreign Disaster Assistance (OFDA) and in cooperation with the University of Missouri-Columbia, has developed agroclimatic assessment methods to provide operational early warning of potential food shortages due to drought in semi-arid regions of the Caribbean Basin (1979), the Sahel Region (1979), Southern Asia (1981), Central America and South American Andes countries (1983), Horn of Africa (1983), Sub-Equatorial Africa (1983), and Southwest Pacific (1984). AISC has also been involved in agroclimatic technology transfer to Latin America (Belize, Colombia, Costa Rica, Ecuador, Panama, Peru and Venezuela), Caribbean Basin (Dominican Republic, Haiti and Jamaica), Southeast Asia (Indonesia, Malaysia, the Philippines and Thailand), and South Asia (Bangladesh, India, Nepal, Pakistan and Sri Lanka). U.S. based short-term training courses have been provided to agrometeorologists from Senegal and Sierra Leone. AISC representatives have designed and conducted training courses, workshops for managers, and policymaker seminars as part of this technical assistance work for AID. The following summarizes recent AISC activities and illustrates the "process model" for technical assistance on national program implementation.

In 1983, AISC and the AID Office of U.S. Foreign Disaster Assistance (OFDA) sponsored the ASEAN Workshop on Climatic Impact Assessments for Agriculture at the Asian Institute of Technology in Bangkok, Thailand. That workshop led to 1983 test assessment programs (Indonesia, Malaysia, Philippines, and Thailand) and expansion of the program to South Asia (Bangladesh, India, Nepal, Pakistan, and Sri Lanka).

As follow-up in January 1984, the UN Economic and Social Commission for Asia and the Pacific (ESCAP) hosted the joint NOAA/NESDIS-AID/OFDA-UN/ESCAP "Seminar on Agroclimatic Models for the Assessment of Drought-Related Food Shortages in South and Southeast Asia." The goal of the Seminar, held at ESCAP Headquarters in Bangkok, was to enhance existing AID drought/disaster early warning and preparedness programs by making available operationally proven NOAA/NESDIS climate impact assessment technology to South and Southeast Asian countries. Representatives from the

nine countries participating in the Seminar (Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, the Philippines, Sri Lanka, and Thailand) endorsed the methodology and asked to become involved in the 1984 technical assistance program. Individual country plans were developed by each participating delegation specifying implementing government agencies, channels for the flow of assessment information, trainees, technical service scheduling, and estimated country inputs. NOAA/NESDIS, AID/OFDA, with cooperative support from the University of Missouri-Columbia, and ESCAP agreed to:

- o Conduct a climate impact assessment training course
- o Provision of micro-computer packages to each participating country
- o Coordination of individual assessment programs
- o Dispatch of in-country technical assistance missions
- o Follow-on evaluation seminar in early 1985

In May 1984, AISC participated with AID and UN/ESCAP in providing a technical training workshop on "Drought/Food Shortage Assessment" in Pattaya, Thailand, for these same South and Southeast Asia countries.

In September 1984, AISC met with AGRHYMET Regional Center, UN/World Meteorological Organization and AID personnel in Niger to plan a two-week technical training course in 1985 on agroclimatic assessment techniques for professionals from the Sahelian countries. AGRHYMET Center Staff were also trained in AISC climate assessment techniques and AISC agroclimatic software and data bases were installed on the AGRHYMET computer system. AISC also held meetings in Senegal to examine the possibility of establishing a national agrometeorological center there. AISC visited Chad to determine training requirements and will assist Burkina Faso on national assessment program development, beginning in February 1985.

From August 1984 to April 1985, 16 trainees will receive six weeks of agroclimatic crop condition assessment training at the AISC Models Branch in Columbia, Missouri, and the AISC Climate Assessment Branch in Washington, D.C. Participating countries are Peru, Costa Rica, the Dominican Republic, Panama, Ecuador, Jamaica, Bangladesh, Nepal, Sri Lanka, and India. This training and previously cited technical assistance are provided under the NOAA/AID-OFDA project called Global Climatic Impact Assessment Technology for Drought/Disaster Early Warning and Technical Assistance in the Developing World (BOF-0000-P-CC-3062-02).

Plans for training programs by AISC during 1985 focus on improved agroclimatic assessments through the use of satellite imagery including microcomputer applications and continued technical assistance on agroclimate assessment in South and Southeast Asia, the Sahel, the Caribbean Basin and Latin America. Special training courses on development of meteorological satellite applications will be conducted for professionals from Malaysia and Thailand.

VII. PROJECT SUPPORT

NOAA/NESDIS would also complete portions of this project through a cooperative agreement with the University of Missouri-Columbia (UMC) - Cooperative Institute of Applied Meteorology and Geographic Resources Center.

Other potential consultants for additional liaison, evaluation and technical assistance based on project requirements include: The Rochester Institute of Technology.

VIII. DISSEMINATION OF RESULTS

Project reports and other deliverables will be provided to AID. The final report will be provided to AID/Bureau for Africa with six complete copies.

IX. LOGISTIC SUPPORT

Office Space, equipment, and secretarial services will be provided or arranged by AISC.

X. GUIDANCE AND LIAISON

A. AID/Bureau for Africa will coordinate the project.

B. Where appropriate, cooperating country and AID liaison officials will be informed of this cooperative project to permit maximum interaction with AID and host-country officials. U.S. Embassy approval will be obtained prior to departure to any country.

C. NOAA/NESDIS/AISC Co-Principal Investigators:
Russell A. Ambroziak
Dr. Sharon K. LeDuc
Dr. Louis T. Steyaert

XI. SPECIAL PROVISIONS

The participating agency is authorized to develop cooperative agreements or subcontract the services of the Cooperative Institute of Applied Meteorology and Geographic Resource Center, University of Missouri-Columbia or potential consultants listed under Project Support, as appropriate.

Appendix A

PROPOSED PLAN FOR IMPLEMENTING NATIONAL CLIMATIC IMPACT ASSESSMENT SYSTEMS IN THE SAHEL COUNTRIES

(NOAA/NESDIS/AISC, September 1984)

The attached plan outlines a proposed process for developing, testing and implementing a National Climatic Impact Assessment System in each Sahel country. Existing weather data resources will be used in agroclimatic/crop condition index models to identify drought and assess weather impacts on crops and rangelands. Monthly impact assessments prepared and distributed by government agencies (e.g., National Meteorological Service and Ministry of Agriculture) can be used to improve agricultural crop forecasting and agricultural policymaking. A 3-6 month early warning alert of potential food shortages due to drought can help determine food assistance needs and improve drought/disaster relief management. Assessment information can also strengthen rangeland management and assist farmers in overcoming potential drought problems during the crop growing season.

The plan outlines requirements for successful implementation and use of the assessment technology. Many government agencies should be involved in the system. The continuing support of high level government policymakers is essential. A country plan which describes the role and mission of each government agency is recommended.

This proposed plan was developed in September 1984 by the NOAA/NESDIS Assessment and Information Services Center (AISC) with project support from the AID Office of U.S. Foreign Disaster Assistance under NOAA/AID PASA "Global Climatic Impact Assessment Technology for Disaster Early Warning and Technical Assistance in the Developing World (BOF-0000-P-CC-3062-02)." Funding in the PASA was intended to initiate technical assistance, and includes provisions for installing NOAA/AISC assessment model software and data bases on the AGRHYMET Regional Center's computer system in Niamey, conducting a professional training course for Sahel country participants (agro-meteorologist and agro-economist) and providing in-country technical assistance by NOAA/AISC representatives. The NOAA assessment software will be operational on the Niamey system by February 1985. The training course is tentatively scheduled to be jointly conducted by NOAA/AISC and AGRHYMET Regional Center staff in Niamey during early May 1985. Trainees will learn how to develop assessment models, prepare reliable impact assessments and design concise assessment reports for distribution to decision makers. Participating countries would conduct test assessments during June-October 1985 with NOAA/AISC technical assistance missions during July-August 1985. Computers will not be required for the training course or test assessments. At the request of USAID Missions, NOAA/AISC is also providing technical assistance to Senegal (September 1984) and Burkina Faso (February 1985).

PROPOSED PLAN OF THE SAHEL COUNTRIES TO TEST AND IMPLEMENT NATIONAL CLIMATIC IMPACT ASSESSMENT SYSTEMS FOR SOCIO-ECONOMIC BENEFIT: DROUGHT IMPACT EARLY WARNING AND PREPAREDNESS, FOOD SECURITY MANAGEMENT AND AGRICULTURAL POLICY DECISION MAKING

I. Executive Summary

Drought is a continuing problem affecting the people, food security, and economic development of the Sahel countries. These countries have agriculturally based economies, and for the past decade drought has caused crop failures which have resulted in malnutrition, food shortages, rural population dislocations, and disruptions throughout the economy of each country. Emergency international food relief assistance has been necessary on many occasions. Their foreign exhange has been depleted by the need for increased food imports while their income from export crops has been sharply reduced. Drought puts a strain on the whole economic system which compounds the impact of other economic problems such as energy costs or debt servicing. The net effect of a drought is lost time in the economic development process which all of these countries need so desperately.

The fight against the drought requires a combination of long and short-term actions. One long-term solution is to minimize the risk of drought by improving agricultural practices and increasing conservation of environmental resources. Although the Sahel Countries are making steady progress towards the goal of reducing drought vulnerability, the process can be accelerated through improved use of meteorological information resources. For example, upgraded weather data collection and communication facilities are available at the National Meteorological Services as result of the AGRHYMET Project. These weather resources can be used to develop applications for users, particularly, decision makers. These applications can be developed in each country by implementing an information system based on Climatic Impact Assessment Technology.

With support from the USAID Office of Foreign Disaster Assistance (OFDA), Climatic Impact Assessment Technology was developed by the U.S. NOAA/NESDIS Assessment and Information Services Center (AISC) over the past seven years. During this period NOAA/NESDIS/AISC has developed a drought, crop condition and food shortage alert assessment program that provides weekly and monthly analysis for more than 90 countries. These assessments are based on a combination of daily rainfall reports from weather stations and meteorological satellite data used in "simple" models used to assess weather impacts on crops and rangeland. The system has been verified with "ground truth" data and it has proven to be reliable, timely and cost effective. For example, NOAA/NESDIS has been assessing climatic impacts in the Sahel since 1979. More recently, the OFDA program has included assistance to countries in the development, testing and operational implementation of assessment programs (Asia, Latin America, and Caribbean Basin). To illustrate, a Climatic Impact Assessment System can be

used to perationally monitor daily weather, reliably detect drought, and determine the impacts of weather on agricultural crops during the crop growing season. If drought is a serious problem, then by the end of August the assessment system can provide government decision makers with a reliable 30-60 day forecast on relative crop yields including crop failure, a 60-90 day forecast on major food price instability and at least a 3-6 month early warning alert on the potential for drought-caused food shortages.

The CILSS countries can develop, test and operationally implement National Climatic Impact Assessment Systems to help government policymakers and planners fight drought impact. Such a system can provide early warning of potential problems involving crop prodution losses. Improved agricultural statistics can strengthen agricultural policy analysis. The 3-6 month alert of potential drought caused food shortages can enhance emergency relief planning. Information from the system can also help farms improve cropping practices.

The resources to implement Climatic Impact Assessment Systems already exist within the CILSS Countries. The data and professional expertise of the National AGRHYMET Center in each country are complemented by data and professional expertise within other government ministries (Note: This does not require extensive computer hardware resources). However, several requirements are necessary to make the system work. Some of these include the need for strong leadership from high government policymakers and planners. Their support is necessary to coordinate the development of National Plans to implement the technology. This will include designating the participating agencies, determining their mission and coordinating how assessment reports will be distributed.

The purpose of this proposed program as outlined in this planning document, is to provide each CILSS Country with the capability to assess and act on its drought problems with an increased measure of technical accuracy. The results will be National not Regional in nature. However, regional resources available from the National AGRHYMET Center could help accelerate national program development and testing and finetuning through applied research results.

If the key policymaker support can be obtained and individual country plans prepared by early 1985, the basic assessment technology can be tested during the 1985 crop season and implemented during 1986. The schedule involves initiating the program in September and October 1984 with required followup actions with each CILSS country. Individualized national assessment plans need to be prepared. A professional training course can be conducted in late April or early May 1985. Each CILSS Country could potentially test the system during the 1985 crop season (May-October, 1985). Expert technical assistance could be provided to each country during July and August 1985. Plans for followup technical assistance need to be established.

II. Justification and Policymaker Needs

Senior government policymakers or planners need timely, reliable early warning information on drought conditions as one input to formulate plans for overcoming potential problems. This early warning information can be used to formulate and initiate goverment policy involving drought preparedness, food security management, and short-term economic decision making. Drought relief preparedness plans can be updated and set in motion at the appropriate time. Existing food stocks and agricultural production forecasts (based on weather information plus other existing forecast systems) can be used to project emergency food assistance needs. This same information can be used to evaluate needed adjustments in import and export requirements and maintain price stability. Early warning information on droughts enables the government to more effectively maintain public confidence by keeping the citizens abreast of the situation and government actions being taken in response to it.

Sufficient early warning of potential drought caused problems improves the policy decision making process. Available options can be systematically reviewed so that the appropriate responses can be determined and then action taken. All available information from government ministries can be used to develop required policy actions. For example, weather information can be combined with agricultural crop condition reports collected directly from farmers to determine expected impacts on food supplies: who will be affected, how many people, when, and where. If food assistance is required, the government can more effectively determine where to get the food and then how to transport it to the public in time.

III. Climatic Impact Assessment Technology

A. Technology

Since 1979 Climatic Impact Assessment Technology has been successfully used by NOAA/NESDIS/AISC to predict drought induced food shortages with lead-times of up to 3-6 months throughout Africa, South and Southeast Asia, Latin America, Caribbean Basin and the Pacific. Daily rainfall data are used in simple mathematical models to determine the cumulative effect of weather on crops. Crop conditions are assessed during the season, from planting through harvest. If there is drought, its effect on potential yield can be reliably determined near the end of August (when the crops need water during the critical flowering/reproductive crop stage that determines yield at harvest 30-60 days later). At

this time, the potential for major crop losses can be determined and appropriate reports including food shortage alerts can be provided to decision makers.

The five essential components of the NOAA Climatic Impact Assessment Technology include:

- systematically collecting daily rainfall reports from weather stations;
- analyzing the data and using them as input to various simple mathematical models (10 day, 30 day and seasonal rainfall totals);
- using several different models to determine the impacts of weather on crops;
- preparing concise written assessment reports and rapidly distributing them to other agencies, and
- most importantly, using the assessments to improve drought relief management, economic analysis and agricultural policy decision making.

A Climatic Impact Assessment System is inherently a multi-disciplinary activity involving meteorologists, agronomists, agricultural statisticians, agricultural economists, sociologists, and other disciplines. Therefore, it requires the active participation of key government agencies including the national meteorological services, ministries of agriculture and rural development, national agencies responsible for food security and drought/relief management, national planning agencies, and others in the context of each country. Because the effective use of the technology involves a multi-discipline and inter-agency coordinated effort, the need for dynamic and continuing high level leadership is critical.

B. Capabilities of Climatic Impact Assessment Technology

A national Climatic Impact Assessment System is the most timely, reliable and cost-effective method to identify drought stricken areas and forecast the potential for food shortages in the Sahelian countries. Why? Most agricultural crops are grown under rainfed conditions. Rainfall during the growing season is the dominant climatic factor that determines agricultural practices and potential yields. As much as 80 percent of the annual swings in agricultural production are solely due to year-to-year variations in the timing and amount of annual rainfall. Because rainfall determines agricultural production which in

turn drives the national economy, it is evident why weather information represents a powerful tool for use by many different government agencies. The system is cost-effective to these agencies because the required data are readily available through the AGRHYMET system already in place, and the assessment process is inexpensive to develop and operate.

Climatic Impact Assessment Technology helps meet the needs of the policymaker (see discussion section III.A). As a management information system, it has the capability for the continuous monitoring of weather events, it identifies weather related problems and provides a sufficient lead time so that managers can determine strategies to cope with drought problems. The system has a reliable stand-alone capability (drought monitoring, crop condition assessment and reliable 3-6 month forecasts on potential for food shortages). However, the assessments are most beneficial if coupled with other information systems (e.g., existing agricultural forecast methods such as field reports and crop-cutting). The technology does not forecast weather or predict drought. It uses observed weather data to assess weather impacts on crops and then to forecast socio-economic impacts. The assessment technology is not based on complex mathematical or statistical models. The most reliable methods involve various ways of analyzing growing season rainfall or interpreting simple soil water balances. Weather satellite information is not required, but will eventually represent a powerful assessment tool (when developed) to complement the existing tools based on rainfall reports.

C. "End User" Applications

The maximum benefit from a Climatic Impact Assessment System can be realized if a variety of government agencies receive assessment reports, analyze incoming reports and data and use these to prepare their own assessment reports designed for their individual needs. In a sense the system is analogous to runners passing a baton in a relay race, as illustrated below.

The process begins with the national meteorological service (data collection and dissemination, drought identification and qualitative assessments of weather impacts on agricultural and non-agricultural sectors). Their assessment report plus current decadal and monthly rainfall data are provided to the ministry of agriculture, national planning agency and other ministries. At this point, weather information and data are available to several types of users. If there is a drought, its regional extent and severity has been reported. The question then becomes, "Now that we know there is a drought, what does it mean and what can we do about it?"

Climatic impact assessors in other agencies can use the information and data provided by the meteorological service for other applications. The agency responsible for food security management could determine if there is the potential for drought caused food shortages. This sensitive information can be confidentially communicated, as appropriate, to senior government policymakers.

Agricultural statisticians and economists in the ministry of agriculture can use the information to qualitatively assess weather impacts on specific crops and in late August make qualitative forecasts of expected crop yields. Their crop condition assessments can be combined with other information sources to make quantitative crop production forecasts. The agricultural economist could use the information as a key input for economic analysis (e.g., what does this drought problem and the expected crop production losses mean in terms of marketing strategy, import/export requirement, pricing policy and relief planning).

IV. COSTS

The costs for implementing a national Climatic Impact Assessment System are minimal. The required data are already available. The appropriate assessment system can be rapidly designed, tested and implemented by qualified professionals working within key government agencies of each country.

Expert technical assistance including provisions for professional training and in-country assistance are also available. The commitment of the member country is represented by the time spent by the appropriate officials required to be trained and then utilize the technology: Agro-meteorologists, Agricultural Economists, Agricultural Statisticians and other professional staff.

V. IMPLEMENTING A NATIONAL CLIMATIC IMPACT ASSESSMENT SYSTEM

A. Essential Requirements

There are five requirements to fulfill to effectively design, implement and operate a National Climatic Impact Assessment System. These are summarized as follows and explained in more detail with parts B-D below:

1. obtaining the strong leadership and continuing support of the appropriate policy level agency which would coordinate the design and operation of the system;

2. developing individual country plans which specify the participating agencies and outline the process for development, test and operation of the assessment system;

3. inviting specialists to provide professional training and technical assistance to facilitate implementation of the system;

4. designating the professional and management resources to test and evaluate the system in a quasi-operational mode during the May-October 1985, rainy season; and

5. conducting an evaluation seminar so that policymakers and other government officials can report on their systems, the test assessment results, benefits and future plans.

B. Policymakers Leadership

Policymaker leadership is essential to develop a plan for implementing assessments, to determine the role of each participating government organization and to assure effective international coordination. The policy leaders should represent the principal user of assessments provided by all participating agencies.

C. Designing National Assessment Plans

Each country should prepare a concise National Assessment Plan which can be used as the foundation to design, develop, test, implement and operationally use a Climatic Impact Assessment System. The plan should specify the lead policy agency. The plan should specify the role of each participating agency, its resources and how this assessment activity complements other activities within their assigned governmental mission. The plan should specify what division in the agency is responsible for preparing the assessment, the data and information to be included in the assessment, schedules for distributing the assessment and the list of agencies to receive the assessment.

The national plan should specify how the assessment activities of agencies will be organized. Two alternative yet equally effective, approaches for interagency coordination are suggested. The role of Coordinating Committees and the Regional AGRHYMET Center should be determined.

1. Informal Agreements

Because each government agency has a clearly defined mission, its assessment activities should conform with and contribute directly to the agency's assigned mission. The National Plan would specify when and how the agency's assessment report will be distributed to other agencies. Therefore, interagency coordination is attained by regular exchange of data and assessment reports. Agencies are not required to prepare joint reports, although informal coordination and a professional dialogue is beneficial. A typical plan would usually specify agency functions as follows.

a) <u>National Meteorological Service Function</u>

The meteorological service would be responsible for collecting required daily rainfall data, making quality control checks, computer processing the data, analyzing the weather events, using the data to monitor for and identify drought, determine the regional extent and severity of the drought (i.e., place an historical perspective on the drought by comparisons with previous drought occurrences), describe the qualitative impacts of the drought (agriculture, transportation, etc.) and publish all of this information for timely release to designated agencies. These agencies

would include the ministries of agriculture, rural development, public health, the food security agency, national planning agency and others. Various maps and tables containing current rainfall data and drought information could be included. It would be very important to include a monthly summary as an attachment to the decadal agrometeorological bulletin. The meteorological service would not forecast agricultural production or report the potential for food shortages. The climatic impact assessments are based on various agroclimatic index models (agroclimatic/crop conditions, soil moisture balance and drought/food shortage alert) which are most easily calculated on a computer. In some cases, the National Plan could specify that the indexes will be calculated on the AGRHYMET computer located at the National Meteorological Service. Computer printouts containing index calculations would be provided to the user agencies by the meteorological service.

b) Ministry of Agriculture Function

There are at least two offices in the ministry that need timely meteorological data and assessments from the meteorological service. The agricultural statistician needs that information plus agroclimatic/crop condition index tables. These are used to assess weather impacts on specific crops, determine crop conditions, make preliminary crop production forecasts and whenever possible combine the weather information with field information to improve agriculture production forecasts. The economist can use the products from the meteorologist and agricultural statistician as direct input for economic analysis involving food supplies, prices, markets, imports and exports and other applications.

c) Policy Function

Senior officials and their professional staffs can use reports from the meteorological service and agriculture service to assess the potential impacts of weather on food security, imports/exports, government economic policy and other factors associated with government administration.

2. Formal Interagency Agreements

As an alternative approach, agencies would co-locate key professional staff who would be assigned to prepare and distribute a joint assessment report. This approach can be highly effective, but requires maximum inter-agency coordination. Interministerial and regional coordination must also be included in the plan.

3. Coordinating Committees

The National Assessment Plan could include provisions for the formal establishment of professional, mid-management and policy level Coordinating Committees. These Committees would meet at least once a month to discuss a prepared agenda. Topics could include assessment methodology, assessment preparation, assessment of current conditions and discussion of new innovative assessment tools. Continuing dialogue is essential between users of assessments (what the user needs and in what format) and agency assessors (what they can do and what they would like to do in the future). Note: One process for coordination is already underway. It is termed "GDP" as defined in the March 1983 Operations Plan which provides regular meetings of Working Groups.

4. AGRHYMET Regional Center

National Assessment Plans should specify the role and mission expected of the AGRHYMET Regional Center. This could be divided into three types of support activities as follows:

- operational: using current weather to calculate indexes and providing these in an uninterpreted format to each country;

- applications: improving Sahel Country assessment methodologies based on results of applications research and field study findings; and

- training: providing regular training courses on the assessment methodology.

D. Proposed Implementation Plan

Four activities can be used by the policymaker to assure maximum coordination of agencies and timely implementation of the assessment plan. These include professional training, test assessments, in-country technical assistance and an evaluation seminar to discuss country programs and test results.

1. Professional Training Course

At least two qualified professionals from each country could attend a proposed two week training course to be conducted jointly by NOAA/AISC, AGRHYMET and USAID during April (or May) 1985, at the AGRHYMET Regional Training Center, Niamey. Participants from each country should include an agrometeorologist and an agricultural economist. Trainees would learn how to develop agroclimatic/crop condition assessment models based on host-country data, use these models plus weather analysis to prepare climatic impact assessments

and develop a preliminary impact assessment bulletin appropriate for their individual agency. The course would also focus on how host-country assessments could be used for drought impact early warning applications (weather monitoring, crop condition assessment and drought/food shortage alerts).

a) Qualifications of Professional Trainees: In general, a professional agrometeorogist and professional agricultural economist who are in service and in working level positions would be designated to participate in the training course and subsequent in-country test assessment activities. Trainees should have at least two years professional experience, preferably with at least a B.S. degree, and a thorough knowledge of agricultural practices in their country. They would be responsible for implementing agroclimatic/crop condition models and using these models to prepare test assessments for distribution. The agrometeorologist should be in the national meteorological service office which is participating in the AGRHYMET Project. The economist must be located in the government office which is responsible for conducting short-term economic analysis and making policy recommendations associated with agricultural forecasts and crop/weather problems. Each trainee should be skilled in basic statistical concepts and be capable of interpreting computer print-outs and making careful analysis of model results.

b) Training Course Agenda. An agenda will be developed jointly by NOAA and AGRHYMET. The focus will be on agroclimatic/crop condition index models which are based on rainfall data and basic agronomic information (statistical models are not used for operational assessments). The course is designed for 10 working days. Topics will include general meteorological and agricultural background information requirements, factors affecting crop yield variability, basic statistics, introduction to the assessment technology, development of index models, preparation of assessments and design of assessment reports- all within the framework of the country's national plan.

2. Quasi-operational Test Assessments

Following the Professional Training Course, host-country professionals will be ready to begin preparing and distributing decadal/monthly test assessment bulletins. These bulletins should begin with the June 1985 assessment. Senior policymakers and high-level ministers should be receiving reliable, timely assessments each month.

3. Evaluation Seminar

Although resources need to be identified, an Evaluation Seminar should be planned for late 1985. Host-Countries could report on their national assessment system, how well it worked, the benefits, and what they will do in the future.

E. Computer Resources

Although assessment system implementation does not require computers, there are two major computer resources available for the countries. These include the PDP-11 computer systems installed at the National AGRHYMET Center in most countries. These facilities are complemented by the computer system located at the Niamey Regional Center. AGRHYMET and NOAA/AISC are developing assessment model software for use on these systems. National plans should specify how these resources should be used in the assessment process. In particular, provisions have to be made for computerized reports being made available to the ministry of agriculture and other agencies.

VI. IMPLEMENTATION SCHEDULE

Task	Date
Conduct AGRHYMET, WMO, NOAA/NESDIS and USAID meetings; Prepare proposed Sahel Country Planning document	September 1984
Install and demonstrate NOAA Assessment Software/Data Bases on Niamey PDP-11 system	September 1984
Present Proposed Plan at Executive AGRHYMET Committee Meetings	October 1984
Submit Proposed Sahel Plan to CILSS	December 1984
Develop Individual Country National Assessment Plans	January 1985
Select Professional Participants for Training Course	January and February 1985
Conduct Two-week Professional Training Course in Niamey	April 1985 (or May 1985)

Begin Sahel Country Test Assessments in conjunction with AGRHYMET Regional Center (every 10 days with monthly summary)	May 1985
Provide In-country Technical Assistance (NOAA and AGRHYMET)	August 1985
Conclude Test Assessments	October 1985
Conduct Evaluation Seminar; Develop Follow-up Plans	November 1985

VII. TECHNICAL ASSISTANCE RESOURCES

At least two forms of technical assistance resources are available for program implementation. The first involves the strong commitment of the AGRHYMET project to focus on end users of AGRHYMET data resources and products. Emphasis on user applications could include national policymaking, drought/food shortage alerts, crop condition assessments, agricultural statistics, farmers' advisories, integrated pest management and potentially many other applications for socio-economic benefit. The second resource is the U.S. Agency for International Development's Office of U.S. Foreign Disaster Assistance (OFDA) which is supporting efforts to improve disaster preparedness programs in the Sahel Region.

OFDA through a formal agreement with NOAA/NESDIS Assessment and Information Services Center (AISC) has contributed resources to initiate implementation of National Climatic Impact Assessment Systems in the CILSS countries. This has included support for joint AISC/AGRHYMET meetings in Niamey (Oct. 1983 and Sep. 1984). AISC and AGRHYMET staff have worked jointly to design the activity, evaluate assessment modeling approaches and develop integrated assessment computer software for national and regional PDP-11 Computer systems. OFDA will also jointly sponsor the professional training course provide resources for in-country technical assistance missions before and after the training course.

VIII. FUTURE ACTIVITIES

Plans need to be established to improve the National Climatic Assessment Systems through additional training and the incorporation of improved assessment tools. Some follow-up activities could include:

- Training. Consideration should be given to the establishment of a formal training course on Climatic Impact Assessment Methodology. The course could be conducted at the AGRHYMET Regional Center on a regular

basis. Meteorologists, agronomists, economists, statisticians and other professionals could attend the course. There is also the potential for some professional training that could be provided at NOAA/AISC facilities in the United States.

Improved Assessment Tools. The assessment systems can be eventually improved by incorporating results of field studies and experiments (AGRHYMET and ICRISAT), by including methods for assessing crop conditions based on weather satellite information models being developed by NOAA/AISC and by adding more microcomputer technology (including "user friendly" software packages developed by NOAA/AISC).