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REQUIREMENTS NEEDS ANALYSIS AGRHYMET PHASE III

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

June, 1988

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AGRHYMET PHASE III

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Niamey, Niger

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

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NOTICE

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LIST OF ACRONYMS

ACMAD	African Center for Meteorological Applications for Development
AGRHYMET	Agriculture, Hydrology, Meteorology
AISC	Assessment and Information Services Center, NOAA
ARC	AGRHYMET Regional Center (Niamey)
ARTEMIS	Africa Real Time Environmental Monitoring Using Imaging Satellites
ASECNA	National Meteorological and Transportation Service
AVHRR	Advanced Very High Resolution Radiometer
CAC	Coordinating and Advisory Committee of AGRHYMET
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CLICOM	Climate Computing
CNAVS	Comite National d'Aide aux Victimes de la Secherese, supported by PNUD
CRTO	Regional Remote Sensing Center of Ouagadougou, Burkina Faso
CRTO	Centre Regional de Teledetection de Ouagadougou
DCP	Data Collection Platform
EEC	European Economic Community
EPSAT	Estimation des Precipitations par Satellite
EROS	Earth Resources Observations Systems, USGS, Sioux Falls, South Dakota
EWS	Early Warning System
FAO	U.N. Food and Agriculture Organization
FEWS	USAID Famine Early Warning System
GIEWS	FAO Global Information and Early Warning System
GIS	Geographic Information Systems
GRID	Global Resources Information Database of UNEP
GSFC	NASA Goddard Space Flight Center
GTP	Groupe de Travail Permanance (Permanent Working Groups NAC's)
GTS	Global Telecommunications System
ICOMHA	International Center for Operational Meteorology and Hydrology in Africa
IDA	Image Display and Analysis
ITCZ	Intertropical Convergence Zone
LAC	Local Area Coverage
LAS	Land Analysis System
NAC	National AGRHYMET Centers
NASA	National Aeronautic and Space Administration
NDVI	Normalized Difference Vegetation Index

NESDIS	National Environmental Satelite Data and Information Service, NOAA
NOAA	National Oceanic and Atmospheric Administration
OSCE	Office Statistique des Communautes Europeenes
PTT	Post and Telecommunications Office
RCSSMRS	Regional Center for Services in Surveying, Mapping, and Remote Sensing, Nairobi, Kenya
RNA	Requirement Needs Analysis
SAP	Systeme d'Alerte Precoce
SHARE	Software Help in Applications Research and Education
SWD&M III	Sahel Water Data and Management III Project
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UPS	Uninterruptable Power Supply
USAID	United States Agency for International Development
USGS	United States Geological Survey
WFP	World Food Program
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

AGRHYMET Requirements Needs Analysis

Current Situation

The CILSS/AGRHYMET Program has two components. The foundation consists of the National AGRHYMET Centers located in the member states. The national programs provide meteorological and hydrological data to the agricultural community. The Regional AGRHYMET Center in Niamey provides support and services to the National Centers. Its' purpose is to strengthen the capability of the National Centers to provide agrometeorological and hydrological information that can be used for resource management and early warning assessments.

The AGRHYMET centers currently have complete, but aging computer facilities for agrometeorological and hydrological analysis. At the end of Phase II, it was concluded that the computers should be replaced by equipment that is more feasible and sustainable.

Study Objective

The Requirements Needs Analysis was conducted to determine the specific form of USAID's Phase III assistance to the AGRHYMET program. It was prepared through an examination of the information needs of AGRHYMET users in Niger, Mali, Burkina Faso, Chad, Senegal, and Mauritania. A definition of the computer hardware and software required to meet project objectives was based on their needs.

Current Products and Users

The Regional Centers' main responsibility is to support the National Centers through products, training, and assistance in equipment maintenance. The Regional Center also provides decadal, monthly, and seasonal bulletins describing regional agrometeorological and hydrological conditions. The main users of the bulletins are international donors.

The National Centers collect basic meteorological and hydrological data. The data are analyzed to produce bulletins describing national agrometeorological conditions. The bulletins are used in Agriculture, Livestock, Water Resources, and Food Security Directorates and Ministries.

Phase III Products

The Regional Center should concentrate on providing the following products in the next two years:

Vegetation Index Data - The users in the National Centers believe that 1-kilometer vegetation index maps should be the key data contribution of the Regional center. For purposes of continuity and time series assessments, general vegetation index statistics such as has been provided by NOAA should continue to be provided.

Rainfall Probability - Maps should be generated during the season to address the probability of additional rainfall given the amount that has currently fallen.

Regional Bulletins - Bulletins should continue to be produced.

In the last three years of the project, several additional products should be developed:

Regional Rainfall Maps - There should be a major initiative to establish a Meteosat-based rainfall estimation system at the Regional Center.

Additional AVHRR Products - Including Intertropical Convergence Zone (ITCZ), biomass production, phenological development of principal crops, and locust infestation maps.

In the National Centers, the highest priority is the development of a comprehensive climate data base. A computerized historic data base will significantly enhance their ability to analyze country conditions and improve the effectiveness of their decadal bulletins.

Recommended Computer Systems

The AGRHYMET Regional Center does not need new computers to produce AVHRR products. The current VAX 11/780 is relatively new, dependable, and has a complete inventory of spare parts. The addition of memory, disk drives, color image display, large-format raster plotter, and image processing and

geographic information system software will provide sufficient capability to meet the Center's needs. Two VAX-compatible super-microcomputer should be added to the system within the next three years. One will replace the VAX and the other is needed for rainfall estimation mapping.

The Center will immediately need eight new IBM-compatible personal computers to meet the remainder of their needs. Systems will be configured for the following activities:

- Climate Data Base
- Agrometeorological Assessment and Bulletin Preparation
- Agrometeorological Applications Research
- NDVI Applications and Analysis
- Hydrology Data Base
- Hydrology Assessment and Modeling
- Communications
- Back-up Spare and Training

The Regional Center should surplus the PDP 11/34 and phase out the PDP 11/60's once software has been transferred to the VAX and personal computers.

The National AGRHYMET Centers should immediately switch from their PDP 11/34 minicomputers to IBM-compatible personal computers. Five computers are needed the first year. They will be used for:

- Climate Data Base
- Agrometeorology Bulletins and NDVI Analysis
- Hydrology Data Base
- Communications
- Back-up Spare and Training

Three additional microcomputers are scheduled for the National Centers in 1990-1991.

Training Requirements

A major element of the Phase III data processing improvements is training of AGRHYMET personnel. Training will cover all aspects of the new systems. However, emphasis will be placed on training users in applications of the microcomputer capabilities. Courses planned include:

- Decision Maker/Technician Workshop

- Computer Management and Maintenance
- In-Country Technical Training in Microcomputer Applications
- Climate Data Base (CLICOM)
- Microcomputer Applications for Agrometeorology and Hydrology
- Satellite Applications for Agroclimate Assessment
- Agroclimate Methods and Applications
- Preparation of Visual Aids

Technical Assistance Requirements

Four full-time staff are needed to meet program objectives (cf. Appendix L for technical assistance scope of effort). A Team Leader will serve as chief of party and function as both a technical councilor and as team liaison to other organizations. An Agrometeorologist is needed to develop applications for use in the National Centers. An Operations Production Supervisor with image processing and computer operations and maintenance skills will head the AVHRR products effort. The final position, NAC Client Representative, is outside the original scope of the project. It is needed to coordinate the required support to the National Centers.

A significant amount of short-term technical assistance will be needed throughout the program. Tasks requiring short-term experts include installation of equipment, implementation of AVHRR product generation procedures, development of agrometeorological models and methods, NDVI verification, assessment of rainfall estimation techniques, GIS planning, program planning, and training.

Finally, the complexity and diversity of the program will require technical backstopping by organizations with operational agrometeorological and AVHRR processing experience.

Concerns

There are risks associated with this program. It will require organization, planning and strong management to be successful. The infusion of the technology and staff into the AGRHYMET Program is not enough. There must be the backing of top-level management if the program is to be effective.

1.0 STUDY CONSIDERATIONS

1.1 SCOPE OF EFFORT

The scope of effort was defined in the Participating Agency Service Agreement (PASA) Statement of Work between the U.S. Geological Survey (USGS) and the U.S. Agency for International Development (USAID) - PASA #AFR-0510-P-GS-7022-00. The EROS Data Center of the USGS National Mapping Division was responsible for the completion of the study.

1.1.1 OBJECTIVES

As stated in the Statement of Work, the Requirements Needs Analysis (RNA) team "will prepare a report that will serve as an updateable 5-year data processing plan that will allow the acquisition of an initial hardware/ software and support configuration for the AGRHYMET Regional Center (ARC) and member National AGRHYMET Center's (NAC's). It will also provide direction for the continued development of AGRHYMET data processing systems".

"The RNA will look at both the needs of the ARC in Niamey, Niger and the user requirements of selected NAC's. It will be developed with a recognition and general understanding of the collaborative relationships of other donors and participating organizations including WMO, FAO, CILSS, ACMAD, FEWS, GIEWS, and others (see List of Acronyms). The RNA will include the user requirements for products and services from Advanced Very High Resolution Radiometer (AVHRR) data, and to the extent possible, administrative, financial, and human resource requirements relating to agrometeorological, meteorological, and hydrological data processing." More specifically:

(1) Conduct a user needs survey in Burkina Faso, Mali, Niger, and Chad NAC's to identify the types, formats, frequency, and quantity of desired products and services;

(2) Define and recommend the analysis capabilities and training needed to satisfy user needs at both ARC and the member NAC's;

(3) Review the AGRHYMET Program's existing data processing capabilities related to collection, storage, archiving, analysis, and dissemination of agrometeorological, meteorological, and hydrological data;

(4) Define and recommend the computer hardware and software needs and supporting training and logistical requirements for both ARC and the member NAC's;

(5) Prepare computer hardware and software specifications that can be used in an RFP for the procurement of required facilities."

The team was also, informally, asked to make observations and suggestions about other aspects of the program which might come up as part of our work.

1.1.2 METHODS

In each of the countries visited, the RNA team met with individuals from two major groups: those in-country responsible for collecting agrometeorological, climatological, and hydrological data and creating of products from these data; and the users of these data and products within the countries (international development agencies (eg. USAID), regional projects (eg. FEWS, IWACO), and government ministries).

The team usually began at the agrometeorological and hydrological centers. They may inventories of equipment and software used, looked at copies of regular products created by the centers, and interviewed all key people. Interviews were usually in French, though many could be held in English as a number of the AGRHYMET personnel have received their training in the United States.

For a complete list of persons contacted in each country, see Appendix A, which is followed by specific country by country reports of field visits (Appendices B - G).

1.1.3 SCHEDULE

Week One:	Sioux Falls, South Dakota (USGS/EROS Data Center)
Week Two:	Washington, D.C. to visit USAID and other U.S. Government agencies, and Geneva, Switzerland to visit World Meteorological Organization
Week Three:	Niamey, Niger to visit with ARC and Niger NAC
Week Four:	Burkina Faso to visit with NAC, and Paris, France to meet with French engineering company providing AVHRR satellite reception station
Week Five:	Mali to visit with NAC
Week Six:	Niger to present draft of RNA document to USAID/Niger and Rome, Italy to meet with FAO

Week Seven:	Computer specifications prepared in USA
Week Eight:	Computer specifications prepared in USA
Week Nine:	Final RNA document review and comments in Washington, D.C.
Week Ten:	Final RNA document presented to USAID/Washington

1.1.4 TECHNICAL TEAM

The Requirements Needs Analysis Team was assembled by the USGS EROS Data Center and was comprised of both USGS/EROS staff and representatives of other agencies. The team included:

Dr. Richard A. Swanson, Team Leader, Agricultural (FSR)/Natural Resources Specialist and Development Anthropologist, USGS

Mr. Thomas Loveland, AVHRR-GIS Specialist, USGS

Dr. Bruce Quirk, Computer Software Specialist, USGS

Mr. John Boyd, Electrical Engineer/Computer Systems Specialist, USGS

Mr. Gray Tappan, AVHRR Applications Specialist, USGS

Dr. Clarence Sakomoto, Agricultural Meteorologist, NOAA/NESDIS, Columbia, Missouri

Mr. Mitch Kemp, Computer Hardware/Software - Computer Logistics/Procurement Specialist, USAID/Information Resources Management, Washington, D.C.

1.2 STATED OBJECTIVES OF THE AGRHYMET REGIONAL CENTER

The AGRHYMET Regional Center is to provide services to the CILSS National AGRHYMET Centers. These services are for the purpose of strengthening the capability of the NAC to provide agrometeorological and agroclimatological information to improve food production and water resource management as well as to provide early warning assessment for food security. The functional services of the ARC include:

1. Providing regional operational products on spatial information over the CILSS countries. Examples of these products are rainfall probability maps, satellite vegetation index data, satellite-derived rainfall maps, and soil moisture maps.

2. Conducting and coordinating training courses on a broad spectrum of needs to fulfill the AGRHYMET mission. These include, but are not limited to meteorology, hydrology, agroclimate applications microcomputer applications, computer programming, and telecommunications.

3. Conducting applied research for using climate, satellite and agricultural data for the purpose of improving information for agricultural and water resource management as well as for early warning assessment.

4. Developing and maintaining a regional data bank of quality checked data and station history information. These data include climate, selected agricultural and satellite data as well as additional data required to meets its mission.

5. Developing/acquiring standardized software packages in such areas as data base management, agroclimatic applications, and statistical analysis, and distributing them to the NAC's.

6. Providing equipment maintenance services and advice as well as logistical supply support to itself and the NAC's.

1.3 STATED OBJECTIVES OF THE NATIONAL AGRHYMET CENTERS

The National AGRHYMET Centers are represented in the CILSS member countries by the official meteorological and hydrological services of each government. Their objectives are to basically provide agrometeorological and agroclimatological services to the agricultural and hydrological user community. A major objective of the AGRHYMET program is to improve resource management as well as to provide information for early warning assessment and food security. The functional services of the NAC's include, but are not limited to:

1. Collection and archiving of basic hydrological, meteorological, climatological and agrometeorological statistical data originating from various in-country field stations.

2. Contributing data summaries to the Multi-disciplinary Working Groups (GTP). The GTP is created from technical personnel from various government and non-government agencies in each country with agrometeorological information derived from meteorological, satellite and phenological observations.

3. Collaborating with the AGRHYMET Regional Center by providing operational weather and climate data, and phenological and agricultural pest information as necessary as well as coordinating applied research activities and needs.

4. Maintaining computer operations, software libraries, and coordinating software requirements with the ARC.

2.0 AGRHYMET USER COMMUNITY

The AGRHYMET user community is diverse and varies depending on the component of the program - National AGRHYMET Centers (NAC) or the AGRHYMET Regional Center (ARC) - and the specific activity of the program (data, products, and services). While there is overlap, each program and activity tends to have a unique constituency.

2.1 AGRHYMET REGIONAL CENTER

ARC has currently two main users - the NAC and the international community. The NAC's benefit from training programs and support services relating to supplies and equipment maintenance. This will continue to be a major area in the next five years. The NAC's are not currently major users of ARC data or products (such as the regional bulletins). This is expected to change in Phase III. The AVHRR reception facility will provide both data and new products that will be of use to the NAC's.

The primary users of the products available through ARC are the international community and African regional organizations. These users do not participate in other ARC activities. The AVHRR facility will likely be a source of data that will increase this groups' use of ARC products. A partial list of users of the ARC products include:

International Organizations

- European Economic Community
- World Meteorological Organization
- Food and Agriculture Organization
- United Nations Development Program
- World Food Program
- U.S. Agency for International Development (including the Famine Early Warning System - FEWS)
- Government of France
- Foreign Embassies

Regional Organizations

- CILSS
- OCLALAV
- Panafrica Press
- Comite Interafricain Etudes Hydrauliques

2.2 NATIONAL AGRHYMET CENTERS

The NAC's provide data and products to a large, diverse group. They are not currently a formal provider of training.

The NAC's are the primary data collection component of the AGRHYMET program. The meteorological, climatological, and hydrological stations distributed throughout each of the member countries provide the data available through either the respective NAC's or ARC. Data are regularly transferred to ARC, and in both a regular or as needed basis, provided to government agencies in each country. To a lesser extent, the international and regional organizations receive data from the NAC's. For example, the USAID Famine Early Warning System (FEWS) receives data from some of the NAC's.

The NAC agrometeorological and hydrological bulletins are used by host governments, international and regional organizations, and in some cases, the national citizenry. Some countries, for example, broadcast information from the bulletins over national radio to help farmers and pastoralists in their decision making. Perhaps the key user in all the countries is the Multidisciplinary Working Group (GTP) that meets to assess the agricultural outlook and review the food security situation. This group is made up of representatives from many ministries and agencies. While the list of government users vary for each country, the following is a list of the common users:

- Meteorological Service
- Hydrological Service
- Ministry of Agriculture
  - Agricultural Statistics
  - Crop Protection Services
- Ministry of Water Resources
- Ministry of Environment
- Ministry of Livestock
- Drought Commission
- Food Security Directorates
- National Early Warning Systems

3.0 DATA ACQUISITION

3.1 AGRHYMET REGIONAL CENTER

3.1.1 PRESENT DATA ACQUISITION/TRANSMISSION

The Global Telecommunication System (GTS) is the heart of the communication system in the AGRHYMET program. It consists of land-line, microwave and satellite transmission and receiving capabilities (see Figure 3-1). The NAC's collect their synoptic station reports, summarize them for 10-day periods and transmit these data to a hub such as Dakar. Dakar receives the data from Bamako, Mali, Nouakchott, Mauritania, Banjul, Gambia, and Cape Verde and transmits these data via satellite to Niamey. Ouagadougou, Burkina Faso and N'Djamena, Chad transmit their data through land-line. Commercial TELEX system is also used where urgency is necessary.

Each 10-day period during the rainy season (May through October), the ARC is scheduled to receive summarized data from the NAC for about 210 stations. Satellite transmission from Dakar to Niamey is reliable; however other modes of transmission are prone to break down. Consequently, percent receipt is not as high as desired. Effectively, only about 60 percent of these stations are received on time each 10-day period. About 80 percent of the stations report with delays of 10 to 20 days. This record is not very good and indicates that telecommunication is one of the major problems in the AGRHYMET program. Until the basic communication system is improved, reporting progress can be expected to be very slow.

The Italian funded telecommunications study recommended a several phased approach to improving telecommunications. The one short term recommendation made in the Italian study was to investigate telephone communication via modem between the NAC's and the ARC. This has been investigated by ARC personnel and shows positive possibilities. These investigations should continue. One concern might be the expense of such types of telecommunications.

3.2 NATIONAL AGRHYMET CENTERS

3.2.1 PRESENT DATA ACQUISITION/TRANSMISSION

The system of telecommunication from the field synoptic stations to the NAC's is based on radio transmission in

L'insertion du Centre AGRHYMET dans le réseau spécialisé météorologique (SITI).
Place of the AGRHYMET Center in the network specialized in meteorology (GTS).

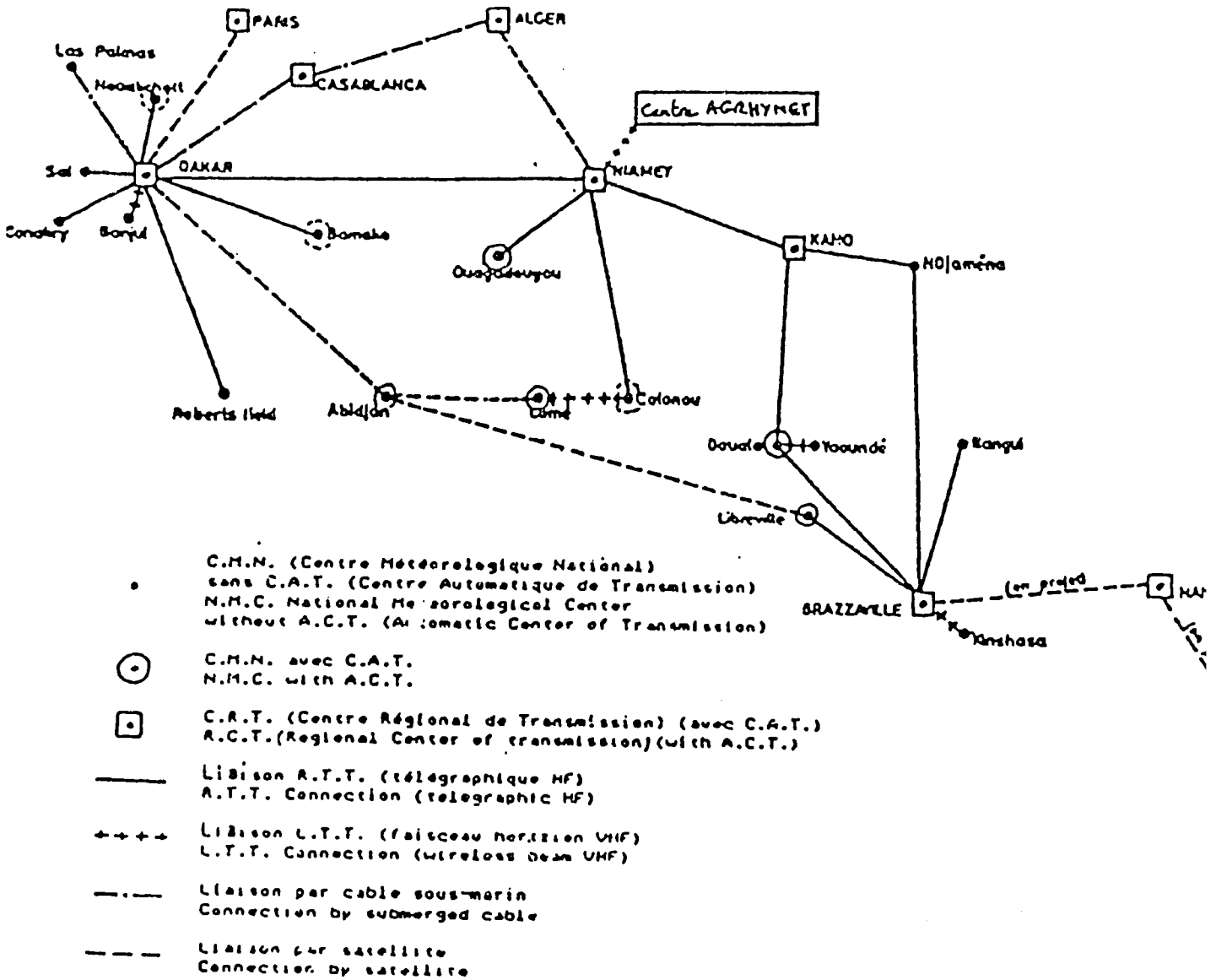


Figure 3-1 AGRHYMET Global Telecommunications System Network

standardized synoptic codes. In most countries, these messages are received by ASECNA, located at the national airport and then communicated to the Meteorological service. In some instances, the Meteorological services are able to obtain these data at the same time that ASECNA receives it by using their own SSB radios. The number of these sites vary from country to country (estimated between 9 and 50) and is associated with ASECNA. Its' primary service is for aviation; consequently agrometeorological activities command a lower priority which affects communication from the NAC to the ARC.

Station reports are sent by the Single-Side Band (SSB) radio. The message is voice transmitted in a format accepted by the CILSS countries. Variables include temperature, precipitation, wind, visibility, pressure, humidity, evaporation, soil temperature, phenology observation and other remarks including unusual meteorological phenomenon such as dust or thunderstorm. Although observations are made each hour, only 3-hourly observations are transmitted by SSB to the NAC's. These are transmitted daily. At the end of each month, the entire records at the synoptic station are sent to the NAC for their archival record and disposition.

Each 10-day period during the rainy season (May through October), the daily data are summarized and transmitted to the ARC in a synoptic code group that includes station identification, temperature (maximum, minimum), rainfall total (including rain days), sunshine, evaporation, soil temperature and phenological observations (crop stage), and pest information.

3.2.2 NAC STATION NETWORKS

Each NAC has its' own system of weather stations (see Figures 3-2 through 3-4). These include:

Synoptic stations
Agrometeorological stations
Climatological stations,
Supplemental rainfall stations

In addition, the Hydrological Service also has its own network of hydrologic stations.

Synoptic stations report in real-time through SSB radios or telephone lines. They report specific types of data for mainly aviation purposes, but because of cost and expediency, these stations may also report on some agricultural

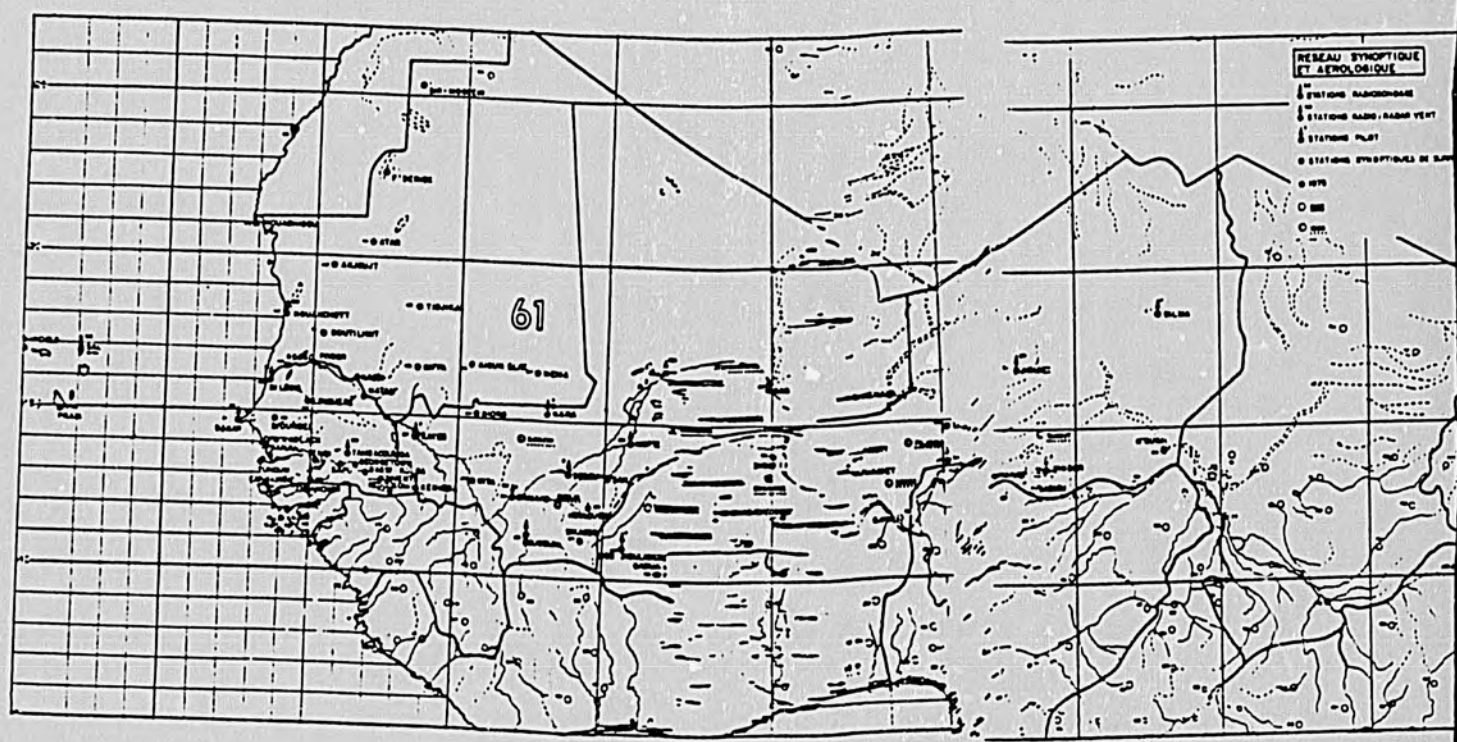


Figure 3-2 Locations of AGRHYMET Synoptic Stations

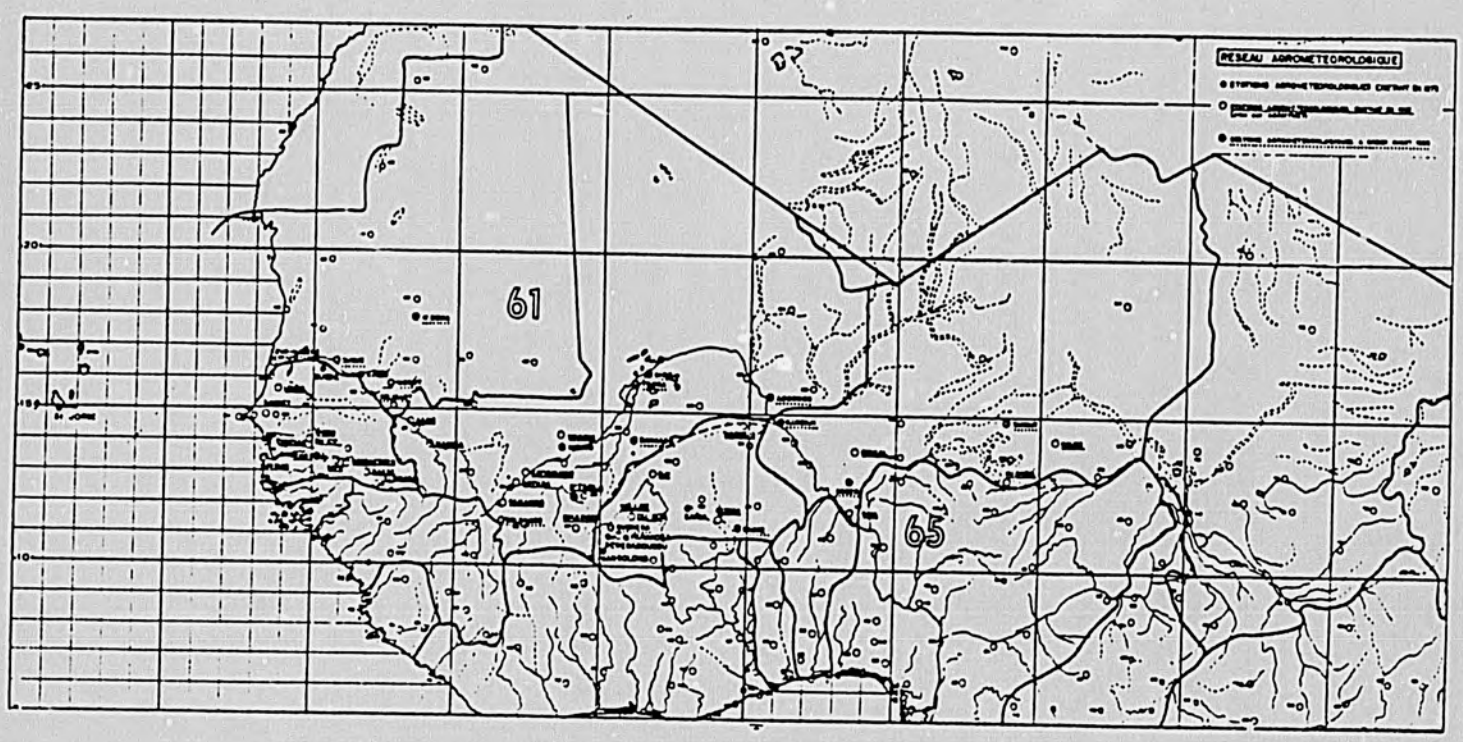


Figure 3-3 Locations of AGRHYMET Agrometeorological Stations

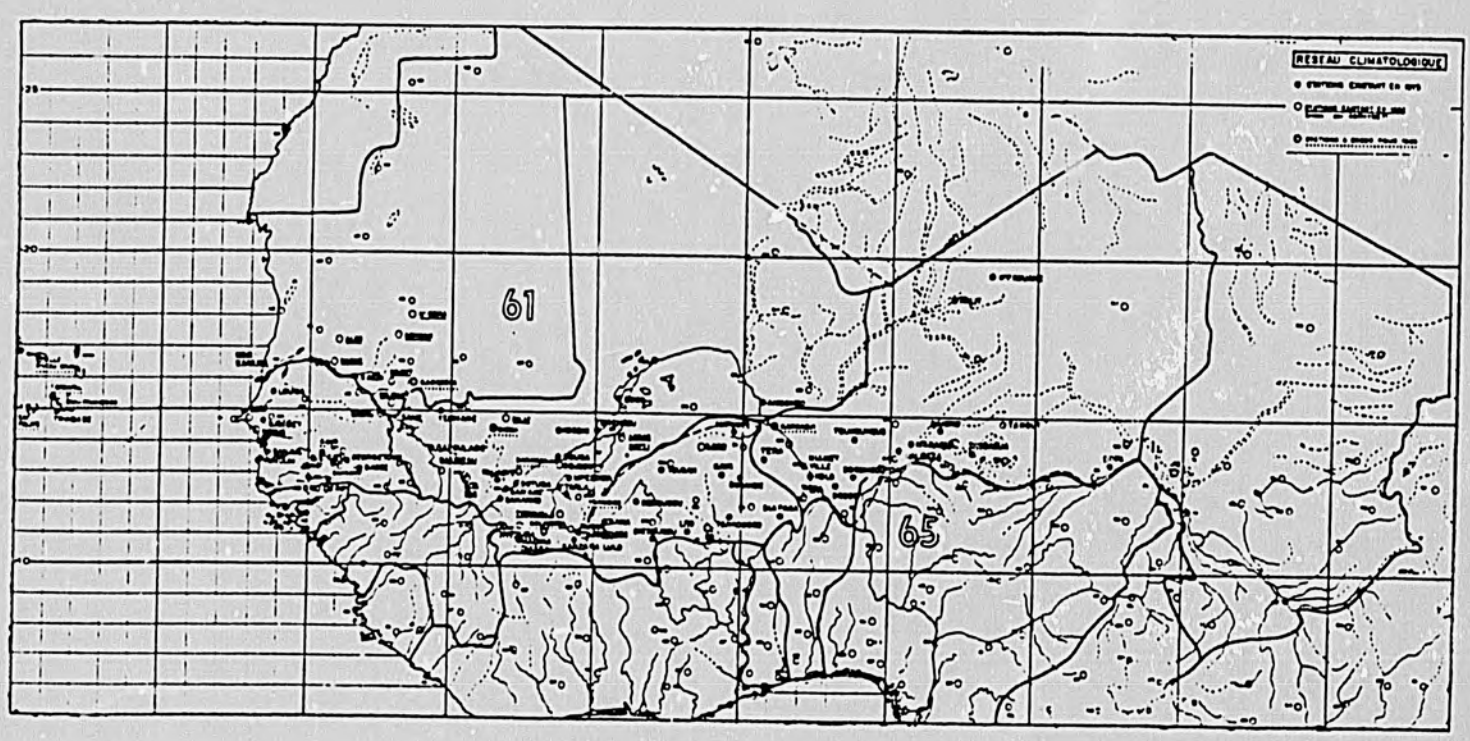


Figure 3-4 Locations of AGRHYMET Climatological Stations

related variables (eg. rainfall, soil moisture, evapotranspiration, and crop observations).

Agrometeorological stations record basic variables including:

Precipitation
Air temperature (maximum/minimum)
Soil moisture
Soil temperature (at different depths)
Evapotranspiration (ETP)
Wind speed and direction
Humidity
Day length
Solar intensity.

These may or may not be reported in real-time to the NAC's. This reporting is a function of available SSB radios for the site.

The most numerous station networks in each country are made up of hundreds of rainfall centers, where only daily rainfall is recorded. The records are sent on a monthly basis to the NAC's. Because those taking the readings at such stations are paid very little, and often not at all, records are often poorly kept or missing for entire periods of time. In addition to this network of stations, there are usually numerous other rainfall recording stations in the country kept by other organizations, some government, but many private.

The climatological station network collects primarily rainfall and in some cases, temperature data. These are often communicated through slower methods such as regular mail or hand delivery.

The hydrological station network may include some of the synoptic stations or agrometeorological stations as part of its system of information. In any particular country, there may be an overlap or in some cases no overlap of stations between the hydrological and meteorological station networks. This is because they often represent different government services. In some cases, the Meteorological Services may not be aware of other sources of data taken in the country, particularly of the observations taken informally. In some countries, government Ministries may also collect their own data with may or may not be given to the country's Meteorological Services. The various institutions (Meteorological, Hydrological) keep track of their own records, but also share when possible.

The Hydrological Services also record river gauge data such as rate of flow and water depth at selected sites along rivers, lakes and dams. Results are published in decadal bulletins and distributed to their own network of users.

3.2.3 FUTURE DATA ACQUISITION/TRANSMISSION

A high priority should be placed on equipping the field stations with solar powered SSB's. The current diesel/batteries configuration has been a major source of breakdown, as is the cost and availability of fuel for generators. Timely and reliable data acquisition must begin from the field. The team observed a solar powered SSB in Burkina Faso and was informed that a similar unit adjacent to the synoptic station has lasted for four years. A potential problem exists with damage from wind blown sand. A more serious problem results when solar panels are insufficiently protected (from animals, people). Besides gridded wire coverings, the units need to be placed high enough (at least 2 meters) to be out of the way of roaming animals or people.

The RNA team was informed that the Italians have committed to improving the SSB capabilities in each country. In addition, the French plan to test the telephone lines for modem to modem communication at various locations. Preliminary tests have been completed from Burkina Faso to Niamey, from Dakar to Niamey, from France to Niamey and from Niamey to New York. Further tests are planned during the rainy season.

The NAC's will need trained staff to implement and maintain an improved communication system. The USAID Mission in each country can play an integral part of the NAC program by supporting communications training and equipment.

4.0 PRODUCT GENERATION, DISTRIBUTION, AND USE

4.1 REGIONAL CENTER

The arguments for ARC products are fairly straight forward. Rainfall isohyets (lines of equal rainfall) are not discontinuous at political boundaries, nor do locusts, grasshoppers, or crickets respect national borders. Drought conditions often have a regional impact impacting movements of people and food, spread of disease, and creating social unrest. The NAC's need to be aware of data from neighboring countries because weather systems do influence adjacent areas. Furthermore, specific software applications or even products generated may be beyond the resource capabilities of the NAC to design or maintain/update (e.g. satellite products, commonly used software analytic programs).

4.1.1 CURRENT OPERATIONAL PRODUCTS

Four products were produced in 1987. They are scheduled to be available for the 1988 agricultural season - if there is adequate ARC personnel resources and management support.

4.1.1.1 REGIONAL DECADAL BULLETIN

The Bulletin AGRO-HYDRO-METEOROLOGIQUE Decadaire Regional is released approximately five days after the end of every 10-day period during the growing season (see Appendix K for example). This bulletin usually consists of four pages of information, plus two maps. The contents include a general description of regional meteorological conditions, rainfall distribution and anomalies, vegetation and agricultural situation including the hydrologic balance, phenology, insects and other pest conditions, pasture conditions. A general resume is provided for each country. Stream flow for the major rivers are also provided. The maps depict spatial and cumulative rainfall, anomalous areas and spatial crop condition for the region.

This bulletin is transmitted via telex to a select group of international clients such as the UNDP, FAO, WMO, and CILSS. This mode of communication is limited because of cost. In 1987, the ARC spent 10 million CFA for this service alone. While it is difficult to justify the cost, other modes of transmission are unreliable and slow, and many users require timely information. Some bulletins are telefaxed to selected

users, adding to the cost. Various international organizations, embassies, and AID missions working in Niger receive a courier-delivered copy. The bulk of the users receive their bulletin through the mail. The total number of users in 1987 was about 400.

Users indicated the usefulness of the bulletin in giving a rapid overview of the progress of the season on a regional basis. However, many indicated that the bulletin did not arrive in a timely fashion, and therefore was not used.

4.1.1.2 REGIONAL MONTHLY BULLETIN

The Bulletin Regional de Suivi et d'Evaluation de la Saison des Pluies Dans Les Pays du CILSS is provided to users primarily for retrospective analysis and historical interest. It consists of data and information which have been aggregated to a monthly period. Additional information include average position of the Intertropical Convergence Zone (ITCZ/FIT) position including three decadal positions, gridded satellite normalized difference vegetation index (NDVI) from NOAA/NESDIS.

Users at the NAC's did mention this bulletin as a useful product from the ARC - most likely because of the limited numbers distributed. Based on a new prototype document reviewed by the RNA, improvements can be made to future bulletins which should increase its usefulness.

4.1.1.3 SEASONAL REGIONAL EVALUATION

This product, last produced in 1986 summarizes the season during the past year. It is completed several months after the end of the growing season and is primarily of historical interest and for verification of special problems. Users at the NAC's with whom we spoke did not mention this bulletin as a useful product from the ARC.

4.1.1.4 NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI) DATA

In 1987, NOAA/NESDIS provided weekly NDVI data for 1/2 by 1 degree latitude/longitude grids to all CILSS countries except Cape Verde. These were produced in Columbia, Missouri under an AID PASA and were telexed to the ARC. The data were received approximately 7 to 10 days after the last date of the satellite observation. Upon receipt of these data, an automated process was used to send each country their necessary grid data through GTS.

Users at the NAC's indicated that these data were very late or not received at all. They have received the training necessary to utilize these data when received and all users expressed their belief in the usefulness of this product as an early indication of seasonal progress in distant and often poorly monitored regions of their countries. A desire was expressed for a continuation of this service -at least until something with more spatial detail could be obtained.

A possible reason for the delays in reception from the ARC was attributed to the unreliable ASECNA-based GTS through which AGRHYMET must transmit their data. Nevertheless, this product was unique and demonstrated the type of assistance the ARC can provide to the NAC's to add to their information flow.

4.1.2 CLIMATOLOGICAL PRODUCTS

This type of product is based on the analysis of what has occurred (e.g. historical analysis to provide probability of rainfall at given periods as the season progresses). There is currently no periodic or systematic operational task to provide this type of information because the analysis, presently led by Dr. Morel at Niamey, will not be completed until June, 1989. One of the products of this research will be a regional atlas. Other country results may be provided on an ad hoc basis when the NAC's request them.

After review of the progress made on the regional atlas and accompanying data sets, it is apparent that the results could easily be included as one of the operational products. The user community would certainly find these basic data sets and their analyses extremely useful.

4.1.3 FUTURE REGIONAL PRODUCTS (1988-1989)

The following are suggested regional products that could be provided starting in 1988-1989. The philosophy of these products is to provide additional information to the NAC's and to add to their capabilities. The ARC's own credibility and ultimate survival will be linked to the extent to which it will be able to provide the NAC's with relevant new products and training which are currently beyond the NAC's evolving personnel/financial resources. These have been listed according to recommended priority.

In addition to the new products, those products described in Sections 4.1.1.1 through 4.1.1.3 should be continued.

4.1.3.1 NDVI - LATITUDE/LONGITUDE GRID

This product must be continued - as an operational ARC product. The capabilities to produce the data are either currently available or will soon be installed as part of the French AVHRR reception station. The ARC should start providing the data to the NAC's as soon as possible.

4.1.3.2 NDVI - LOCAL AREA COVERAGE (LAC) MAPS

The AVHRR data that will be directly received at ARC has a nominal resolution at nadir of 1.1 kilometers (the data are referred to as Local Area Coverage - or LAC - data. These relatively high resolution data are frequently spatially degraded prior to their use. For example, the latitude/longitude grid and eight-kilometer FAO/ARTEMIS NDVI data are sampled from the original 1.1 kilometer imagery.

The one-kilometer data can be used in the same way as the sampled data. However, the higher spatial resolution expands data utility and the potential range of applications. LAC NDVI maps have been produced operationally for selected countries as part of USAID grasshopper control projects and FEWS by the USGS, EROS Data Center (Figure 4-1). These products are produced by aggregating maximum vegetative index values over a two week period. Such maps have been sent directly to the users in selected countries in 1987 and 1988.

In-country users of NDVI LAC maps have shown a very strong preference to these products over the more general gridded NDVI data - though they wish to receive both products until such a time as they are better trained to interpret the LAC imagery.

4.1.3.3 NDVI DIGITAL PRODUCTS

The same LAC NDVI data used to produce maps might also be provided directly to the NAC's in the form of a diskette which could be displayed using a color monitor for internal analysis and use. Microcomputer-based capabilities can be provided to permit display of this satellite imagery and some statistical analysis capabilities.

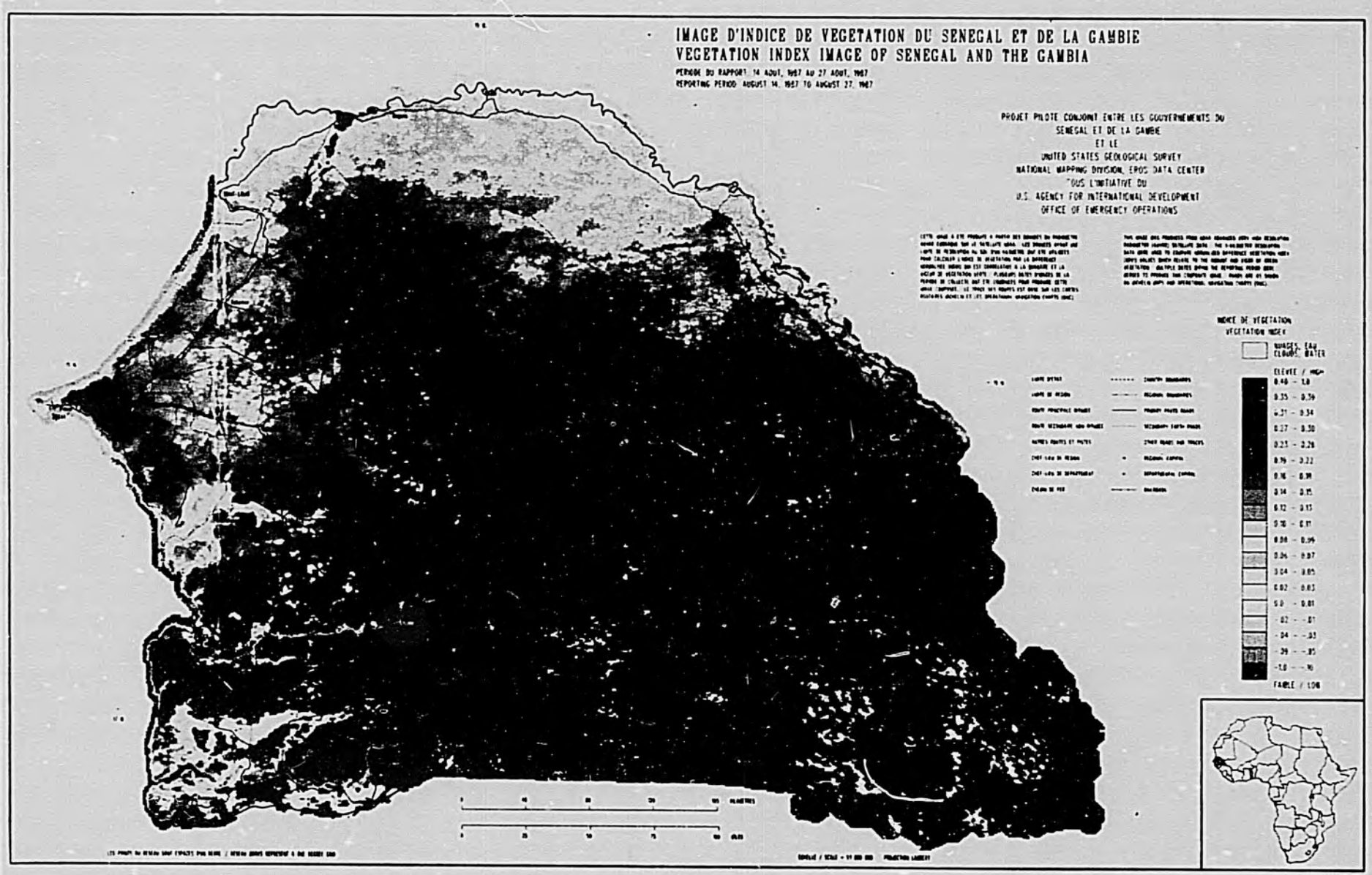


Figure 4-1 Example Product - Senegal NDVI LAC Map

4.1.3.4 RAINFALL PROBABILITY

Regional probability maps should be generated during the season to address questions such as: given that a certain amount of rain has fallen, what is the probability of receiving a specified additional amount? Both tabular and spatial summaries representing each 10-day period is needed.

4.1.4 FUTURE REGIONAL PRODUCTS (1989-1991)

There are other useful products that could be developed in Phase III. These have been designed by the staff at the ARC, but using the newer data processing capabilities that will be provided to the NAC's, these examples can be improved considerably. The products could be displayed on a computer monitor, printed for reports, and if telecommunications are improved as planned by the Italians, transmitted to the NAC's in near real time.

These future products presuppose that an improved telecommunication system is incorporated into the system in 1990 and 1991. Rapid telephone modem to modem data transfer is assumed and even preliminary satellite transmission incorporated into the network.

4.1.4.1 INTERTROPICAL CONVERGENCE ZONE

With the acquisition of satellite data, the position of this zone can be monitored and provided on a timely and periodic basis. The position relative to a referenced period (e.g. previous year, previous decade, normal) would be useful to the NAC,s (Figure 4-2).

4.1.4.2 REGIONAL RAINFALL MAPS

Recent advances in estimating rainfall from satellites, such as Meteosat, have led to optimism for securing better spatial information about this variable in the Sahel. Regional rainfall maps would be extremely helpful to NAC's where a sparse meteorological station network has handicapped their ability to obtain better data. When the NAC's are able to combine their ground observed data with satellite-derived rainfall data, it is reasonable to assume that a quantum increase in information could be achieved (Figure 4-3). The provision of this product should be a major initiative started at the mid-point of Phase III.

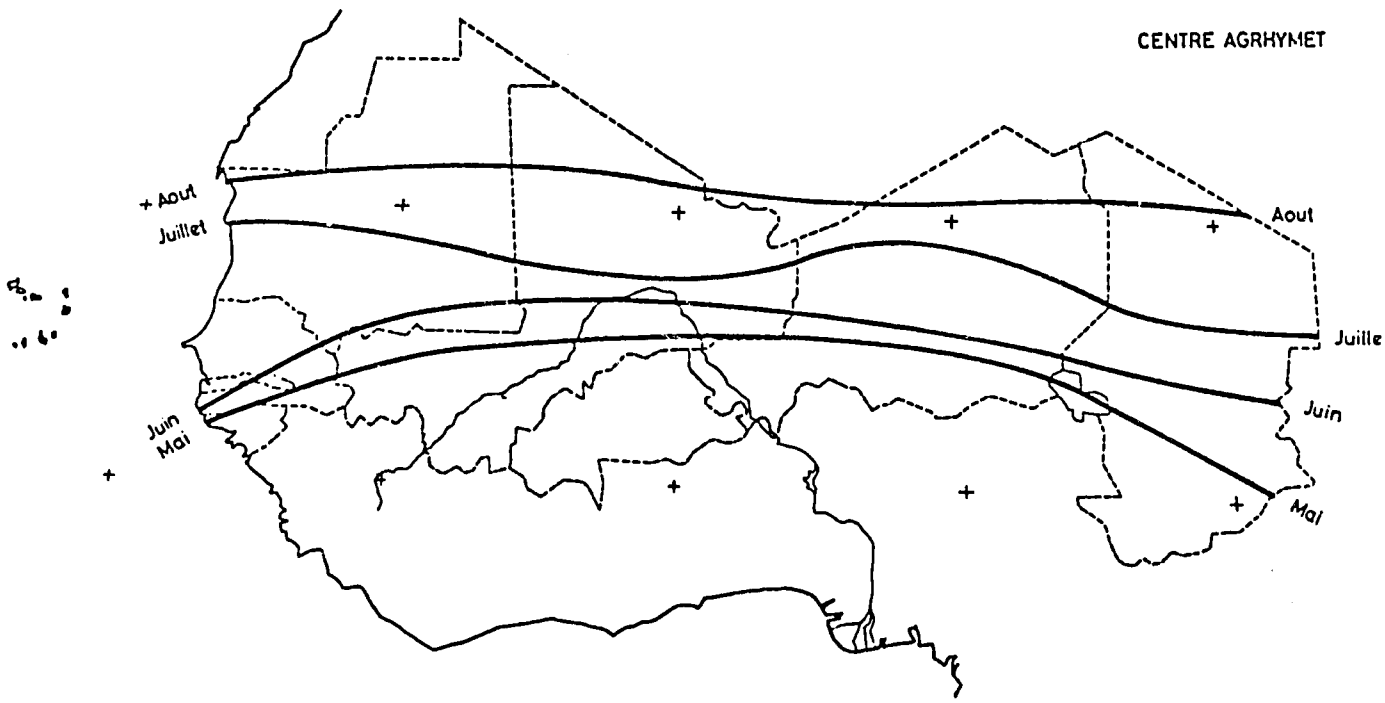
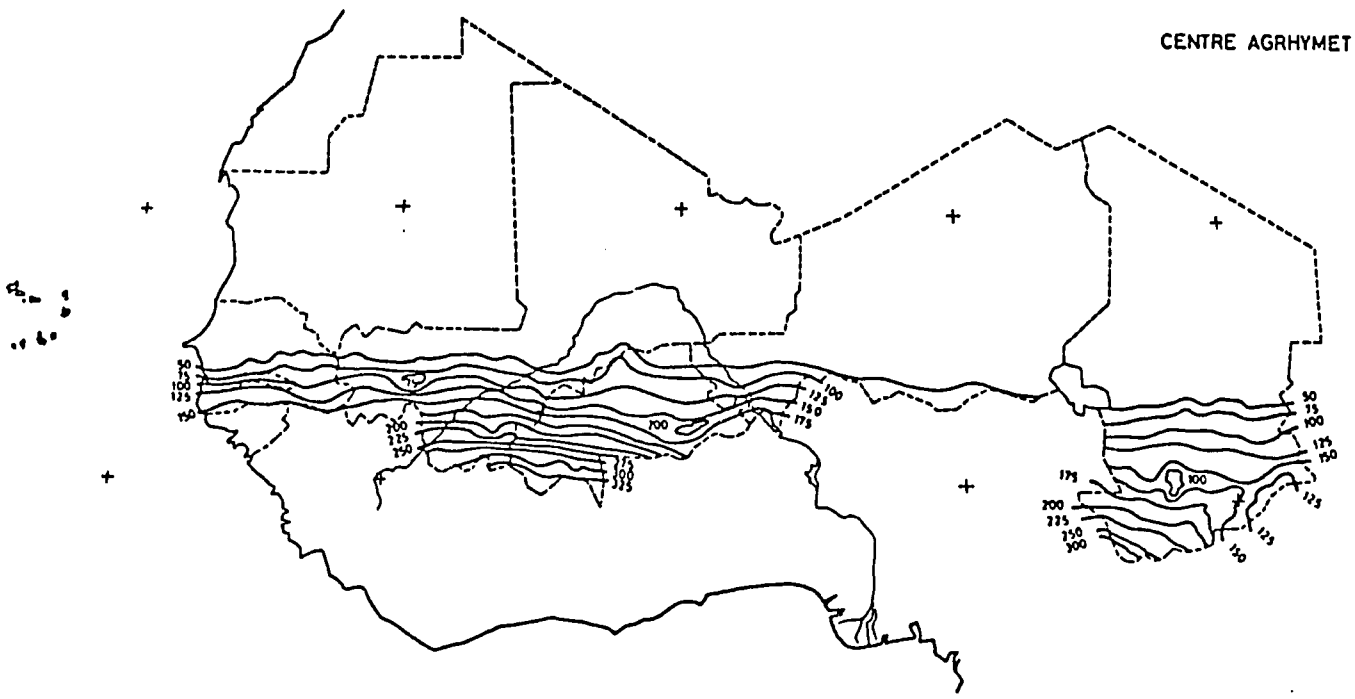


Fig. Positions caractéristiques moyennes du FIT de Juin à Aout

Figure 4-2 Example Product - Intertropical Convergence Zone



Pluviométrie cumulée au 10 Juillet 1991 déterminée par satellite (intervalle de confiance à 95% ± 25 mm)

Figure 4-3 Example Product - Regional Rainfall Map

4.1.4.3 BIOMASS DEVELOPMENT

Regional progress of green-up relative to a referenced period is a potentially useful tool in early warning crop assessment. Spatial depiction on a regional basis can isolate problem areas where a more detailed analysis can be provided by higher resolution satellite data (Figure 4-4).

4.1.4.4 PHENOLOGICAL DEVELOPMENT OF PRINCIPAL CROPS

This product is an essential data base for crop assessment. When used in connection with other products (e.g. soil moisture, satellite imagery, vegetation index time series, and rainfall probability), a rational basis for forecasting crop production can be developed (Figure 4-5).

4.1.4.5 POTENTIAL LOCUST INFESTATION

This product is an integration of field reports, combined with information including rainfall, NDVI data, position of the ITCZ, and wind. As with the other products, this depicts regional assessment. The NAC's must then use their additional information sources and resources to secure a more refined localized assessment of the situation (Figure 4-6).

4.1.4.6 THERMAL FIELDS FROM NOAA SATELLITES

Thermal fields from NOAA satellite data can be used to depict ground surface temperature. Areas of extreme temperature is an important consideration of the state of the crop as well as the condition of the rangeland. Temperature fields can also be used as an indirect and qualitative measure of soil moisture and possibly a tool to detect recent rain areas by monitoring changes in surface temperature.

4.1.4.7 GEOGRAPHIC INFORMATION SYSTEMS

All of the products described require geographically based data and spatial analysis methods. These tools could be made available to the NAC's through the establishment of an appropriate GIS. GIS capabilities in the NAC's will improve their analytic capabilities and also improve the utility and quality of products and services available to their users.

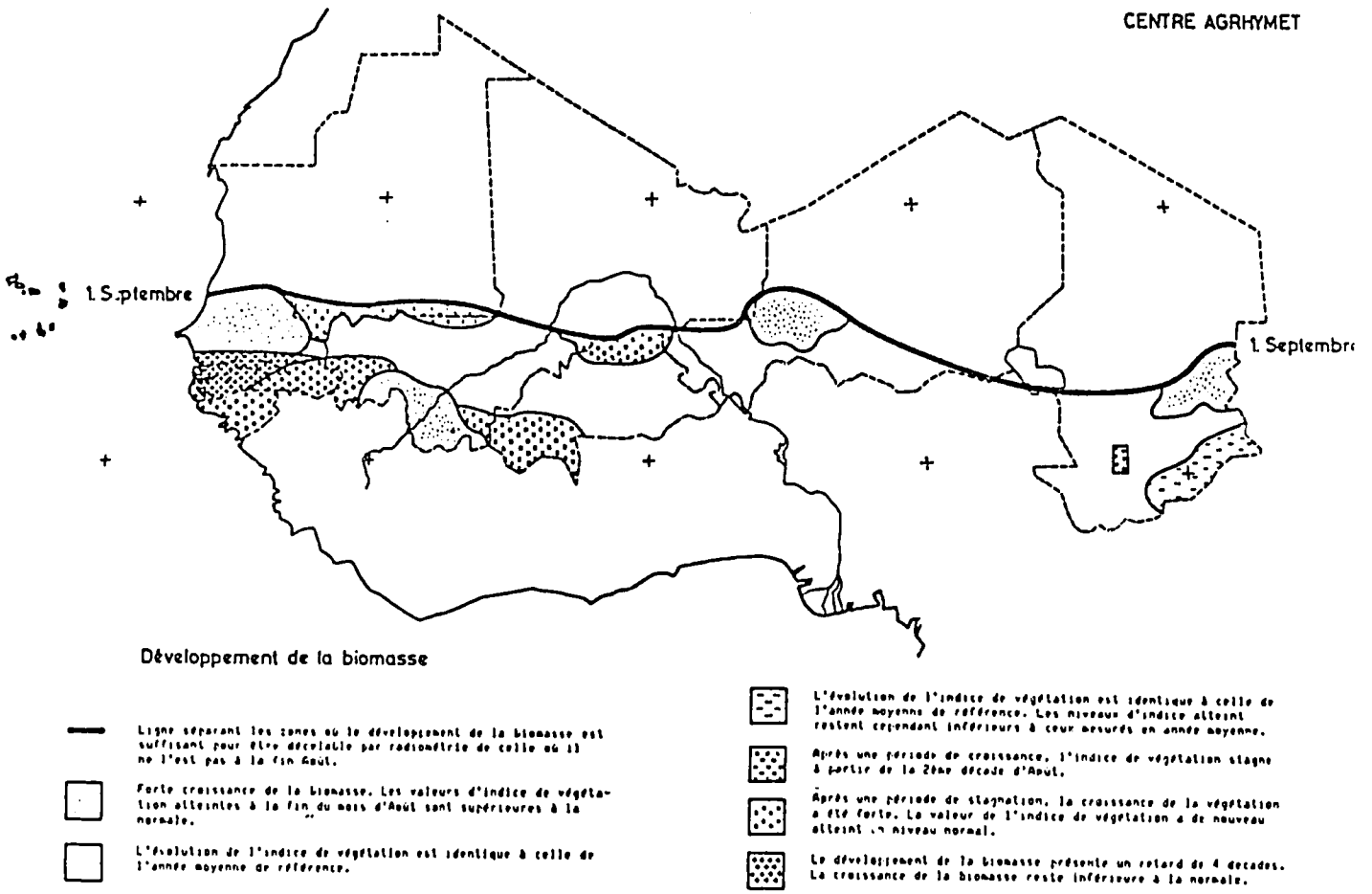


Figure 4-4 Example Product - Biomass Development Map

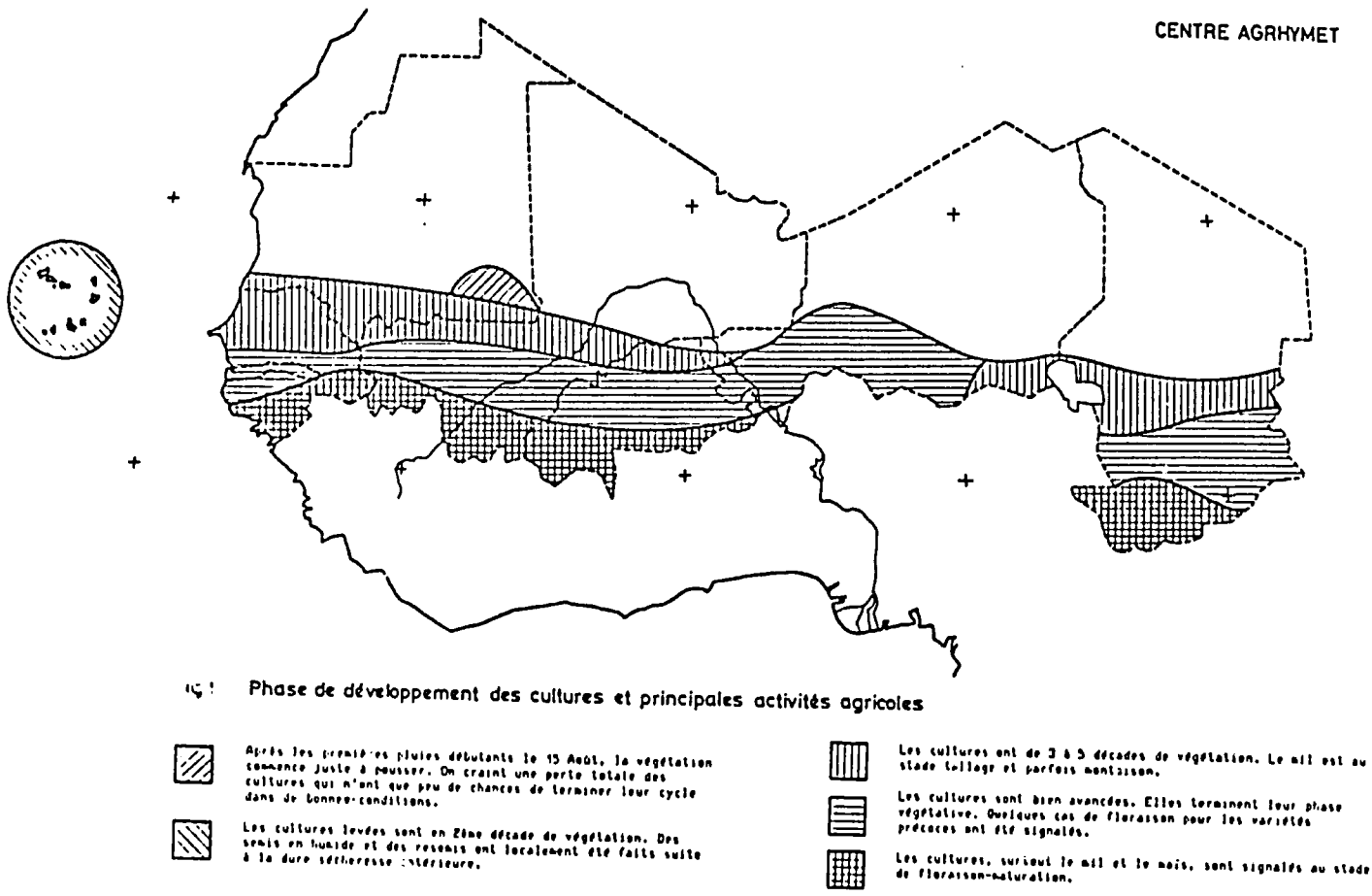


Figure 4-5 Example Product - Phenological Development of Principal Crops

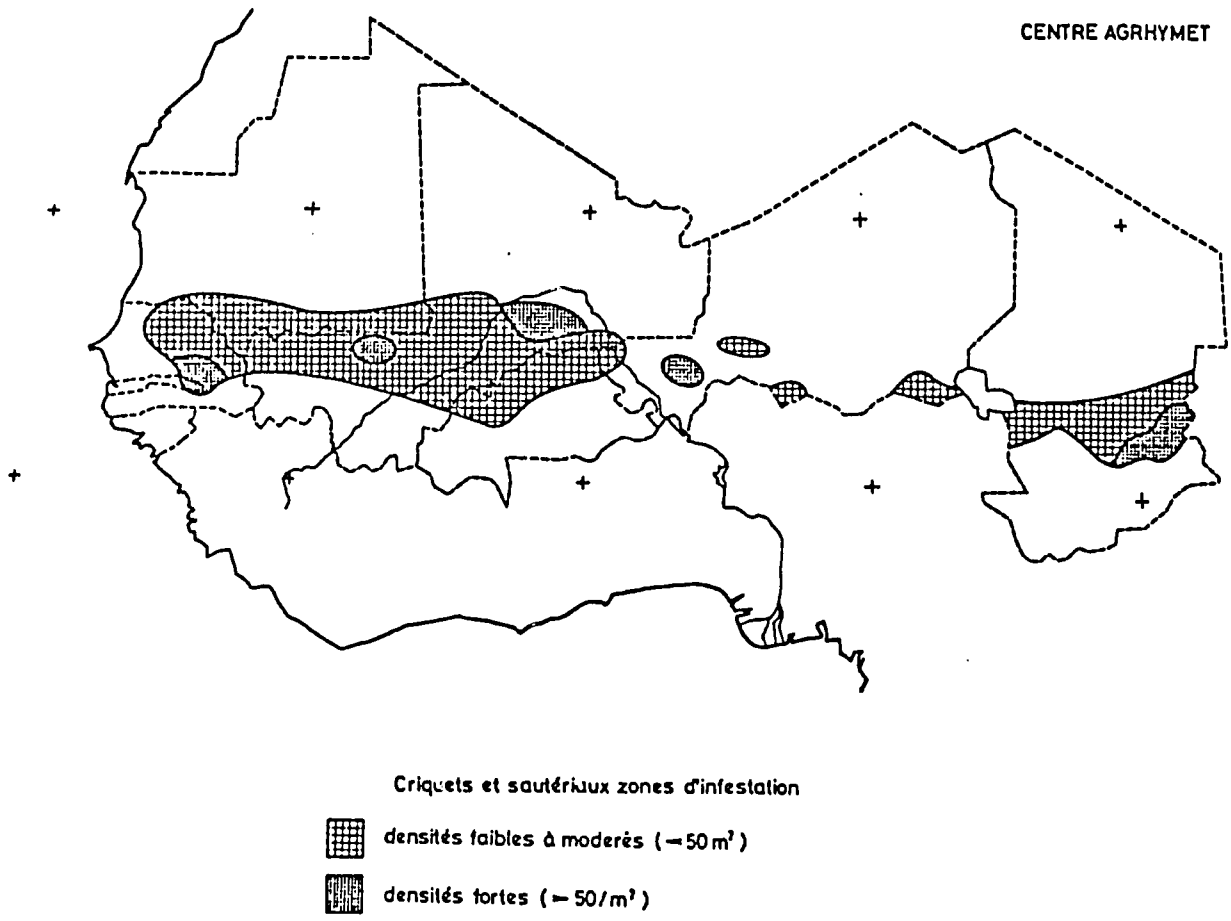


Figure 4-6 Example Product - Potential Locust Infestation Map

4.1.4.8 AVHRR RAW DATA

The AVHRR imagery collected at the ARC is a valuable resource. An archive and dissemination capability can be established to provide, on a repay basis, satellite data to non-CILSS users.

4.1.5 RESEARCH CAPABILITIES

A major area where the ARC could contribute to the NAC's is in developing methods to use the bank of climatological, hydrological, agricultural, and NDVI data. The NAC's do not have the cadre of expertise that have been or are expected at the ARC. The output products have been limited primarily because of human and computer resources. The climatological database, for example, requires extensive quality control. Substantial progress has been made towards completing the climatological data set for each of the CILSS countries. In fact, preliminary analysis of probability of selected amounts of rainfall, analysis of the 250 mm annual rainfall boundary (assumed limit of agricultural production) and initial work toward crop zonation have been completed. An atlas of the completed data for the period 1950 to 1980 is targeted for June, 1989. Completion of the data base will be a major hurdle for the Applications Division at the Regional Center. These data could then be used to address the following examples of research.

4.1.5.1 CROP ZONATION

What is the probable success of a selected variety of crop, known its water requirement, and estimated rainfall for an area. This type of information will be useful to determine the probable success of a specified variety in a given area. Furthermore, this type of information can be used by geneticists for selective breeding for a specified zone.

4.1.5.2 RAINFALL PROBABILITY

This product address the issue of the probability of receiving "x" amount of rainfall given that an observed amount of rain has fallen at a particular time in a particular region in the growing season, and how unusual is the rain that has fallen in a particular period.

4.1.5.3 CROP AND PASTURE CONDITION ASSESSMENT

Can satellite vegetation index data be used to detect pockets of stressed crops? Can the vegetation index be used to forecast crop yields? Can NDVI data locate probably locations of locusts and other potential crop pests? Can satellite data be used to estimate carrying capacity of rangeland and hence an indirect indication of pastoral movement? Preliminary studies have indicated that there are reasons to be optimistic about the information that can be extracted from satellite data.

4.1.5.4 CLIMATE CHANGE

Can hydrologic water balance studies show a need to adopt a shorter or longer season crop variety or species to maintain or increase food production? Is is evident, for example, that the wet period of 1950-1967 was followed by a dry period during 1968-1985. Forecasting changes in climate is beyond the current capability of the scientific community; however, there are indications that these changes occur in observed patterns suggesting that the dry years may not persist over the next decade.

4.1.5.5 RAINFALL ASSESSMENT

Can NDVI data be used to augment spatially sparse rainfall data collection networks?

4.2 NATIONAL AGRHYMET CENTERS

The NAC's represent the foundation of the AGRHYMET system. There has been a correct belief that the NAC's have not benefited as much as they might have during the last two phases of the AGRHYMET project. Phase III seeks to give more attention to this issue by giving greater support to improving NAC capabilities to provide timely, accurate and extensive information from their field station networks, improve computer facilities, and create a climatological database. Improvement of this kind will also assist the ARC in providing more timely and effective regional support to these same countries and the wider international user community. Remotely sensed data will become more accessible to user groups in the NAC's.

The NAC's have been producing a number of products over the past years, most of which will continue to be produced in more timely and accurate a manner through third phase funding assistance. These products are reviewed briefly below.

4.2.1 CURRENT OPERATIONAL PRODUCTS

4.2.1.1 DECADAL BULLETINS

As with the ARC, a decadal bulletin is issued during the growing season. The NAC bulletins vary in their presentation, but they essentially include similar types of data. These include a synopsis of the 10-day rainfall, temperature (maximum, minimum), evaporation, description of crop conditions for the principal crops, soil moisture status, humidity, sunshine, and soil temperature. One to four maps or tables are also included to provide a time and spatial indication of the variable. The maps predominately depict rainfall anomalies from the mean. When available, satellite vegetation index maps have been included in the bulletin (see Appendix L for an example of the Burkina Faso bulletin).

Some users indicated they wished that more station reports could be included in these bulletins. Furthermore, wide distribution, even in-country, is frequently a problem. Computer systems designed for Phase III and software systems designed for in-country type data sets should greatly increase the scope and usefulness of these bulletins. This implies increased costs in reproduction and mailings which must not be overlooked.

4.2.1.2 CLIMATOLOGICAL PRODUCTS

This is essentially a service outlined in the objectives for the NAC's. The NAC's provide reproduced historical data to various users in each country. Therefore, a considerable amount of data entry and quality control resources are required to provide this service. Where resources are deficient, this service falters. The actual in-country data bases for the climatological network are more extensive than the operational synoptic network (e.g. 80 in Mauritania; 130 in Chad; 150 in Niger; 130 in Burkina Faso). The number of data requests made to various NAC's varies considerably, but as an example, in Burkina this averaged 10 to 15 per month for official requests only. <u>The establishment and maintenance of a current, comprehensive climate data base is the most important activity for the NAC's.</u>

4.2.2 FUTURE OPERATIONAL PRODUCTS

4.2.2.1 NDVI - LATITUDE/LONGITUDE GRID

This product is one the NAC's can continue to use in the assessments associated with the preparation of decadal bulletins. These data can be transmitted in near real time to the NAC's, and they have been useful for understanding the large regions that must be monitored. The grid data provide rapid, generalized assessment of what is happening in the country. However, these data are very generalized and are not useful for localized response to potential developing problems.

4.2.2.2 NDVI - LAC MAPS

As mentioned earlier, one-kilometer resolution LAC NDVI maps have demonstrated utility for many assessment applications. There seems to be little question that such data represent the immediate wave of the future and will quickly replace the gridded NDVI data where possible. However, they wish to receive both products until such a time as they are better trained to interpret the LAC maps.

It must be understood that the data satellite data must be complementary to other sources of objectively measured field data. Furthermore, a test phase should be encouraged to determine what kind of information can be extracted with the different products which could conceivably be created from the NDVI LAC imagery. Comparison of vegetation index values must be made with ground observations in various parts of each country in order to begin to understand how to interpret this tool. This is another area where the National and Regional program can work with each other as well as provide assistance to other USAID programs such as FEWS.

Users of NDVI LAC maps have shown a very strong preference to these products over the more general gridded NDVI data. The maps are sufficiently detailed to permit savings in fuel and personnel costs in monitoring crops and pest conditions. Finally, users in many different services (eg. livestock, crop protection, crop production) could see this product as a research tool that complements other available data sources. A major user of this product will likely be the national GTP group.

4.2.2.3 OTHER PRODUCTS

With functional, well developed, and operational microcomputers and data entry systems, other types of products are possible. These include soil moisture, humidity, wind, temperature and precipitation fields depicted to provide space and time information to user groups. It is essential that improved telecommunication systems, including networking, software, supplies and trained personnel be in place of the NAC's prior to the out years of 1990-1991. The training strategy to achieve this goal is outlined in the training section (Section 9.0) of this report.

5.0 FUNCTIONAL REQUIREMENTS FOR PRODUCTS

The general functional requirements for ARC and the NAC's are nearly the same. While the other general requirements are identical, the specific characteristics of each functional area vary based on performance, data volume and interface requirements of the respective groups.

5.1 GENERAL CONSIDERATIONS

Functional requirements for the creation of products are the basis for the selection of computer software and hardware. If computer specifications do not provide the needed capabilities, the ability to create products in the AGRHYMET program will be jeopardized.

Several general factors must be considered as functional requirements. These are compatibility, flexibility, and information networking. Consideration of these factors will increase the utility of the processing systems.

5.1.1 COMPATIBILITY

The role of the ARC as a service organization to the NAC's requires that there be functional and system compatibility whenever possible. There should be compatibility in the following areas:

- When possible, the specific software used for common ARC and NAC tasks should be the same. This will allow easy data exchange without format conversions and will allow sharing of techniques. Costs associated with training and preparation of applications documentation will be reduced.

- Data sharing should always be possible between the NAC's and ARC. Software should be selected that supports data conversion to the common data formats used on all of the systems.

- If unique data formats must be used, the ARC will need to develop conversion capabilities so that data exchange is possible.

Compatibility should not, however, be forced if it results in the sacrifice of required processing power, flexibility, and functionality needed at the respective sites.

5.1.2 FLEXIBILITY

The products needed by AGRHYMET users should evolve over the next five years. An increased familiarity with the characteristics of the data bases, the available analytic capabilities, and the applications which can be made will create a need for new products. Country priorities and problems will also create situations where a different or specialized products will be needed by decision makers. Considerations include:

- The tools selected for providing the functionality of the AGRHYMET data processing system must not be so rigid that they exclude other potential applications.

- Applications software should be general and based on the tool box concept that will allow tailoring of processes to meet new needs.

- The tools must be simple enough for use by the undertrained, occasional user, and still powerful enough for trained analysts and programmers to carry out sophisticated analyses.

5.1.3 INFORMATION FLOW

All data and information used in either the ARC or NAC data processing systems should be movable from one functional area to another. It is especially important that the records in the data bases be easily movable from one system to another. This will require data exchange both between different software packages and different computer systems.

5.2 AGRHYMET REGIONAL CENTER

Figure 5-1 summarizes the functional components that are needed for each of the current and future ARC products, research programs, and support activities.

Most products require use of several functional tasks. Each is used for the analysis or preparation of a task associated with the final product. The following is a brief description of each product or activity and the associated functional tasks.

Product	WP	SS	DBMS	STAT	PG	MG	IP	GIS	CM	LANG	COMM	MISC
-- Current --												
Regional Decad. Bulletin	X	X	X	X	X	X						
Regional Month. Bulletin	X	X	X	X	X	X			X			
Seasonal Region Evaluation	X	X	X	X	X	X			X			
NDVI Grid Data							X		X			X
Climate Data Base			X	X	X	X			X			
-- Future (1988-1989) --												
Rainfall Prob.		X	X	X	X	X			X			
NDVI - LAC Images						X	X	X				X
NDVI Digital Products							X					
-- Future (1989-1991) --												
ITCZ Monitoring			X			X	X	X				
Regional Rain. Map						X			X			X
Biomass Production						X	X	X				X
Phenological Crop Devel.			X	X	X	X	X			X		
Locust Infest.						X	X					
Thermal Fields						X	X					X
AVHRR Raw Data			X			X						
GIS		X	X	X		X		X				X
-- Research --												
Crop Zonation			X	X		X		X		X		X
Rainfall Prob.		X	X	X	X	X			X			
Crop/Pasture Conditions			X	X			X	X				
Climate Change			X	X				X				
-- Support --												
Software Development	X		X							X		X
Data Reformat.		X	X									
Communications										X		X
Training	X	X	X	X	X	X	X	X	X	X	X	X

Key:
- WP - Word Processing
- SS - Spread Sheet
- DBMS - Data Base Management
- STAT - Statistical Analysis
- PG - Presentation Graphics
- MG - Map Graphics
- IP - Image Processing
- GIS - Geographic Information System
- CM - Contour Mapping
- LANG - Programming Languages/Compilers
- COMM - Communications
- MISC - Others (utilities, etc.)

Figure 5-1 Functional Processing Components for ARC

5.2.1 CURRENT PRODUCTS

5.2.1.1 REGIONAL DECADAL BULLETIN

- Access to data base to select the data that will used to assess current agrometeorological and hydrological conditions.
- Analysis of statistical data using statistical analysis package, spreadsheets, and data base management system.
- Preparation of graphs and charts summarizing conditions.
- Creation of maps displaying isohyets, rainfall anomalies, and others. Generation and editing of contour lines.
- Prepare text for report, integrate graphics and tables.
- Print black and white report for mail distribution.
- Electronic transfer via modem and telex to key users.

5.2.1.2 REGIONAL MONTHLY BULLETIN

- Same as Regional Decadal Bulletin except no electronic transfer.

5.2.1.3 SEASONAL REGIONAL EVALUATION

- Same as Regional Decadal Bulletin except no electronic transfer.

5.2.1.4 NDVI - LATITUDE/LONGITUDE GRID

- The analysis tasks used to create this product are part of the French AVHRR processing system. The processing involves georeferencing, cloud masking, compositing, and statistical analysis.
- Statistical results must be sorted by country and transferred to respective NAC using modem or telex.

5.2.1.5 CLIMATOLOGICAL DATA BASE

- Note: The WMO-sponsored Climate Data Management System (CLICOM) is becoming a world-wide standard. The ARC climatological data base should subscribe to the CLICOM standard. Capabilities include:
- Standardized data entry using formatted data entry screens. Error checking procedures for quality control of the data base.
- Data management for organization and control of data.
- Computation of new variables (for example, monthly means).
- Standard tabular reporting capabilities.
- Graphs of station data.
- In addition, query capabilities are needed to retrieve data needed to support product generation and user requests.

5.2.2 FUTURE REGIONAL PRODUCTS (1988-1989)

5.2.2.1 RAINFALL PROBABILITY

- Selection of historic records using data base management system.
- Analysis of historic rainfall records using statistical analysis techniques.
- Creation of charts or tables depicting trends.
- Generation and refinement of isolines illustrating areas of equal probability.
- Preparation of final black and white maps or tables.

5.2.2.2 NDVI - LAC MAPS

- On a daily basis, accept LAC imagery from AVHRR reception station and reference the data to a geographic grid.
- Calibrate the reflected energy channels using pre-launch coefficients and calculate vegetation index using a normalized difference procedure.
- Masks representing areas obscured by clouds, haze, or dust.
- Every 10-days, create an image containing the maximum vegetation index values. Categorize the values into predefined ranges.

- Prepare map collars that contains desired reference information (country boundaries, administrative units, towns and villages, synoptic stations and legend information.
- Merge map collar and vegetation index data and make large format plots to create maps representing each country.
- Ship maps to NAC's.

5.2.2.3 NDVI DIGITAL PRODUCTS

- Using geographically referenced, calibrated NDVI 10-day composites, resample data to a 4- or 8-kilometer grid cell.
- Subset the sampled composite data into country files.
- Mail country digital data on floppy diskettes to respective countries.

5.2.3 FUTURE REGIONAL PRODUCTS (1989-1991)

5.2.3.1 INTERTROPICAL CONVERGENCE ZONE

- Display georeferenced AVHRR images, interpret image characteristics, and electronically delineate ITCZ to create digitized line. Store interpretation in a spatial data base.
- Merge interpretation with historic ITCZ lines contained in a geographical data base.
- Create black and white map of current and historic ITCZ positions.

5.2.3.2 REGIONAL RAINFALL MAPS

- This task will require ARC to have real-time Meteosat acquisition capabilities. Also, an acceptable algorithm for rainfall estimation (such as methods developed at the University of Reading or University of Bristol) must be implemented. The result will be the statistical and map-based data files of estimated regional rainfall amounts for 10- and 30-day periods.
- Isohyets of estimated rainfall amounts are created using contouring procedures.

- The results can be used in the regional bulletins or as special products. Results should be in both digital form for electronic transfer and printed as black and white maps for distribution.

5.2.3.3 BIOMASS DEVELOPMENT

- This requires the same process as is used to create vegetation index maps from LAC data. Only the aggregation of information differs.
- The results can be used in the regional bulletins or as special products. Results should be in both digital form for electronic transfer , and printed as black and white maps for distribution.

5.2.3.4 PHENOLOGICAL DEVELOPMENT OF PRINCIPAL CROPS

- Appropriate statistical models would need to be either installed or programmed using proven algorithms. Spatial climatological and NDVI data bases would be accessed in the model to create statistical and map-based summaries.
- The results can be used in the regional bulletins or as special products. Results should be in both digital form for electronic transfer, and printed as black and white maps for distribution.

5.2.3.5 POTENTIAL LOCUST INFESTATION

- Geographically referenced AVHRR imagery and meteorological data would be spatially processed using and an appropriate model.
- The results can be used in the regional bulletins or as special products. Results should be in both digital form for electronic transfer, and printed as black and white maps for distribution.

5.2.3.6 GEOGRAPHIC INFORMATION SYSTEM IMPLEMENTATION

- Interface GIS to existing software (data base management systems, image analysis, spreadsheets, map graphics).
- Develop spatial data analysis methods for implementation as NAC applications.

5.2.3.7 AVHRR RAW DATA

- An AGRHYMET AVHRR archive data base would be needed to keep track of the Center's's holdings. This data base would need to keep track of image data, identification, geographic location, and storage location. This data base could be queried to determine if suitable coverage is available for areas of interest.
- Reproduction of master AVHRR scenes in archive would be done (on appropriate media such as magnetic tape) and sent to user.

5.2.4 RESEARCH CAPABILITIES

5.2.4.1 CROP ZONATION

- Statistical analysis of data from appropriate data bases would be conducted using appropriate models.
- Creation of maps from appropriate algorithms.

5.2.4.2 RAINFALL PROBABILITY

- See rainfall probability section in future products category.

5.2.4.3 CROP AND PASTURE CONDITION ASSESSMENT

- Spatial analysis of satellite imagery, weather station data, and other geographic variables is required. Map and statistical output would be created.

5.2.4.4 CLIMATE CHANGE

- Statistical analysis of appropriate data.

5.2.5 SUPPORT

5.2.5.1 SOFTWARE DEVELOPMENT

- There must be tools available to create models and methods needed to support ARC and NAC operational products and research needs.

5.2.5.2 DATA REFORMATTING

- Conversion of data from one format to another based on program needs, and the development of interfaces to other data bases on an as-needed basis.

5.2.5.3 COMMUNICATIONS

- Development of appropriate interfaces for electronic transfer of data using GTS, telex and telephone

5.3 NATIONAL AGRHYMET CENTERS

Figure 5-2 summarizes the functional components that are needed for each of the current and future products and support activities.

5.3.1 CURRENT PRODUCTS

5.3.1.1 DECADAL BULLETIN

- Access data base to select the data that will used to assess current agrometeorological and hydrological conditions.
- Analysis of statistical data using statistical analysis package, spreadsheets, and data base management system.
- Preparation of graphs and charts summarizing conditions.
- Creation of maps displaying isohyets, rainfall anomalies, and others. Generation and editing of contour lines must be done.
- Prepare text for report, integrate graphics and tables.
- Print black and white report for mail distribution.
- Electronic transfer via modem or direct delivery to key users.

5.3.1.2 MONTHLY HYDROLOGY BULLETIN

- Same as Decadal Bulletin

Product	WP	SS	DBMS	STAT	PG	MG	IP	GIS	CM	LANG	COMM	MISC
-- Current --												
Decadal Bullet.	X	X	X	X	X	X			X		X	
Monthly Hydro Bulletin	X	X	X	X	X	X					X	
Climate Data Base			X	X	X	X			X	X		X
-- Future (1988-1989) --												
NDVI Analysis		X	X		X	X	X		X			X
-- Future (1989-1991) --												
GIS			X	X		X		X				
Other Products	X	X	X	X	X	X	X	X	X			
-- Support --												
Software Development	X		X							X		X
Data Reformat.		X	X									
Communications										X		X
										X	X	X

Key:
- WP - Word Processing
- SS - Spread Sheet
- DBMS - Data Base Management
- STAT - Statistical Analysis
- PG - Presentation Graphics
- MG - Map Graphics
- IP - Image Processing
- GIS - Geographic Information System
- CM - Contour Mapping
- LANG - Programming Languages/Compilers
- COMM - Communications
- MISC - Others

Figure 5-2 Functional Processing Components for NAC's

5.3.1.3 CLIMATE DATA BASE

- Note: The WMO-sponsored Climate Data Management System (CLICOM) is becoming a world-wide standard. The NAC climatological data base should subscribe the the CLICOM standard. Capabilities include:
- Standardized data entry using formatted data entry screens to build data base. Error checking procedures for quality control of the data base.
- Data management for organization and control of data.
- Computation of new variables (for example, monthly means).
- Standard tabular reporting capabilities.
- Graphs of station data.
- In addition, query capabilities are needed to retrieve data as needed to support product generation and user requests.

5.3.2 FUTURE PRODUCTS (1988-1989)

5.3.2.1 NDVI ANALYSIS

- Display ARC-provided NDVI data on interactive color monitor. Display appropriate geographic reference data and statistics (such as rainfall at reporting stations) with NDVI. Study regional and local vegetation conditions. Aggregate NDVI values into appropriate ranges and color code for improved interpretability.
- Generalize NDVI using contouring or polygon building methods. Create black and white maps for selected geographic areas suitable for inclusion into decadal and monthly reports. Maps should contain both general NDVI regions and geographic reference data.
- Calculate statistics for country monitoring units (i.e., grids, administrative areas, land use, soils). Enter statistics into historical data base. Conduct time series statistical analysis. Create graphs and statistical summaries of conditions.
- Incorporate maps, graphs, and statistics into bulletins.

5.3.3 FUTURE PRODUCTS (1989-1991)

5.3.3.1 GEOGRAPHIC INFORMATION SYSTEMS

- Use of GIS for interface to other data bases, production of products, and spatial analysis.

5.3.3.2 OTHER PRODUCTS

- A range of data base, statistical, and mapping tools for experimentation and application of new processes.

5.3.4 SUPPORT

5.3.4.1 SOFTWARE DEVELOPMENT AND MAINTENANCE

- There must be tools available to create models and methods needed to support NAC operational products.

5.3.4.2 DATA REFORMATTING

- Conversion of data from one format to another based on program needs, and the development of interfaces to other data bases on an as-needed basis.

5.3.4.3 COMMUNICATIONS

- Use of appropriate interfaces for electronic transfer of data through GTS, telex and telephone.

6.0 DEFINITION OF RECOMMENDED COMPUTER SYSTEM CONFIGURATION

This section describes, in general terms, the characteristics of the recommended AGRHYMET computer facilities. For a more detailed technical description of the equipment, see Appendix H.

6.1 BASIC ASSUMPTIONS

The computer hardware and software configuration recommended for ARC and the NAC's are based on the user requirements for data bases, products, and support services. The systems must provide the functionality identified in the previous section (Section 5.0).

There are four basic assumptions that were used in the definition of the system configuration: feasibility, sustainability, compatibility, and flexibility. The first two were identified in the Sahel Water Data and Management III Project Paper (625-0973) as the overriding principles that should be applied in the project. They certainly must be applied to the identification of the data processing system. The final two factors, compatibility and flexibility, are necessary to guarantee the overall effectiveness of the program.

> Feasibility: Both the overall system and its' individual components must be technically proven. All complementary inputs are identified, feasible, and have available funding.
>
> Sustainability: The system can operate effectively with low reoccurring costs, failure rates, and support requirements. Access to local support, both vendor and private, is highly desirable.
>
> Compatibility: Compatibility includes two issues. The systems should be based on accepted, widely used hardware and software in order to insure compatibility with other related programs (other government, donor, and regional programs). This will facilitate exchange of data and methodologies and allow sharing of support experience and resources. The sub-systems must be compatible with each other in order to to allow networking and data exchange.
>
> Flexibility: The system should have the flexibility to adapt to changes in both technology and user needs that will occur over the next five years. The products

needed by AGRHYMET users will change over the next five years. The system must be able to supply the needed information without wholesale changes.

Finally, a strong recommendation stated in the project paper should be followed. "Anticipating technology change and keeping abreast of it will likely reduce overall project costs and will certainly allow transfer of a more appropriate and cost-effective system in 1991."

6.2 AGRHYMET REGIONAL CENTER

The ARC must be able to both provide products and serve as the support organization to the NAC's. As a result, they not only must have the tools needed to carry out their unique responsibilities but also duplicate the capabilities of the NAC's in order to provide new methodologies and training support.

6.2.1 CONFIGURATION DESCRIPTION

The initial recommended configuration for ARC will consist of the existing VAX 11/780, the new MicroVAX-based AVHRR reception station, plus the addition of eight microcomputers. At the midpoint of Phase III, an additional two super-microcomputer and three microcomputers may be added to the network. All systems must be connected to a network that will permit access to peripherals, and sharing/movement of data between computers.

6.2.1.1 EXISTING EQUIPMENT

VAX 11/780

Purpose: Product generation - large-scale LAC vegetation index maps and NDVI digital products for NAC's. NDVI latitude/longitude grid mapping and transfer process will remain, as will the continuation of the climatological Atlas.

Hardware: On site - and
Augmentation of 32 Mb of cpu memory to replace existing 4 Mb
Additional two tape drives
Large-format color raster plotter
Adequate disk space to store satellite images

Color recorder
Color display devices
Digitizing table

Software: On site and
AVHRR image processing
General purpose image processing
Raster/vector plotting
Geographic Information System (GIS)

MicroVAX II

Purpose: AVHRR tracking, reception and processing system.
Hardware: Provided by France
Software: Provided by France

6.2.1.2 NEW EQUIPMENT (1988)

Microcomputer #1

Purpose: Climatological Data Base
Hardware: CPU
Modem
Software: see CLICOM
Word Processing
Communications

Microcomputer #2

Purpose: Agrometeorological assessments, and preparation of decadal, monthly, and seasonal bulletins.
Hardware: CPU
Printer
Software: Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities

Microcomputer #3

Purpose: Agrometeorology applications, research and development. Specific products include rainfall probability, phenological crop development, crop zonation, and climate change.

Hardware: CPU
Printer
Software: Word Processing
Spread Sheet
Data Base Management System
Statistical Package
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities
Fortran

Microcomputer #4

Purpose: NDVI applications development for NAC's.
Hardware: CPU
IBM Compatible Mouse
Second 40 Mb hard disk
Modem
Software: Image Display and Analysis (IDA) Software
Map Graphics Package
Surface Generation - Contour Mapping Package
Word Processing
Communications
Utilities

Microcomputer #5

Purpose: Hydrological data base and hydrological assessments, preparation of bulletins, development of applications and models.
Hardware: CPU
Printer
Plotter
Digitizing Table
Modem
Software: Word Processing
Spread Sheet
Data Base Management System
Graphics Data Entry Package
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities
Fortran

Microcomputer #6

Purpose: To be used primarily for training purposes and as a CLICOM data entry station.
Hardware: CPU
Printer

Software: use CLICOM
Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities

Microcomputer #7

Purpose: To be used by USAID technical person in developing new techniques.
Hardware: CPU
Printer
Software: Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities
Fortran, Pascal, Basic

Microcomputer #8

Purpose: To provide access to GTS data stream.
Hardware: CPU
EXTEL hardware adapter
Software: EXTEL communication interface

6.2.1.3 FUTURE EQUIPMENT (1990-1991)

Super-microcomputer #1

Purpose: Replacement of VAX 11/780.
Hardware: On site peripherals
CPU
Increased disk capacity
Color raster plotter
Plotter
Laser printer
Software: On site and
TBD

Super-microcomputer #2

Purpose: Rainfall estimation system. Includes reception of MeteoSat digital data, and

related modelling and mapping processes. Also research and development related to creation of future spatial products - ITCZ Monitoring, Vegetation Progression, Locust Infestation.

Hardware: CPU
Color display device
Meteosat Receiver

Software: Rainfall estimation model
Mapping and plotting
Meteosat Satellite Data Reception and Processing
Data Base Management System
Statistical Package

Microcomputer #9

Purpose: Preparation of climate products, continuation of climate atlas activities.

Hardware: CPU
Printer

Software: Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Fortran, Pascal, C

Microcomputer #10

Purpose: Hydrological model development

Hardware: CPU
Printer
Plotter

Software: Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Fortran

Microcomputer #11

Purpose: Testing of microcomputer GIS capabilities suitable for implementation at NAC's.

Hardware: CPU
Printer
Digitizing Table
Plotter

Software: GIS
Word Processing
Data Base Management System

6.2.2 HARDWARE DESCRIPTION

The super-microcomputers and microcomputers needed to provide the capabilities described in the previous section should be flexible, compatible, and provide the basic computer capabilities for Phase III.

6.2.2.1 CENTRAL PROCESSING UNITS

It is suggested that the procurement be limited to two types of vendor cpu's, one for the super-microcomputers and one for the microcomputers. Purchase of cpu's from more than two vendors is not desirable and may cause compatibility problems. The ARC and NAC'S microcomputers should have the same characteristics. Documentation for these computers should ideally be in both French and English. The cpu's should have the following general characteristics:

<u>Super-microcomputers</u>

- 32-bit cpu
- Eight Mb of memory, expandable to 16
- Two Gb of disk space, expandable to 4
- Two tape drives, 1600/6250 bpi, 50 ips
- Ability to support 10 terminals
- Network capability
- CRT console
- Lineprinter

<u>Microcomputers</u>

- IBM or IBM-compatible 286 cpu, 12 MHz, 0 wait state
- 80287 co-processor, where appropriate
- Real time clock
- Seven expansion slots
- MS-DOS and OS/2 operating system compatible
- One Mb of memory, expandable to 4
- French keyboards
- At least Enhanced Graphics Adapter (EGA) board and color monitor VGA is desired for 1990-1991 enhancement
- Floppy disk drive, 5-1/4 inch, 1.2 Mb
- Hard disk drives, 40 Mb, and 2 x 40 Mb disk storage capacity, 28 ms access
- IBM compatible mouse capability
- Ports, one parallel, two serial
- Network capability for 1990-1991 enhancement

6.2.2.2 PERIPHERALS

The peripherals needed to support both the super-microcomputers and the microcomputers will come from a number of vendors and the compatibility of the final configurations, especially with the microcomputers, will be need to be insured. Documentation for all peripherals should ideally be in both French and English.

Super-microcomputers

- Disk space, 2 Gb originally, expandable to 4 Gb, for each super-microcomputer

- Tape drives, 2 drives 1600/6250 bpi, 50 ips, for each super-microcomputer

- Terminals, CRT terminal with 80 character screen, keyboard, multi-baud rates, to be used for system consoles, display device terminals, and as ports into the super-microcomputers, six each super-microcomputer

- System lineprinter, paper width of 34", print speed of 300 cps, French and English character set, for each super-microcomputer

- Laser printer for document preparation, to be on one of the new super-microcomputers or on the network

- Color raster plotter, paper width of 34", 400 dpi, plot speed of X plot accuracy of X, both paper and film

- Raster display device, 1024 x 1024 x 32, trackball, with CRT terminal, two are needed

- Color recorder, both 35mm slide and 6.5" x 11" print film

- Digitizing table, 34" x 44" surface, 16 button cursor, RS-232 connection, resolution .0001, for one super-microcomputer

- Network capability between super-microcomputers and between super-microcomputers and microcomputers.

Microcomputers

- Printer, BW, 200 cps, 132 columns, parallel interface, auto paper load, friction feed, dot-matrix, for all microcomputers

- Hard disk drives, 40 Mb and 80 Mb capacity

- Uninterruptable power supply (UPS), for all microcomputers to be installed in some offices at the NAC's

- Backup devices, preferably 800 Mb optical disk drives

- Modem, 1200/2400 baud, full/half duplex, answer/originate, for four of the microcomputers

- Plotter, 8 pen, D size sheets or rolls, paper and film, omitted if ARC Benson plotter can be utilized

- Digitizing table, 17" x 24" surface, 16 button cursor, RS-232 connection, resolution .0001, for two microcomputers

- Network capability between super-microcomputers and microcomputers, see section E below

6.2.3 SOFTWARE DESCRIPTION

The software for these computer systems can come from several sources. Commercial software are available to do just about everything required for either the ARC or NAC'S. There is also nonproprietary software packages written by universities, government institutions, or private firms or individuals that can be used. The last option for the ARC or NAC'S is to develop their own software. This is very time-consuming and costly. Obviously, they will need to do some of their own software development, but this should be held to a minimum. The NAC's should be kept informed and consulted on all software procurements or packages being developed. Software documentation should ideally be in both French and English.

Finally, the ARC and NAC'S should contact SHARE, Software Help in Applications, Research and Education. This program has been established to manage the transfer of software from developed to developing countries. The program is supported by UNDP and WMO and all the software is free.

6.2.3.1 SUPER-MICROCOMPUTERS

- It is assumed that each super-microcomputer will come with an operating system, compilers, programming tools, utility packages, text editors, and diagnostic software. Compilers should include Fortran and Pascal.

- An image processing system is also required in order to aid the development of products and to conduct research with satellite data. It should also be user friendly, well documented, easy to support and easy to modify. This system should have the following capabilities:

  - Handle unlimited line, sample arrays
  - Ingest Level 1-B AVHRR data, and other satellite data such as Spot, LGSWOG, CCTX, etc.
  - Geometrically register capabilities including system modelling, image to map (minimum of third order), image-to-image correlation.
  - Data transformations including NDVI, albedo, principal components, ratios.
  - Contrast enhancement
  - Spatial filtering
  - Mapping and renumbering of brightness values
  - Primitive processes (addition, subtraction, multiplication, division, minimum, maximum).
  - Logical processes
  - Statistical summaries by polygon, area, scene
  - Classification using supervised or unsupervised methods
  - Plotting merged raster/vector data
  - Interactive display system
  - Create output files and tapes
  - Interface to vector GIS

- Geographic information system (GIS) software is needed in creation of the NDVI and other spatial products. The GIS system should also be easy to use, well documented, and have a tool box which would allow users to develop their own processing methods. This software should allow

  - Map digitizing with interactive editing and topology definition
  - Independent attribute handling using data base management system
  - Comprehensive coordination and projection conversion system
  - Map paneling
  - Boolean, arithmetic, and statistical overlay capabilities
  - Distance analysis
  - Reclassification functions
  - Interactive map design
  - Plotter interfaces

6.2.3.2 MICROCOMPUTERS

- Each microcomputer will come with a MS-DOS, ungradeable to OS/2 operating system, and MS-DOS tutorial.

- A data base management systems (DBMS) will be needed for the ARC microcomputers. One of these must be DataEase, DataEase International Inc., which is required by the CLICOM microcomputer. Each DBMS must allow the user to import and export data, sort data on any field, set up flexible data field types and attributes, and be flexible enough to allow multi-field sizes, multi-fields per record, a large number of records in a data file and multiple data files per database. The DBMS should also provide capabilities to search on fields, query the database using an SQL structure, perform mathematical functions, generate reports, and provide some security features. A DBMS like dBASE III + would be adequate.

- Each microcomputer should have word processing software for use in creating the decadal bulletin and other documents. This software should allow a user to create, update, modify and delete text files. It should also allow text files to be merged, allow text and graphics to be merged, have a spelling checker, format the text, etc. Word processor must accept graphics files from the selected map and presentation graphics packages. Similar to Word Perfect version 5.0.

- The capabilities of a good spread sheet will also be needed by the ARC staff. A spread sheet package, like Lotus 1 2 3 version 3.3, will be needed on some of the microcomputers.

- The climatological data base microcomputer will be using the CLICOM software developed by WMO. It uses the following commercial packages:

    - DBMS: DataEase 2.5, prefer dBASE III +
    - Sort utility: COSORT
    - Graphics: GRAFMATIC
    - Screen utility: FORLIB PLUS
    - Utilities: Norton Utilities and Norton Editor
    - Macro: Keyworks

- Image analysis and display capabilities must provide ability to display at full and sampled resolution, retrieve map graphics for overlay on screen, permit

manipulation of data into classes, draw on display, calculate statistics from user drawn or digitized polygons, conduct histogram manipulations, and create statistical and map output. The Price-Williams IDA package and associated commercial software (ATLAS*GRAPHICS, Pizazz) could provide this capability.

- Communications capabilities will be needed for transfer of files, data sets, and act as remote terminals. Besides these internal ARC communications, some of the microcomputers will also need to communicate with the NAC'S and other groups outside of ARC. This package, like Procomm, should also allow terminal emulation.

- A statistical package will be needed on some of the microcomputers. The package should have a wide range of capabilities, from simple mean and variance calculations to the more advanced ANOVA, regression analysis, and time series analysis. The package should be user friendly and well documented. It should also allow data entry by the user or from a DBMS, editting capabilities and output graphical capabilities. One copy of Statgraphics could provide these capabilities, if a French language version is available.

- A standard set of utility routines will be needed by every microcomputer. These routines will allow the user to manage files, and perform various maintenance tasks on the microcomputer. The Norton utilities package may be a likely candidate.

- Meteorological data usually consists of a series of measurements made at points within an area or country. It is important to have the ability to interpolate or create a surface from these points. Software will be needed on five of the microcomputers which will allow the user to input data points, edit these points, create a surface, edit the surface, and output the surface to a file for interfacing to another software package or output device. A package such as Surfer is being considered.

- Map graphics capabilities are needed for display and summarization of spatial information. Capabilities include the ability to ingest coordinate vectors, perform simple coordinate conversions, interactively compose maps, and plot the results. In addition, the map graphics package should include the ability to accept data from spreadsheets and data base management packages. ATLAS*GRAPHICS is an excellent candidate.

- Both the microcomputer digitizing tables will need the associated software which will allow the digitizing of map data into the microcomputer. This software should also allow the display and editing of the digitized vectors, and the ability to export these data to other software packages. A software package such as MapEdit should be considered.

- Other commercial software packages may also be needed to meet unique, unanticipated requirements. Funds must be reserved so that these packages can be acquired.

6.2.4 NETWORKING AND COMMUNICATIONS

The French-supplied MicroVAX and the VAX 11/780 will be connected using Ethernet and DECnet. An RS-232 connection between the VAX 11/780 and the microcomputers will be implemented in 1989 or 1990.

Both super-microcomputers and microcomputers will need software which will allow them to communicate both internally, within the ARC facility, and externally, with the NAC'S and other groups.

The internal communications software should use the network capabilities to transfer files, data sets, and act as remote terminals. The external communications should be able to transfer both files and data sets to and from ARC.

6.2.5 FACILITY MODIFICATIONS

Since the ARC is to become an AVHRR receiving station, it will need to increase its archive tape storage capacity. The present storage facility is used for system backup tapes and does not have the capacity to handle the new volume of tapes. The ARC budget should be adjusted for this significant expenditure for facility enhancement as well as for the recurrent cost of tape media, about $10,000 U. S. annually, minimum.

The ARC computer center should also be improved through the addition of a Halon fire control system. This will help protect the USAID investment and permit 24 operation of the computer center.

6.3 NATIONAL AGRHYMET CENTERS

The National Centers must have the capabilities to organize basic data, assess conditions, and publish reports in a timely, uninterrupted manner. Because they work closely with other government ministries and departments, they should have compatible systems so that they can share data and capabilities.

6.3.1 CONFIGURATION DESCRIPTION

The recommended configuration for NAC will consist of the existing DEC Rainbow microcomputers (unsupported), and initially, five new microcomputers. At the mid-point of Phase III, an additional three microcomputers will be added to the network. The new microcomputers will be placed in the National Meteorological Services. Others will be located at the Hydrologic Service. The systems at the central facility will share peripherals and data. Networking the computer systems will investigated during the mid-Phase III evaluation.

6.3.1.1 EXISTING EQUIPMENT

<u>DEC Rainbow Microcomputer #1</u>

Purpose: Word processing, miscellaneous activities.
Hardware: CPU
Printer
Software: WordStar

<u>DEC Rainbow Microcomputer #2</u>

Purpose: Word processing, miscellaneous activities.
Hardware: CPU
Printer
Software: WordStar

6.3.1.2 NEW EQUIPMENT (1988)

<u>Microcomputer #1</u>

Purpose: Climatological Data Base
Hardware: CPU
Software: see CLICOM
Word Processing

Microcomputer #2

Purpose: Agrometeorological assessments, and preparation of decadal, monthly and seasonal bulletins. Also NDVI applications.
Hardware: CPU
Printer
IBM Compatible Mouse
Adequate Disk Space, 80 Mb
Software: Word Processing
Spread Sheet
Data Base Management System
Image Display and Analysis Software
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities

Microcomputer #3

Purpose: Hydrological data base.
Hardware: CPU
Printer
Modem
UPS
Software: Word Processing
Data Base Management System
Communications
Utilities

Microcomputer #4

Purpose: Communications system - to provide access to GTS data stream.
Hardware: CPU
EXTEL hardware adapter
Modem
Software: EXTEL communications interface
Communications

Microcomputer #5

Purpose: Unobligated system to be used for training, word processing, additional support for decadal bulletins, etc.
Hardware: CPU
Printer
Software: Word Processing
Spread Sheet
Data Base Management System

6.3.1.3 FUTURE SYSTEMS (1990-1991)

Microcomputer #6

Purpose: Agrometeorological modelling.
Hardware: CPU
Printer
Software: Word Processing
Spread Sheet
Data Base Management System
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities

Microcomputer #7

Purpose: Hydrological assessments, preparation of bulletins, development of applications and models.
Hardware: CPU
Printer
Plotter
Digitizing Table
UPS
Software: Word Processing
Spread Sheet
Data Base Management System
Graphics Data Entry package
Map Graphics Package
Surface Generation - Contour Mapping Package
Utilities
Fortran

Microcomputer #8

Purpose: Formalize current geographic data base through the establishment of a geographic information system.
Hardware: CPU
Printer
Digitizing Table
Plotter
Software: GIS
Word Processing
Data Base Management System

6.3.2 HARDWARE DESCRIPTION

The microcomputers needed to provide the capabilities described in the previous section should be flexible, compatible, and provide the basic computer capabilities for Phase III.

6.3.2.1 CENTRAL PROCESSING UNITS

It is suggested that the procurement be limited to only one microcomputer model. Purchase of cpu's from more than two vendors is not desirable and may cause compatibility problems. The ARC and NAC microcomputers should have the same characteristics. Documentation for these computers should ideally be available in both French and English. The cpu's should have the characteristics described in Section 6.2.2.

6.3.3 SOFTWARE DESCRIPTION

See Section 6.2.3 for details.

6.3.4 NETWORKING AND COMMUNICATIONS

The microcomputers will not need to be networked together initially. The cost of equipment, extra maintenance, and training needed to move data between microcomputers is not justifiable. File transfer using diskettes is more practical. There should be an initial effort to develop hardware interfaces and equipment to share peripherals. A local-area-network will likely be needed at the NAC facilities in the future. The microcomputers should ultimately be compatible with the telecommunications upgrades that are expected to be provided by the Italians.

6.3.5 FACILITY MODIFICATIONS

The facilities will have to be rewired to include a two-wire-plus-ground electrical circuit. Air conditioning in the offices in which the computer equipment is installed may have to be upgraded. If necessary, walls should be repainted and cracks or gaps sealed in the window casings and ceilings.

7.0 RECOMMENDATIONS FOR EXISTING COMPUTER RESOURCES

The existing computer hardware for the NAC's and ARC are obsolete, difficult to use, incompatible with other in-country systems, and hard to maintain. All of these systems represent 1970's technology. All PDP 11/34 systems and Rainbow 100s are identical and should be surplused. The ARC has also purchased two PDP 11/60s and a VAX 11/780. Recommendations for these computer systems are also included.

In determining the recommendations for the existing computer equipment there were two assumptions made. First, the countries, and not USAID, own the computer equipment. Second, the countries would not sell or return to ARC any of the computer equipment, except as noted.

7.1 AGRHYMET REGIONAL CENTER

This discussion will pertain only to the ARC computers purchased with USAID funds. Consequently, there are four different computer systems which need to be discussed. They are:

1 - PDP 11/34
2 - PDP 11/60s
8 - Rainbow 100s
1 - VAX 11/780

7.1.1 PDP 11/34

This machine was purchased for use in Mauritania, put was not delivered. The PDP 11/34 should be disposed of according to the ARC policy for disposing of obsolete equipment. The peripherals and spare parts that may be usable by the VAX 11/780 should be kept.

There are no software issues associated with this computer since it is not currently in use.

7.1.2 RAINBOW 100's

The DEC Rainbow 100's are also in various states of repair and use at the ARC. They were originally bought as terminals for the PDP 11/34's, but are now used as terminals for the PDP 11/60's and as personal computers. They are configured without graphics capabilities, have limited memory

and no hard disks. They would be more heavily used if they ran an MS/DOS compatible operating system instead of CP/M. The major use for these computers has been word processing. Unfortunately, since they are not IBM compatible, text files can not be easily transferred.

Some ARC staff have developed software on these microcomputers, but these programs are not integrated or standardized within AGRHYMET. Consequently, this software should be replaced with commercial packages.

It is suggested that the Rainbow microcomputers and their associated printers that currently work, remain at their current locations and be used only for word processing. The Rainbows can be useful as word processing machines, since the ARC will be receiving a limited number of new microcomputers. These might be used by students for report writing. Any software or database development on these computers should be discouraged.

The ARC should not attempt to maintain these units by ordering additional spare parts or consumables, but utilize them as long they continue to work.

7.1.3 PDP 11/60's

The two PDP 11/60s are currently being used for research, applications and operations. PDP 11/60 unit "A" is currently running operational software that decodes incoming telex data into a file. This file is then transferred to PDP 11/60 "B", via diskette, where additional operational software loads the data in the single file to the "master" data files. PDP 11/60 "B" is also used for modelling, like SUIVI, and other applications.

The PDP 11/60s, purchased in 1981, have limited memory and are not networked to each other or to the VAX 11/780. These computers are difficult to maintain, not user friendly, and obsolete. They should be disposed of according to the ARC policy for disposing of obsolete equipment. Any peripherals usable by the VAX 11/780 should be retained.

The timing for these events is very important. This action should take place at the end of the growing season in conjunction with the installation and training on the new computers. It is conceivable that both the old and new computer systems will be up and running concurrently for a short time. The activities on these computers can then be

moved to the new computers being purchased or to the VAX 11/780. This would require either replacing the existing software with commercial packages or rewriting the software for the other computers. For example, the SUIVI model has already been rewritten to run on a IBM or IBM-compatible microcomputer.

The floor space vacated by these systems will be needed for the new AGRHYMET computers and for the AVHRR receiving station computers.

7.1.4 VAX 11/780

The VAX 11/780 was installed in 1986 and is currently underutilized. It is a minimally configured system with potential for expansion. It is currently being used by students, the ARC hydrologist, and has the NDVI mapping software running on it. It will be augmented with additional memory and retained as the primary computer for production of AVHRR products. There are enough parts to maintain this computer for two years. The VAX 11/780 should be networked to the new MicroVAX II provided by the French.

7.2 NATIONAL AGRHYMET CENTERS

Seven PDP 11/34 systems were installed in the NACs starting in 1981 (Mali), an ending in 1987 (Chad). Mauritania did not receive a PDP. The Rainbow 100's have the same installation history, with each NAC receiving two.

The total computer hardware for each NAC is identical, but it has been configured in one of two ways. Either all the hardware is at one location, typically the Meteorological Service, or divided between the Meteorological Service and Hydrology Service.

The computer hardware for each country consists of:

1 - PDP 11/34 cpu
1 - RX02 floppy disk drive
1 - TU80 tape drive
3 - RA60 disk drives
1 - Decgraphic scope terminal
2 - VT240 terminals
1 - Decwriter
1 - Versatec B80
1 - Uninterruptable Power Supply (UPS)
2 - Rainbow 100 microcomputers
2 - LA50 printers

7.2.1 PDP 11/34

The existing computer hardware at the NAC's is in various states of use and repair. Some of the PDP 11/34's are running and being used in creation of the 10-day bulletins. The Niger NAC provides an excellent example of this type. Some of the NAC's (e.g., Burkina Faso) have also started to create meteorological data bases on these computers and have developed applications software. Other PDP 11/34s are not apparently operating or in use (e.g., Chad and Mali), and as mentioned, the Mauritania computer was not delivered.

Overall, the PDP's are undependable and an economic drain. All PDP 11/34's should be phased out as soon as new computers arrive, and the existing data bases and software converted to the new computers.

The peripherals and spare parts for the PDP 11/34's should also be surplused, except for the Niger NAC. Their peripherals and spare parts may be useful for the ARC and should be returned, if possible.

The phasing out of the old computers should take place following the installation and training on the new computers. This should be scheduled during the winter months so that there will not be disruptions during the growing season. The NAC's with the heaviest dependency on computers should be converted first. In some cases it may be wise to have both the old and new computer systems running concurrently for a period. This would allow NAC staff time to transfer needed existing software and databases to the new computer systems.

7.2.2 RAINBOW 100's

The DEC Rainbow 100's are also in various states of repair and use at the NAC's. They were originally bought as terminals to the PDP 11/34's. Most are used as personal computers, even though they have maintenance problems. They are configured without graphics capabilities, have limited memory and no hard disks. They would be more heavily used if they ran an MS/DOS compatible operating system instead of CP/M. The major use for these computers has been word processing. Unfortunately, since they are not MS-DOS compatible, text files can not be easily transferred between the NAC's and other government ministries.

Some of the NAC's have developed software on these microcomputers, but these programs are not integrated or standardized within AGRHYMET. Consequently, this software should be replaced with commercial packages or software developed at the ARC.

It is suggested that the Rainbow microcomputers and their associated printers that currently work, remain at their current locations and be used for word processing. Software or database development on these computers should be discouraged. ARC should distribute the existing spare parts, as needed, until they are gone.

The ARC should not support either computer once the new microcomputers are delivered.

7.2.3 UNINTERRUPTABLE POWER SUPPLY

Each NAC has an Uninterruptable Power Supply (UPS) for the computer systems. These units should be retained and used for the new computer systems being purchased. This may require some modifications such as rewiring.

8.0 MAINTENANCE, LOGISTICS, OPERATIONS, AND TELECOMMUNICATIONS REQUIREMENTS

One of the most important aspects of computer operations is computer system maintenance and logistics. Without regular preventive and emergency maintenance a computer facility can quickly grind to a halt. Logistics play a major role in the provision of services. If a computer board fails or a line printer runs out of paper or ribbons it could take weeks or months to find replacements and consequently bring operations to a halt. Another important aspect to any computer facility is telecommunications. Good telecommunications is essential in order for AGRHYMET to be successful.

Several discussions were conducted which focused on the logistics and maintenance concerns of the ARC and NAC's. A primary concern which arose from the discussions was the necessity for distinction between the following functions.

Maintenance - The physical inspection, removal, or replacement of faulty components. These components may be for computers and peripherals, or electrical equipment such as power supplies and generators. AGRHYMET currently has personnel capable of performing this function.

Supply Depot - The AGRHYMET center currently has a supply depot which is used to store consumables and spare parts.

Inventory - A procedure which establishes accountability for equipment, identifies volumes, specifies status, and predicts requirements for consumables, spare parts, and existing equipment. An inventory program which facilitates this process is available on the PDP 11/60.

Logistics - This basically describes the services provided by NOAA and WMO including 1) the procurement and provision of consumables, 2) the procurement, provision, and/or forwarding for service required to maintain the computer systems, 3) the coordination of training for the operations and maintenance personnel, 4) the contracting of maintenance personnel for emergency technical maintenance support and training, 5) maintaining the inventory of parts and consumables, 6) the arrangement for transportation of maintenance personnel who are traveling to the NAC's for maintenance assistance, and 7) management and control of all the above.

Procurement Services Contract - A recommended contract which will perform parts 1, 2, 3, and 4 of the logistics tasks.

Hardware Operations - The daily operation of hardware and operating system software necessary to create a computing environment.

Production - The daily operation required to produce AVHRR products and other products which are required by the NAC's and other users.

8.1 AGRHYMET REGIONAL CENTER

8.1.1 MAINTENANCE

8.1.1.1 CURRENT SITUATION

Until recently, both hardware maintenanc and logistics were handled by the NOAA representative at the ARC. They are now the responsibility of Director of Technical Services. The Technical Services group has three people providing maintenance support, and two providing logistical support. All maintenance staff has been trained in the United States.

The ARC maintenance staff works primarily on the prime day time shift. Their first priority is the maintenance and repair of the ARC computers. They are available to the NAC's in emergencies. The first attempt at addressing NAC emergencies is through telephone conversations with the country technician. If this does not result in a solution, emergency repair visits from the NAC's are covered by either sending an ARC technician to the country, or by ARC paying for personnel from another NAC to travel to the country.

8.1.1.2 FUTURE

All ARC staff will need to be retrained in the operation and maintenance of new computer equipment. If possible, French documentation should be obtained for the systems at the ARC. This will make both maintenance and operations easier.

8.1.2 LOGISTICS

8.1.2.1 CURRENT SITUATION

NOAA originally provided logistical support to AGRHYMET. Recently, WMO become the supply agent. This arrangement only fills part of the requirements which currently fall under the encompassing title of logistics. WMO, NOAA, and AID have expressed a desire to delegate part of the logistics function to a contractor.

The ARC has established a logistics database for the AGRHYMET computers. This allows the ARC staff to estimate the amount and type of goods which need to be ordered for itself and the NAC's. The logistics database is also used when spare parts are needed by one of the NAC's. Items can be transferred between NAC's without the delay of having to order them from a supplier.

8.1.2.2 FUTURE

In order to accommodate the desires of the donor community and to ensure continuing operations the following is purposed. A procurement services contract should be issued which will provide the following:

1) The procurement and provision of consumables;

2) Services required for the replacement of spare parts (includes procurement, provision, and forwarding for service);

3) The contracting of maintenance personnel for emergency technical maintenance support and training; and

4) Acquisition of additional computer equipment and peripherals as needed.

Further details of the procurement services contract are attached in Appendix I.

In order to effectually utilize the procurement services contract, AGRHYMET will have to improve its current inventory process. This will require the following:

1) Establish an inventory and supply depot at the NAC's;

2) Develop or acquire a microcomputer based inventory program for use at the ARC and NAC's;

3) Centralize all requisitions for supplies and equipment at the ARC.

The existing NOAA PASA arrangement for training of maintenance and operations personnel should be used. However, this arrangement should be phased out during the course of Phase III.

Management controls should be implemented which will guarantee the integrity of the inventory and order processing functions for the NAC's and ARC. Some of the controls are discussed in Appendix J.

Finally, travel arrangements for ARC maintenance personnel using AID procedures and mechanisms should be in place.

8.1.3 OPERATIONS

8.1.3.1 CURRENT SITUATION

The operations staff normally consists of a systems manager, system operators, and programmers. However, both the systems and an applications programmer have recently left the ARC. There is currently no systems programmer at the ARC and none being trained, and one applications programmer position has been cancelled.

Operational support is also available only on the prime day time shift. Even during the growing season, weekend and night time support is not available. There will also be a several month gap in expatriate support for operations this summer.

8.1.3.2 FUTURE

The ARC staff will need to be retrained in the operations of the new computers. French documentation for the new systems should also be pursued. Also a set of operational procedures, for system operation, shutdown, and startup will be needed. The staffing levels for the ARC operations staff should be brought back to the levels that were originally projected.

8.1.4 COMMUNICATIONS

8.1.4.1 CURRENT SITUATION

Improvement in telecommunications is needed at the ARC, between the NAC's, between the data collection stations and the NAC'S, and between the NAC'S and the ARC. Data transmissions between the NAC'S and ARC currently use ASECNA lines, but they are slow and unreliable. Currently, one of the ARC PDP 11/60's serves as the communications hub. The ARC also makes limited use of telex.

A test of telephone communications, via 1200 baud modem, between Dakar and the ARC was completed by ARC staff. They transferred approximately 10,000 byte files in three minutes for cost of approximately $5.00. One drawback to the operational use of procedure is that the ARC has a manual telephone switchboard and only three lines coming into the ARC.

The computer systems at ARC are not networked. Data is currently transferred by diskette or tape between computers.

8.1.4.2 FUTURE

The results of the Italian-funded study on telecommunications suggest improvements that should be made as soon as possible. Telephone transmission of data using modems between NAC'S and the ARC should be attempted. An automatic switchboard with at least ten lines should be installed at the ARC. Eventually telecommunications using a satellites will be feasible.

The new ARC computers should be connected using a local area network. ARC staff will need training on network management and maintenance.

8.2 NATIONAL AGRHYMET CENTERS

8.2.1 MAINTENANCE

8.2.1.1 CURRENT SITUATION

Maintenance at the NAC level is somewhat sporadic. Preventive maintenance is performed once every month or two on

an irregular schedule. Daily maintenance usually consists of mopping the floor and dusting off the terminal screens. Computer rooms are not completely dust free.

8.2.1.2 FUTURE

ARC maintenance personnel should be visiting each NAC at least once a year. This would help insure that the maintenance is taking place and also provide an opportunity to do additional training.

All NAC maintenance staff will need to be retrained to some extent on the new computer equipment and should go through onsite refresher courses every year. French documentation, is needed to improve maintenance.

8.2.2 LOGISTICS

8.2.2.1 CURRENT SITUATION

Some supply and inventory is maintained at each NAC. If a part is required which is not available, it is sent from the ARC. Faulty components are sent directly from the NAC to the manufacturer for repair. Once repaired, it is sent back to the original location. Overall, the logistical support provided by the ARC has been satisfactory.

8.2.2.2 FUTURE

It is recommended that a person be assigned to supply and inventory at each NAC. NAC's logistical staff should make an effort to visit the ARC and review logistical procedures. If possible, a mechanism should be established for the NAC's to place orders with the ARC via telephone modem communication.

8.2.3 OPERATIONS

8.2.3.1 CURRENT SITUATION

Operational support at the NAC level is quite variable. NAC's have from one to four people providing operational support. The staff may include a systems manager, programmers, and operators for the minicomputers. The computer systems are run primarily on the prime day shift.

8.2.3.2 FUTURE

ARC operations personnel should be visiting each NAC at least once a year. This would check the operational procedures are taking place and also provide an opportunity for additional training.

A system manager should be selected from the pool of trained staff. The NAC system managers will need to receive detailed training in both the technical and administrative aspects of operation of the new equipment. In addition, all NAC operations staff will need to be retrained to some extent on the new computer equipment and should go through onsite refresher courses every year.

An attempt should also be made to provide French documentation for the systems at the NAC's.

More emphasis should also be placed on buying or copying existing software, rather than developing new software. The NAC's should communicate their software needs to the ARC.

8.2.4 COMMUNICATIONS

8.2.4.1 CURRENT SITUATION

Communications is probably one of the biggest problems for the NAC's. They have trouble getting data from the field stations and trouble getting the data from the NAC's to the ARC or any other group such as ASECNA.

The NAC's try to receive data every three hours from the synoptic stations via the SSB radios. However, not all the NAC's have working SSB's and others do not have enough for all their synoptic stations. However, Burkina Faso has two SSB radios for each synoptic station, one as a backup. There are high operational costs associated with the SSB's.

The GTS lines are not always operational and some NAC's currently must go to the airport every day to pick up their data. Some of the data is still sent to the NAC's by mail.

Most NAC's do not currently have any communications between their Rainbow and the PDP 11/34 or to any other computers in any of the other Ministries.

8.2.4.2 FUTURE

One of the results of the Italian-funded telecommunications study suggested providing solar powered SSB radios. They also recommended use of Data Collection Platforms (DCP's). The SSB's are needed, but the the DCP's should be limited for use in remote areas only. They are too limiting in the amount of data the operator can transmit. Each NAC should also be provided with modems for communication over telephone lines.

9.0 TRAINING REQUIREMENTS AND PLANS

A major objective of ARC Center is to provide training to the various components of the AGRHYMET program in the CILSS countries as well as to the staff of the Regional Center. The purpose of training is to sustain and in the future to Sahelianize the program. Training can also be used to secure long term support from decision-makers. This is based on the premise that support for technicians can be promoted if the decision-makers are enthusiastic about their program. An excellent example is in Mali where the Director of Meteorology supports the program by actively participating in the GTP, seeks new methodologies, seeks training opportunities for his staff and attends professional meetings to learn of new technologies.

The following sections detail the three levels of training (decision-maker awareness, short courses, and individual training).

9.1 DECISION-MAKER/TECHNICIAN WORKSHOP

This workshop uses a two-pronged strategy to reach government technicians and decision makers (Director of Meteorology, Director of Agriculture, Director of Food Security/Drought Commission, Director of Hydrology). Products and capabilities can be shown as (1) presently feasible, (2) possible in the near term, and (3) potentially available in a few years. The participants will use personal computers and manipulate data to analysis simple problems. This can include from problems ranging from displaying tables of data to spatial assessments of rainfall and satellite vegetation index data in order to identify areas with populations-at-risk. The agriculture director would be interested in a map showing crop conditions.

The technicians should participate with the decision-makers, but break up separately to understand the details of the analysis processes and learn of some of the limitations. This segment of the workshop would be longer than the decision-maker presentations.

Products from this workshop might include 1) a potential list of those appropriate for future training in microcomputer applications, 2) NAC software requirements, and 3) appropriate information presentation for users. The decision-makers should also be asked to draw up a plan for training their constituency.

This workshop should be well-planned and conducted at the ARC with expert assistance. The duration suggested is one week for decision makers and two weeks for technicians. A workshop report should be required. The workshop could be held in conjunction with the annual CAC meeting.

9.2 SHORT-COURSES

Short-courses represent the bulk of the Phase III training. These include one to four week courses covering topics related to the use of the new computers or related methodologies. Most students will come from the NAC's but ARC staff will likely benefit from many of the courses. The majority of the courses are geared towards applications of technology rather than an understanding of technology.

9.2.1 IN-COUNTRY TECHNICAL TRAINING IN MICROCOMPUTER APPLICATIONS

This course is designed to provide in-depth training to the participants who attended the previous course as will as reach additional users who will use the new computers for NAC applications and data base activities. analysis. The microcomputers must be delivered prior to training. The exercises will provide training, in an applications context, on the use of the capabilities of the new computers (spreadsheets, data base management, word processing, map graphics, and communications). Preventive maintenance requirements should also be covered. This should be a two to three week course in each country, repeated annually during the first three years. The number of offerings should depend on the level of microcomputer literacy found in particular NAC's and the number users requiring training.

9.2.2 MICROCOMPUTER APPLICATIONS FOR AGROMETEOROLOGY AND HYDROLOGY

This is a two-week course conducted at ARC that covers principles of the microcomputer for agrometeorological and hydrological applications. Prepared sample data sets and software will be provided to the participants. This course should compliment the in-country training courses and provide more specific and detailed applications training. As a requirement for this course, the participants must prepare data sets of climate and agricultural data on diskette in a specified format.

The training course should have a syllabus with specific subject matter outlined each day. A training activities report by each participant would be required. In essence, the report is a reference manual that they will use upon their return and to prepare for the next phase of training (9.2.3 through 9.2.6).

9.2.3 CLIMATE DATA BASE (CLICOM)

A two-week intensive training course in the development of a climate data base is suggested. Training will involve data management concepts, use of data base management systems and the use of CLICOM software. This course should be offered at the ARC. THe participants will be required to bring a specific data set for use in training exercises. A training report, which can be used as a supplemental reference, should be required for each country participating in the course. The World Meteorological Organization should be contacted on providing CLICOM training.

9.2.4 SATELLITE APPLICATIONS FOR AGROCLIMATE ASSESSMENT

This six-week ARC course is geared towards the principles, applications and interpretation of the vegetation index as well as the use of METEOSAT for spatial interpretation of rainfall. Participants will be required to bring country maps, land-use data, crop yield data and climatological data to the training program. A training report will be required at the end of the course. The major products could include relationships of vegetation index with rainfall, of vegetation index with crop condition, and between rainfall and cloud index. NAC software for display and assessment of satellite data for local analysis will be used. Participants from each country might include an agrometeorologist and a member of the agricultural statistics office.

9.2.5 PREPARATION OF VISUAL AIDS

This is a one-week course offered at ARC that is designed to strengthen NAC and ARC communication with the user community. This course should be designed to challenge the imagination of the participants to create innovative ways to prepare and display data. An exercise could be developed to teach the class the principles of preparing visual aids. A technical assistance expert on visual display is needed. The goal of the course is to increase the communication effectiveness of the products disseminated by the producers.

9.2.6 AGROCLIMATE METHODS AND APPLICATIONS

This is a three-week course for agrometeorologists. The objective of this course is to discuss applications and methods for using climate data. Subject matter include estimating potential evaporation, calculating water-balance, crop yield modeling, regression analysis, and calculating rainfall probability. Requirements for this course should include professional status and well as availability of necessary data for the analysis. All data should be put in a specified format and quality-checked prior to arrival. The participants will return home with a manual covering each of the topics.

9.2.7 SYSTEM MANAGEMENT AND OPERATIONS

This is a four-week course held at the ARC for the persons selected by the NAC's as the computer systems manager for in-country installations. Ideally, these people will have been trained in either computer maintenance or programming during Phase II. The objective of this course is to understand NAC management, maintenance, and repair responsibilities for the new computers. Topics will include hardware maintenance and repair, data security, operation of communications interface, and data exchange methods. In addition, each participant will have to prepare a workplan outlining the maintenance and logistics policies for their respective programs. The trainees will be expected to train other in-country personnel on what they have learned in this course upon their return home.

9.3 INDIVIDUAL TRAINING

Most individual training will be directed to assisting ARC staff understand how to use the new capabilities provided as part of Phase III.

9.3.1 AVHRR PRODUCT GENERATION

A two-month training session should be provided to ARC staff that will be involved in either the maintenance or use of the computer software and hardware used to prepare the AVHRR vegetation index maps and digital data. This session will cover operation of the USGS image processing software, image processing methods, and hardware operation and maintenance.

9.3.2 ESTABLISHMENT OF AVHRR ARCHIVE

This topic should be offered after the ARC staff has had some experience in the operation of the AVHRR reception station. The purpose of the training is to set up operations for an ongoing AVHRR data archive and dissemination program. Issues covered should include establishment of basic data sets, creation of an AVHRR data base, and data reproduction and dissemination practices. The French should be key members of the training.

9.3.3 COMPUTER HARDWARE AND SOFTWARE TRAINING

Training in the maintenance and operation of the new computers should be provided to the ARC Technical Services staff. Training should cover all new ARC equipment including image displays, plotters, and local area networks. In addition, detailed training in the repair of microcomputers should be provided so that ARC staff can assist, if necessary, the NAC's in solving hardware problems.

10.0 TECHNICAL ASSISTANCE REQUIREMENTS

There is a considerable personnel effort earmarked for technical assistance in the project paper. The assistance, using both full-time and short-term personnel must be planned and prioritized so that program goals can be met with maximum efficiency. The key areas of assistance in the early years of Phase III are training, implementation of operational data processing systems, and generation and distribution of AVHRR products. In later years, design of new applications and products, training, and augmentation of data processing capabilities will be high priority. The following sections identify full-time, short-term, and training technical assistance needs for Phase III.

10.1 FULL-TIME POSITIONS

The project paper suggests two full-time technical positions plus a project manager are needed to meet the needs of the Phase III USAID assistance. However, the RNA assessment highlighted the fact that additional staff will likely be need to create an effective program. The RNA team concluded that the the positions defined in the project paper (project manager, agrometeorologist, and satellite data processing specialist) are needed to meet technical objectives. In addition, a forth position, NAC Client Advisor, may be needed for successful transfer of the technology to the NAC's.

There appears to be some possible overlapping of responsibilities between French technicians to be placed in ARC and the functions which need to be filled by the USAID team. This is not a problem if the French and U.S. teams work together.

10.1.1 TEAM LEADER

The team leader serves as chief of party, and will also serve as a technical councilor to the Director of AGRHYMET. Duties will be primarily in the areas of management and liason, but limited technical guidance responsibilities are necessary.

10.1.1.1 SCOPE OF WORK

The Team Leader will be responsible for the following:

- Facilitate implementation of other team member's scopes of work within their respective ARC divisions. Coordinate team logistics (housing, allowances, vacations, TDY travel, etc.) with assistance of USAID project assistant.

- With direct access to the ARC Director, interact to resolve issues of responsibility and accountability to achieve project objectives given personnel provided, and other Center staff available.

- Establish, with ARC Director and colleagues, need for and timing of short TDY consultants, defining scopes of work, and requesting Mission travel authorizations.

- Advise the ARC Director on program issues which need to be addressed so that ARC and USAID the goals and objectives can be met.

- Interact closely with his counterparts from other participating organizations such as the French technicians so that staff activities are complimentary and not duplicative.

- Occasionally participate in ARC training programs.

- Include a section in a proposed quarterly AGRHYMET newsletter that communicates to the users specific USAID contributions to the program (training programs at ARC and elsewhere, product development, NAC and ARC consultant schedules, microcomputer implementation plans, software development issues, program success stories).

- Visit the NAC's once a year (if possible),to provide assistance and encouragement to USAID missions for in-country program issues. Trips should also include visits to key decision makers in each country to inform them of U.S. contributions to the program.

- Find ways to encourage and implement interaction of the program with other relevant projects, such as the USAID-supported FEWS, FSR or Agricultural statistics projects.

- Complete semi-annual project status reports to USAID concerning:

    a) Specific objectives for USAID team for next six months (long and short term staff).

b) Program accomplishments during last six months.

c) Problems encountered (personnel, logistic, programmatic) during past six months with recommendations for ways of to solve them.

d) Actions which must be taken by USAID in support of program for next six months (PIO/T, etc.)

e) Financial status of USAID program contribution. This section should be completed with the help of the USAID project assistant.

- Be informed of program related issues through consultation with WMO officials in Geneva, AID personnel in Washington, and others (CILSS, French and Italian programs) as needed.

10.1.1.2 QUALIFICATIONS

Education and professional experience should be in agrometeorology, hydrology, Sahelian agriculture, or geography. It is preferable that the team leader has extensive experience in West Africa (suggest 10 years). Because this position is essentially management, the person must have at least 5 years of program management and administration experience. However, a strong understanding of the technical aspects of the contract, gained through a career in agrometeorology or related disciplines is essential so that leadership and direction can be provided to the team. A minimum FS-3 capability in French language is necessary. The team leader must have proven organizational skills, the ability to communicate, and a flexible approach to work. There should be demonstrated a ability to work with Sahelians. Finally, there must be a demonstrated ability to work with others (team player), to be able to set priorities and goals.

10.1.1.3 OTHER CONSIDERATIONS

The team leader will report to several people. The position will be primarily responsible to the USAID General Development Officer for overall project responsibilities including project administration, execution of negotiated work plans, dispersal of resources under the project, and reporting of progress and problems associated with execution of project. In addition, the leader will be directly responsible to the AGRHYMET Director for program and technical issues related to the USAID team.

The team leader duty post is Niamey, Niger. While responsibilities are divided between the USAID/Niger mission and ARC, the team leader should reside at ARC so that there can be constant interaction with AGRHYMET leadership and other technical staff.

A local hire administrative assistant and one personal secretary should be provided to assist the team leader.

10.1.2 AGROMETEOROLOGIST

The principal duties are the participation in the development of agrometeorologic applications for the NAC's, and technical assistance to the NAC's in the use of applications software and ARC products.

10.1.2.1 SCOPE OF WORK

The agrometeorologist will be responsible for:

- Assisting NAC's in their development of historical field data bases. This requires visits to the NAC's and work with member state service centers.
- Assisting in the development of applications and products for the NAC's.
- Assisting NAC programs in developing consistent and (where possible) standardized procedures for hydrological, agro-meteorological data base creation and analysis.
- Becoming involved in promoting applied research in member countries. This will require working in collaboration with the NAC's and other programs (such as the the Sahel Renewable Natural Resources Monitoring Project, a CILSS/FED experimental project whose regional coordination is based at the NAC's of some CILSS member countries) to determine research needs and objectives.
- Training of NAC personnel in the use and interpretation of applications software and ARC products.
- Should be prepared to occasionally participate in ARC training programs.

- Establish applications documentation which would serve as step-by-step procedure manuals for using major ARC products and procedures.

10.1.2.2 QUALIFICATIONS

This position requires training and at least 5 years of professional experience in agrometeorology or meteorology. The person must have overseas experience and a track-record in establishing and maintaining professional contacts within the technical user community. This individual should have considerable experience in the use of microcomputers for agrometeorological applications. Professional experience in the Sahel is desirable. A proven minimum FS-3 French capability is mandatory. The successful candidate must possess an ability to work with Sahelians and have demonstrated ability to work with others as a team player and be able to set priorities and goals.

10.1.2.3 OTHER CONSIDERATIONS

The agrometeorologist reports to the team leader but on a task basis, is responsible for coordinating with the head of the ARC Methods and Monitoring Division of the Applied Agrometeorological Section. The agrometeorologist will also need to work closely with Operation Production Supervisor to insure timely and successful transfer of products from ARC to NAC's. Close involvement will be required with the NAC Client Advisor (if this position is filled) in communicating the special needs of member countries and in seeking to provide for these in a systematic, regionally coordinated manner.

This position is headquartered at the ARC but will include extensive work with the NAC's. A minimum of 3 months/year of in-country NAC technical assistance is required.

10.1.3 OPERATIONS PRODUCTION SUPERVISOR

The duties of the Operations Production Supervisor relate to the production of ARC products, particularly AVHRR, that are needed by the NAC's. In this capacity, the position requires the ability to supervise a staff involved in the generation of products, and the technical expertise to solve computer operations problems that impact the successful fulfillment of deadlines.

10.1.3.1 SCOPE OF WORK

The Operation Production Supervisor will be responsible for:

- Production, quality control, and delivery of all AVHRR NDVI products created at ARC for the NAC's. Products include:

    1) Gridded NDVI data by country

    2) Country Format Vegetation Index Maps

    3) NDVI Digital Products

- Investigates satellite data processing requirements for real time use of NOAA data for both ARC and NAC's.

- Responsibilities may include generation of the following products, as defined by NAC program needs:

    1) Intertropical Convergence Zone Definition

    2) Regional Rainfall Maps

    3) Biomass Development for Early Warning from NDVI data

    4) Phenological Development of Principal Crops for Crop Assessment

    5) Locust Infestation Probability

    6) Thermal Fields from NOAA Satellite

    7) AVHRR Raw Data Sets for Historical Analysis

- Training of Sahelian Staff to manage and produce these products.

- Develop limited software tools which may not be commercially available. Most software development, however, should be done by short-term specialists.

- Assists in the transfer of technologies and know-how from the ARC to the NAC's in the operational use and interpretation of satellite data.

- Occasionally participate in ARC training programs relating to remote sensing and AVHRR data.

10.1.3.2 QUALIFICATIONS

The Operations Production Supervisor should have documented professional experience working with minicomputers, particularly VAX 11/780 equipment, and image display and plotting equipment. At least five years of experience in remote sensing, image processing, NDVI data characterization, and data integration techniques is required. Computer hardware operations and programming experience are highly desirable, as is work experience in an operational production environment. A French language capability of at least FS-2 is needed. Some supervisory experience is necessary. The candidate must be self-motivated, possess an ability to work with Sahelians, and have demonstrated ability to work with others as a team player and be able to set priorities and goals.

10.1.3.3 OTHER CONSIDERATIONS

The Operations Production Supervisor is reports to the team leader but coordinates activities with the Head of the Data Processing and Analysis Division of the Operations Section.

Every effort must be taken to Sahelianize the responsibilities of this position so that the duties may be completely taken over at the end of three years by counterparts. Two counterparts should be designated by CILSS. These individuals would receive on-site training from this technician and short term specialists brought in. The Operations Production Supervisor will need to work closely with the French Remote Sensing Product Analyst and his staff.

This position requires occasional travel to NAC member countries (one trip/year).

The Operations Production Supervisor will have an office at the ARC and will be able to use the support staff of his division.

10.1.4 NAC CLIENT ADVISOR

This is new position which would function as an advocate for the NAC's. Duties would include definition of needs and coordination of assistance to the national programs. This position would work closely with the products and applications sections to insure effective provision of services.

NOTE: This position is outside the scope of the original project paper. While it is not needed to provide the technical services defined by the RNA team, it can provide a major role in improving the overall effectiveness in the transfer of products and capabilities to the NAC's. It should, therefore, be included as part of USAID's technical assistance to the AGRHYMET Program.

10.1.4.1 SCOPE OF WORK

The duties of the NAC Client Advisor include:

- Serve as full-time advocate for the national programs. This means close and continual interaction with member country AGRHYMET program leaders in defining their evolving priority needs for a successful program and engaging the ARC to concentrating on these needs.

- Be familiar with ARC capabilities, both in terms of personnel and logistic support and skills, in order to bring skills together with needs. Individual will know enough about ARC products to help NAC's benefit from them by coordinating focused training.

- Coordinate all training programs in the NAC's, establishing with program leaders their specific needs, planning the timing, type, and duration of short term consultant visits, and bringing in the skills of ARC personnel whenever possible. Will need to coordinate this effort at regional level to maximize utility of visiting consultants.

- Contribute to ARC Newsletter, with news on personnel changes, training schedules, training graduates, software announcements, new publications, abstract of new applications in member countries, program news from member countries.

- See that national programs have access to kinds of computer capabilities required to improve efficiency of their programs. Seek applications and applied research opportunities in the national programs for program outputs to different in-country users.

- One of first responsibilities will be to coordinate the installation and training on the microcomputer systems to be placed in the NAC's.

- Seek to increase USAID local mission involvement and support for the in-country programs, help encourage local NAC directors, promote interaction of NAC and ARC products with in-country users.

- Occasionally participate in ARC training programs.

10.1.4.2 QUALIFICATIONS

The NAC Client Advisor should have education and experience in agriculture, agrometeorology, or farming systems with at least 10 years of Sahelian professional experience. Proven French speaking ability, with a minimum rating of FS-3. The person must be able to communicate, and work with Sahelians. The Client Advisor must be self-motivated, have a demonstrated ability to work with others as a team player, and be able to set priorities and goals.

10.1.4.3 OTHER CONSIDERATIONS

The NAC Client Advisor reports to the team leader but must coordinate specific duties with the Direction de l'Exploitation.

This position will require considerable travel among the NAC member countries (minimum 5 months/year).

An office will be provided in ARC, with a full time secretary whose major duties will be support to this position. At least two counterparts should be designated by CILSS, who will receive their training through interaction with this technician and from short-term consultants brought in over live of project.

10.1.5 USAID PROJECT ASSISTANT

10.1.5.1 SCOPE OF WORK

The USAID Assistant Project Officer responsibilities will include the following:

- Assist the USAID Project Officer in day-to-day monitoring of project activities.

- Verify project vouchers received from U.S.-based contractor for completeness and acceptability in accordance with USAID regulations.

- Provide contractor support To the extent possible, such as putting together PIO/T and PIO/C's with input from team leader. Help with customs clearance of contractor personnel and project materials. Finalize project status reports with inclusion of fiscal data on expenditures and obligated funds. Support contractor personnel in official dealings with member country governments. Keep contractor team informed of USAID program initiatives in CILSS countries which may be of relevance to AGRHYMET program activities.

- Participate in and report on yearly donor committee and biannual technical committee meetings.

- Serve as the link between USAID/Niger and USAID/Washington program office.

- Draft Project Implementation Letters, Amendments, and other documentation and correspondence. These should be coordinated with the team leader when directly effecting program implementation.

- Assist in financial and end-use audits.

- Other assignments as requested by the designated USAID Project Officer.

10.1.5.2 QUALIFICATIONS

At least three years experience in Sahel West Africa. French level of at least FS-2. The successful candidate must possess an ability to work with Sahelians, be able to work with others, be self motivated, and good organizational skills.

10.1.5.3 OTHER CONSIDERATIONS

The project assistant is reports to the USAID General Development Officer responsible for AGRHYMET. The project assistant must work closely with team leader and establish regular contact with AGRHYMET Director, as well as other technical and administrative personnel on the French and Sahelian staff.

The office for the project assistant is in the USAID/Niger mission. The person will receive USAID backstopping support in accordance with established mission policy for Personal Service Contractors.

10.2 SHORT-TERM TECHNICAL ASSISTANCE

Almost 5 person-years of short-term technical assistance is needed to provide the remaining USAID Phase III support.

10.2.1 PROCUREMENT OF EQUIPMENT

The procurement of equipment may be best handled by a short-term expert with experience in procurement functions. It is critical that high priority be placed on delivery of equipment to the various centers before the end of 1988.

10.2.2 INSTALLATION OF EQUIPMENT

Rapid installation of equipment at all centers must be achieved. The new data processing capabilities for ARC must be operational prior to the start of the growing season so that operational AVHRR products can be delivered to the NAC's. The installation of equipment at ARC will require a person with experience in system installation, electronics, facilities preparation, mini- an microcomputer systems, networking, and communications.

The NAC's also should be operational well before the growing season so that climate data bases and bulletins can be created using the new facilities. Careful planning is needed to have experts arrive at the approximate time that equipment arrives in each of the National Centers. Ideally, three people (each covering three countries) should direct the installation and testing of the equipment and provide limited, informal training in simple system operations. The experts must have French language skills, overseas experience, and extensive professional experience in microcomputer technology, local area networks, and electronics. Approximately 10-days should be allocated for each installation.

10.2.3 COMMUNICATIONS

A communications expert is needed to interface ARC and NAC facilities to each other, GTS, Telex, and telephone systems. Ideally, the short-term staff setting up the NAC systems should carry out the country installations.

10.2.4 DEVELOPMENT OF AVHRR PRODUCTS

The development of procedures for providing AVHRR LAC map products to all NAC's for the 1989 growing season should be a high priority. This must be completed well in advance of the growing season. It is recommended that short-term expertise be secured to carry out this task. The U.S. Geological Survey can provide the software, data bases, and procedures needed to product the specified products. Limited assistance from the USGS in software and data base installation, and training of the full-time staff in the use of the equipment would be necessary. Approximately six-months of support is required.

10.2.5 CONVERSION OF DATA BASES

Short-term assistance should be used to survey the available data bases in both NAC and ARC and develop and apply procedures for their conversion to the new systems. Most of this will involve conversion to PDP-based data bases to CLICOM.

10.2.6 DEVELOPMENT OF MODELS AND METHODS

When possible, the creation of agrometeorological and agroclimatological models and assessment procedures should be carried out by the two full-time staff. It is likely, however, that other demands on their time may require use of short-term assistance to develop, test, and implement new models and methods.

10.2.7 NDVI VERIFICATION

An effort should be initiated to start a field test of the meaning of NDVI data in the Sahel. The project should be geared to the creation of operational crop and pasture condition assessments, and biomass estimation methods. Short-term experts should be called in to establish a project design and field methodology. The experts should also provide training to NAC staff that will participate in the effort.

10.2.8 MID-PROJECT EVALUATION

A team of short-term experts with expertise in agrometeorology, remote sensing, African agricultural systems, and computer technology should review the results of the first two years and refine the plans for the remaining three. This should include a state-of-technology assessment in order to determine if equipment changes or augmentation is warranted.

10.2.9 INVESTIGATION OF RAINFALL ESTIMATION TECHNIQUES

A major effort should be initiated to establish an operational rainfall estimates mapping capability at ARC. Short-term experts should be called in to evaluate the suitability of current methodologies to the Sahel and recommend a plan for the creation of this capability at ARC the following year.

10.2.10 DEVELOPMENT OF GIS PLAN FOR NAC'S

The movement towards geographic data bases and geographic information systems for the NAC's should be started during the third year. This should be a team effort lead by short-term experts with extensive experience in GIS technology and institutional issues. The results should be a plan for implementation of the technology in the NAC's, and an identification of the development activities needed to support the program.

10.2.11 AUGMENT DATA PROCESSING SYSTEMS

New computers should be provided to the NAC's and ARC this year. The equipment provided should be based on the recommendations offered in this document and verified by the previous years' mid-term evaluation.

10.2.12 IMPLEMENTATION OF ARC RAINFALL ASSESSMENT SYSTEM

Short-term assistance should be used to implement the results of the rainfall estimation study conducted during year three. This should be done as early as possible so that the products can be provided operationally during the growing season.

10.2.13 IMPLEMENTATION OF NAC GIS CAPABILITIES

This effort should consist of implementing the GIS plan prepared during year three. GIS capabilities, procedures, and training should be provided to the NAC's.

10.3 TRAINING

There will be a heavy training commitment throughout the course of Phase III. While it is desirable to have training provided by full-time staff, the many priorities will necessitate extensive use of short-term experts. The courses that should be designed and provided by short-term experts include:

Decision Maker/Technician Workshop (While short-term experts should design and lead this effort, ARC representation and participation in this course is critical)

Computer System Management and Maintenance

CLICOM

Satellite Applications for Agroclimate Assessment

In-country Training in Microcomputer Applications

Microcomputer Applications for Agrometeorology and Hydrology

Agroclimate Methods and Applications

Preparation of Visual Aids

GIS Training

10.4 TECHNICAL BACKSTOPPING

The complexity of activities and technology used in the AGRHYMET program is tremendous. It is unlikely that the full-time staff provided by USAID will have the qualifications and time to handle all the problems and questions that arise during Phase III. It is therefore necessary that a technical backstop be established to provide the support and advice needed during the project. Without this, it is likely that technical isolation will lead to frustration, inefficiencies, and re-inventing the wheel.

The technical backstop should have extensive staff and facilities that can solve problems and test ideas. Experience in agrometeorology, hydrology, AVHRR processing, mini- and microcomputer applications, software development and maintenance, and systems development is needed.

11.0 COORDINATION AND INTERFACE REQUIREMENTS

There are several benefits that can be realized if there are technical interfaces between related donor systems. Data and technique sharing, for example, fosters improved relationships between organizations, can reduce the duplication of effort, and can lead to cost savings for the cooperating organizations. The Phase III data processing upgrades must be coordinated, and to the extent feasible and desirable, compatible with the capabilities of potential collaborating organizations.

11.1 PROGRAM COORDINATION

From a program perspective, there must be coordination with organizations that advise or provide financial assistance to groups that could cooperate with AGRHYMET. Coordination must be maintained at the program level to insure that systems that will share data be compatible, and that new development benefits from technologies that have proved effective. The key organizations for program coordination are the World Meteorological Organization (WMO), CILSS, and the U.N. Food and Agriculture Organization (FAO). In addition, the potential relationship with African Center of Meteorological Applications for Development (ACMAD) and International Center for Operational Meteorology and Hydrology in Africa (ICOMHA) should be monitored.

11.1.1 WORLD METEOROLOGICAL ORGANIZATION

The key organization is the World Meteorological Organization (WMO). WMO's responsibility for standardizing meteorological and climatological data collection and records is important to AGRHYMET. AGRHYMET must maintain compatibility with the programs driven by WMO.

Of particular importance is the World Weather Watch (WWW). WWW has three functions - 1) Global Observing System (GOS), 2) Global Telecommunications System (GTS), and 3) Global Data Processing System. AGRHYMET is a full participant and has subscribed to standards of WWW. The Phase III data processing systems must continue to support WWW and have mechanisms for the exchange of data through GTS.

WMO plans to establish two additional regional projects in Africa that have similar capabilities to AGRHYMET. A center covering east Africa is planned for Nairobi,Kenya, and a center

covering southern Africa is scheduled for Harare, Zimbabwe. All will have reception stations which should provide almost complete AVHRR coverage for Africa. WMO believes that the three centers should have either 100% compatible systems for processing AVHRR data, or preferably, all have identical processing systems. Because AGRHYMET will be the first operational reception station, it can define the standard. It is too late to have a discussion on whether the AGRHYMET design meets the functional requirements of the planned WMO regional centers. However, a successful AGRHYMET facility will provide direction for the planned centers.

WMO is urging the adoption of CLICOM as the standard for climate data bases. Nine Sahel countries are on the probable list for CLICOM implementation. WMO recommends that the AGRHYMET Phase III system have the hardware and software required by CLICOM.

SHARE (Software Help in Applications, Research, and Education) is a WMO/UNDP program established to collect and make available public domain software. Colorado State University has the contract to gather the software and provide training to developing countries in their use. This program has strong potential in AGRHYMET and should be consulted frequently for advise on suitable meteorological, climatological and hydrological software.

WMO officials stress the need for equipment standards. For computers, the standards for computers in the worldwide meteorological community are Digital Vax mini- and super-microcomputers, and IBM-compatible personal computers. WMO strongly recommends that AGRHYMET consider these standards.

11.1.2 CILSS

CILSS does not operate under a technical charter but instead coordinates and facilities the activities and needs of the member states. Technical coordination needed with CILSS includes use of the organization as a communications channel between AGRHYMET and the national members.

The activities of CILSS should be compatible with AGRHYMET. The agricultural data collection standards promoted by the organization provide a uniform data base that can be used in conjunction with the AGRHYMET data bases. This requires little technical coordination but rather an understanding of the CILSS guided data collection activities.

11.1.3 FOOD AND AGRICULTURE ORGANIZATION

The AGRHYMET program is a data contributor to FAO. FAO field representatives in each country send rainfall amounts in a weekly telex to the capitol cities. These are provided to the AGRHYMET program of the National Meteorological Services.

11.1.4 AFRICAN CENTER OF METEOROLOGICAL APPLICATIONS FOR DEVELOPMENT

ACMAD is an outgrowth of efforts by the United Nations Economic Commission for Africa and WMO. It was approved by WMO, and the first Board of Governors meeting was held in April, 1988. ACMAD is to support all African countries and regional centers including AGRHYMET. Technical program objectives include providing meteorological and climatological data, strengthening institutional capabilities, providing products to national and regional groups, and improve application of ACMAD data.

ACMAD will be located adjacent to AGRHYMET. The proximity can result in lower data processing system operations costs if the two organizations use compatible computer and communications facilities. This which will allow the sharing of computer maintenance staff, and may permit sharing of an integrated communications system.

It is too early to tell the exact form of the ACMAD center. As ACMAD moves toward an operational status, negotiations should take place concerning adoption of equipment that is compatible with AGRHYMET as well as defining its operational functions. ACMAD should consider using the same computer and communications equipment, and share data, software and methodologies.

11.1.5 INTERNATIONAL CENTER FOR OPERATIONAL METEOROLOGY AND HYDROLOGY IN AFRICA

The World Bank, FAO, and WMO are considering the establishment of ICOMHA. ICOMHA plans include providing capabilities to meteorological services to receive geostationary and polar orbiting weather satellite data, provision of up to 300 data collection platforms, and establish INTELNET communications for transfer of data. ICOMHA funds are to be divided between national meteorological services, ACMAD, and the three African regional centers, including AGRHYMET.

The impact of ICOMHA is unknown. Realization of the objectives of the program would have significant technical interface implications for AGRHYMET. At this time, the potential for ICOMHA implementation too uncertain to be a factor in the current system design.

11.2 TECHNICAL INTERFACES

The establishment of technical interfaces with other donor programs can include information networking that can lead to cost sharing between programs. However, AGRHYMET's role as a provider of primary data rather than as a decision making body results in a low number of useful interfaces with other donor programs. Interfaces to FEWS and FAO/Artemis deserve consideration. Other programs, including CRTO, RCSSMRS, GIEWS, and GRID are related but do not warrant a formal association.

11.2.1 GLOBAL TELECOMMUNICATIONS SYSTEM

GTS is the communications link between ARC and the NAC's. Most data are transferred via GTS. The AGRHYMET data processing systems must develop interface mechanisms that allow automated transfer of data into and out of GTS. The mechanism of GTS, i.e., mode of transmission, would be improved by including the use of satellite communications.

11.2.2 ASECNA

ASECNA maintains a data base of historic meteorological data for the AGRHYMET countries in Dakar, Senegal. The data are collected from the synoptic stations and others in West Africa. They are encoded by national meteorological service staff on computer coding forms and mailed to Dakar to become a component of the ASECNA data base. This data base is of considerable value to AGRHYMET. Most NAC's have not established a comprehensive historic data base. The establishment of an information network with ASECNA will allow the NAC's to import the records for their stations. It could also lead to the elimination of the hand encoded forms in favor of digital input at the NAC's and transfer of data diskettes to ASECNA.

11.2.3 FAMINE EARLY WARNING SYSTEM

The USAID Famine Early Warning System (FEWS) is unique in its' use of AVHRR-derived vegetation index data as an indicator of food security status. It should rely on AGRHYMET for agrometeorological and vegetation index data.

FEWS could become a major user of AGRHYMET products in the coming years. Both NAC and ARC data will be needed. It is a data customer. However, while it cannot exchange primary data with AGRHYMET, it can be a source of technical assistance. The country FEWS programs will have staff with training in the use of information systems and image analysis. The program may also be able to provide prepared data bases that may augment those of the NAC's. FEWS can be a strong asset to the NAC staff. Because of the mutual relationship that could evolve, software compatibility is desirable. AGRHYMET should consider development of data exchange procedures that will allow use of FEWS data bases. This will enhance the USAID investment in both systems.

11.2.4 FAO/ARTEMIS

There is potential to establish a data link with the FAO/Artemis System. Artemis is a Rome-based image processing system that will have near-real time spatial data bases representing Meteosat imagery, vegetation index (from AVHRR imagery), rainfall estimates (from Meteosat), and locust breeding activity index data. The system is scheduled to be operational in mid-1988. The data bases will cover all nine AGRHYMET countries.

Artemis uses a Hewlett Packard minicomputer. For AGRHYMET to use the data, a communications channel from Rome to ARC, and programs to process the data into an ARC and NAC compatible format would need to be established.

The real-time vegetation index data used by Artemis is redundant and of lower resolution than the data that will be received at the ARC AVHRR reception station. It is not needed. The processing used in the locust breeding activity index is of general nature and again based on AVHRR data. ARC can produce this product if it is required. The rainfall estimation data could benefit AGRHYMET. However, there is some question as to the reliability of the data. If the evaluation is positive, AGRHYMET should arrange for routine communication of the data and establish reformatting and distribution procedures for relaying the data to the NAC's.

The historical data bases that will be part of Artemis are unique and can be very useful to AGRHYMET. The vegetation index data, dating back to 1981, will allow time series analyses of vegetation conditions and can be very useful for early warning purposes. However, ARC can also obtain these data from FEWS.

In conclusion, only the rainfall data are potentially useful to AGRHYMET, and only then if the product accuracy is acceptable. It is unlikely that establishment of an interface to FAO/Artemis will be required.

11.2.5 UNEP GLOBAL RESOURCES INFORMATION DATABASE

The UNEP Global Resource Information Database Processor Facility (GRID) of the U.N. Environmental Program was established in Geneva to assemble and provide global data bases to anybody free of charge. GRID databases are global in scale and are not likely to be of use to the general AGRHYMET community.

11.2.6 GLOBAL INFORMATION EARLY WARNING SYSTEM

The FAO Global Information Early Warning System (GIEWS) of the FAO provides national estimates of food production. It currently uses rainfall data from the AGRHYMET program as one input to its estimation process. GIEWS does not have data bases or capabilities that are likely to be required by AGRHYMET, but instead will continue to be a user of the program's services.

11.2.7 CRTO/RCSSMRS

The two regional remote sensing centers in Africa, Centre Regional Teledetection - Ouagadougou (CRTO) in Ouagadougou and the Regional Center for Services in Surveying, Mapping, and Remote Sensing (RCSSMRS) in Nairobi will have little impact on AGRHYMET. Neither group has a strong computer analysis capability. RCSSMRS does not operate in the AGRHYMET region and thus will not have exchangeable data. They are a potential source of short-term expertise in remote sensing. CRTO does not have active data collection programs and has shown little interest in AVHRR data applications. Their strength has been remote sensing training and applications. CRTO could be a resource for AGRHYMET staff requiring in-depth Francophone technical training in remote sensing. They may also be a source of short-term expertise.

12.0 IMPLEMENTATION OF PHASE III TASKS

The implementation of the USAID Phase III assistance should ideally be completed prior to the 1989 growing season. However, in order to meet this deadline, it will be necessary that all activities be carried out within a specified period. Unfortunately, the completion of many critical tasks can only be possible if predecessor tasks are completed on schedule.

There are three main groups of tasks that must be completed before Phase III is operational. The ARC Vax computer must be upgraded so that it has the capabilities needed to provide AVHRR products. Parallel to this, the microcomputers must be delivered and installed in both the ARC and NAC's. Finally, basic training in the use of all new systems must be provided. These tasks must be completed prior to the 1989 growing season. The remaining Phase III activities, mainly training, can then be scheduled to best meet the needs of the NAC personnel.

12.1 CRITICAL ACTIVITIES IMPLEMENTATION SCHEDULE

The following schedule of critical activities should be used in order to have operational capabilities by the beginning of the 1989 growing season:

Task	Early Start	Early End
Identify Technical Assistance Contractor	05/16/88	08/29/88
Procure VAX Upgrade	05/24/88	09/07/88
Procure Microcomputers	05/24/88	09/07/88
Identify Procurement Services Agent	05/24/88	09/07/88
Install AVHRR Receiving Station (France)	07/01/88	11/03/88
Technical Assistance Contractor Preparation	08/30/88	12/04/88
Procurement Services Agent Preparation	09/07/88	09/30/92
Install VAX Upgrade	12/14/88	03/30/89
Technical Assistance Contractor In-Place	12/14/88	05/12/92
Install ARC Microcomputers	01/03/89	01/13/89
Install NAC Microcomputers	01/03/89	04/17/89
Install AVHRR Software at ARC	03/30/89	06/08/89
Operational Capabilities In-Place	05/15/89	06/08/89

12.2 TRAINING PRIORITIES

The basic training needed at the NAC's prior to the start of the growing season include:

- Decision-Maker/Technician Workshop
- Computer Systems Management and Administration
- CLICOM
- In-Country Techniques for Microcomputer Applications

The remaining courses should be scheduled during the winter months so that they do not conflict with other activities.

12.3 SHORT-TERM TECHNICAL ASSISTANCE SCHEDULE

During the gear-up period of Phase III, several short-term consultants are needed to allow rapid implementation of capabilities. The remainder of the short-term technical assistance will be distributed during the three-year period. The tentative schedule for short-term assistance is:

<u>Year One</u>

Procurement of Equipment

Installation of Equipment

Installation of AVHRR Product Generation Facilities

Conversion of NAC and ARC Data Bases

Training

Decision-Maker/Technician Workshop

Computer Systems Management and Administration

CLICOM

In-Country Techniques for Microcomputer Applications

Microcomputer Applications for Agrometeorology and Hydrology

Satellite Applications for Agroclimate Assessment

Year Two

Development of Models and Methods

NDVI Verification Study

Training

- Computer Systems Management and Administration
- CLICOM
- In-Country Techniques for Microcomputer Applications
- Microcomputer Applications for Agrometeorology and Hydrology
- Satellite Applications for Agroclimate Assessment
- Agroclimate Methods and Applications
- Preparation of Visual Aids

Year Three

Mid-Project Evaluation

Investigation of Rainfall Estimation Techniques

Develop NAC GIS Plan

Training

- Computer Systems Management and Administration
- Satellite Applications for Agroclimate Assessment
- Preparation of Visual Aids

Year Four (or Late in Year Three)

Augment Data Processing Systems

Implementation of ARC Rainfall Assessment System

Implementation of NAC GIS Capabilities

APPENDIX A

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APPENDIX B

Niger Situation Report

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Data Products

Dr. Boulama and his deputies work to produce the ten (10) day bulletin which is sent to over fifty (50) people and government Ministries within Niamey, and to approximately one hundred (100) groups around the country. The Ministry of Agriculture is the main user of the decadal bulletin. They also produce a yearly summary of 10 day bulletins.

Data Collection

They routinely collect data from 150 rainfall posts, fifty (50) being new. They also have fourteen (14) synoptic stations, five (5) agrometeorological posts, and nineteen (19) climatic meteorological posts. Data is communicated using ASECNA. They usually only have data from fifty (50) posts available when they produce the decadal bulletin. The data is forwarded by SSB or through a system developed with the local police. They do send the decadal bulletins and daily rainfall data to the Regional AGRHYMET Center. All the meteorological data up through 1987 is on the PDP 11/34.

They also have forty (40) locations around the country where people can fill out forms with information on the type of crops they are growing. They can use this information to collaborate other data.

Data Processing

They use the DEC PDP 11/34 and Rainbow micro computers to produce their bulletins. The PDP 11/34 has been in use for over two (2) years.

The PDP 11/34 is also used to store their meteorological database. They did indicate a preference for mini-computers over micro-computers. They are now trained on how to use and maintain the PDP 11/34 and believe a mini-computer would provide a central place for storing their databases and have the capacity for storing their databases.

Their PDP 11/34 has three (3) RA60 disk drives, one (1) TU80 tape drive, and a Decwriter II. A Versatec B80 is also available. The Rainbow 100s are used for word processing and as terminals to the PDP 11/34. They have four (4) Rainbow 100s, but only one works. They currently have four (4) people who know how to use the word processor.

Their computer facilities were quite good. The PDP 11/34 is setup in a room by itself. The room was air-conditioned and appeared dust-free. The terminal room contained the working Rainbow 100, and two (2) VT-240 terminals. They receive their power from the National power company and have their own UPS system.

The file containing all their meteorological data from approximately 1930-1980 was 11,016 blocks or approximately 5.6 Mb. It would seem their database files would fit onto the storage available on a micro-computer.

They would like a newer mini-computer and a fax machine, do not look forward to being retrained, and would hope that in three years they would not be asked again to change their computing facilities.

APPENDIX C

Mali Situation Report

Dates of Interview: May 7-13, 1988

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Background

The Mali National AGRHYMET program includes officials of both the National Meteorological Service and the Hydrology Service. The Mali program has innovative staff with a good understanding of the utility of their data bases. There is a good atmosphere of cooperation between the Mali NAC and other Government of Mali (GOM) ministries.

Mali has had a difficult time carrying out some of their plans because the NAC data processing equipment has not been working for several months. No power is available for the PDP minicomputer because of a poor electrical system in their new building. The Rainbow microcomputer is operational and is used to a limited extend for word processing. They also have an Olivetti microcomputer that was provided by the EEC. A final problem is that there are no trained programmers on the staff. However, a programmer is currently being trained in Ouagadougou.

Users

The Mali multi-disciplinary working group (GTP) is an active element of the National AGRHYMET Center. NAC staff are members of GTP, and GTP is a major user of NAC information. The GTP included representatives of over 14 GOM organizations They meet approximately four days after the end of the 10-day period to compare AGRHYMET data to information gathered in other ministries in order to assess the status of food production. The formation of the Mali GTP is considered to the most important result of the AGRHYMET program.

The Direction Etude Nationale de la Statistiques et Informatiques and the Direction de la Documentation et Statistiques Agricole of the Minstrie de l'Agriculture are both use NAC rainfall data as inputs to their crop production estimates. Rainfall is used to set the bounds of the estimates. Both agencies are hoping the NAC will expand their analytic capabilities to be able to carry out special studies on subjects including relative yield estimation and identification of areas with enough rainfall for irrigated agriculture.

The NAC is participating with the Ministrie de l'Agriculture in a pilot test to determine the impact and feasibility of using meteorological data to increase the yields of farmers engaged in traditional agriculture. In the pilot study, planting, fertilizing and weeding dates are based on an analysis of soil moisture conditions. The experiment was controlled. Both groups used fertilizer and plowed but one group fertilized when they wanted and the other waited until the data analysis suggested that conditions were correct. This gave an overall yield increase over 30% Three results were positive enough to start a second test in a different rainfall zone.

USAID/Mali is also an AGRHYMET user. They use NAC bulletins for the preparation of their monthly AGRHYMET situation report. In addition, FEWS uses rainfall data and the NAC 10-day agrometeorological bulletins. USAID/Mali has a staff member assigned to coordinate mission AGRHYMET activities. This appears to have substantial positive benefits and should set an example on proper program management.

There are many other users in Mali. The Systeme d'Alerte Precose early warning system uses the AGRHYMET decadal and hydrology bulletins. Other GOM agencies using NAC products include Division Hydrologique, Direction Nationale de l'Elevage, Textile Commission, and Crop Protection Service.

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NAC Products

As with the other NAC's the key products are bulletins. Data for the decadal agrometeorological bulletin comes primarily from the national network of meteorological stations. They have 20 synoptic stations, 52 climate stations, and 226 rainfall stations. Some of the data have been computerized. The 1955-1985 rainfall data are in a data base that can be used for probability analysis. There is almost 30 years of station data available for Mali that can be included in a data base for use by other organizations.

The hydrology component of the NAC produces monthly hydrological bulletins. In addition, the Hydrology Service published an annual report and many special reports on topics including regional studies, influence of dams, and water deficiency.

Hydrology has 85 data collection stations that are located in six geographical regions. They have a hydrology data base from covering 1979 to 1984. Annual reports are made using the computer.

Needs

The desired assistance to Mali from ARC include: 1) improve data collection stations, 2) provide satellite NDVI data, 3) make computer facilities more operational, and 4) improve exchange of data between ARC, NAC, and users in Mali. Continuation of the training program is also a high priority.

In addition, the Meteorological Service needs immediate assistance in the purchase of a 30kv generator. Power to the Met Service has been cut for as long as two weeks making use of their computers impossible.

Mali has several communications problems that should be addressed. The GTS data goes to airport, not NAC. This has been very inconvenient. They have also been unable to link the PDP to GTS. Data collection from the field is sporadic because of SSB problems. The SSB's run on generators and batteries. They are expensive to operate and unreliable. They asked that the generators and batteries be replaced with solar panels. The NAC would like capabilities for data transfer to ARC using modems. This may be difficult because telephone connections between Niamey and Bamako is poor.

There is a strong need for NDVI data in Mali. Mali is large and the rainfall stations are widely spaced. The satellite data allows an understanding of what is going on in all areas of the country. To assist in a national assessment, they have use the NDVI grid data provided by NOAA. While the satellite data were useful, they would have been useful had they been provided on time. Still, NDVI grid data is valuable because they have a historical data base for comparison of conditions. The general nature of the data is compensated by the historic data base.

The availability of 1-kilometer NDVI maps would be very beneficial since the added detail increases both the utility and range of applications. The GTP sees a need for the additional detail for their assessments. The maps have also shown to be very useful for grasshopper control. For the data to be most useful, the maps should be delivered quickly. Most users concluded that the maps would still be useful even if they came late.

The general consensus was that the NOAA grid data should still be provided. The current program should continue but the high resolution product should be included as soon as possible. Ideally, they would like to use both so they can decide what is most appropriate.

The Mali NAC has major computer problems. The PDP does not run because of air conditioning problems. It has not run since it was moved from the airport in December. They also have a serious problem with power outage that can last for several weeks.

In spite of the problems with their current situation, the NAC staff has many applications that require computer support. They include:

- Data encoding for use in both a NAC data base and for later transfer to ASECNA
- Forecasting
- Sorghum growth modeling
- Automated generation of isohyets
- Analysis of NDVI
- Statistical analysis of rainfall patterns
- Bulletin preparation
- Accounting
- Data exchange capabilities

The NAC believe the PDP should be replaced. They suggested that 10 microcomputers would be needed to fill the void. The microcomputers should be networked so they can all access the same data bases. It is important that the equipment provided be compatible with other ministries so that data sharing is possible.

APPENDIX D

BURKINA FASO COUNTRY REPORT

Dates of Interview: April 2-4, 1988

Interviews

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Comite Interafricain Etudes Hydrauliques

Background

Burkina Faso is the country headquarters for the CILSS organization through which the AGRHYMET program is channeled. Unfortunately none of the key people were in the country at the time of our visit, including Mr. Ibrahim Ba, head of the Diagnostic Permanante, though we did pay a courtesy visit to Mr. Camara Ibrahima, Director of Studies and Plans. Following visits to USAID, the team met several times with different members of the agrometeorological station, as well as the hydrological service (located elsewhere), IWACO (a project concerned with regional water uses), CIEH (a multi-donor funded program concerned with regional ground water and hydrology issues), the USAID FEWS representative, and the Ministry of Agriculture, Agricultural Statistics Office. The team took a day trip to visit one field based synoptic station in Fada N'Gourma, 230 kilometers east of Ouagadougou, where we were able to observe first hand, field data collection and transmission activities to the National Center.

Burkina is a country which has had a fairly active group running its in-country AGRHYMET program, and we were generally impressed with the personnel at the agro-meteorological headquarters. The number of contact made were limited but sufficient to cover all those involved as either users or suppliers of AGRHYMET related products. The USAID mission was most helpful in assuring that a vehicle was available as needed.

Data Collection

Data collection comes from a network of stations. First among these are the synoptic weather stations of which there are currently 9 (Ouagadougou, Dori, Ouahigouya, Bobo,

Fada N'Gourma, Boromo, Dedougou, and Po). Data for these stations goes back to 1920, while the latter two have only been added in last three years. All these stations have two SSB radios (one as backup), some with solar power, which forward data every three hours to the National Program in Ouagadougou, through ASECNA.

There are 10 climatological stations, 15 agro-climatological stations, 120 official rainfall stations, and some 300 unofficial rainfall stations managed by various research stations, private companies, missionary groups, other government services. Much of these data seem to be collected on an ad-hoc basis - though records are believed to be complete in many places in the field.

The basic data sent from the synoptic stations are recorded every 3 hours and sent by SSB to NAC/ASECNA, and are also reported in ten day bulletins to the NAC. All CILSS countries follow the same procedure, using similar coded forms to fill out. Data collected include:

(1) total rainfall
(2) maximum/minimum air temperature, and average
(3) average humidity
(4) total evapotranspiration
(5) solar intensity average
(6) soil temperatures at surface, 50 cm. and 1 meter depth
(7) wind speed and direction

A visit to the synoptic station in Fada N'Gourma permitted the team to observe data being recorded and transmitted in the field. These posts have two SSB's, one for backup, which are solar powered. The technicians noted that except for wiping them occasionally, they had never had the least problem with them.

Data Processing and Analysis

The mini-computer (PDP-34) currently was not operational. It had been down for two weeks, a replacement part sent to them from the ARC, but the local technician (in hydrology) had not yet had the time to come and repair it (meteorological service lost their own repair technician to the private sector). Only one of two Rainbows work, and it is running on 20/20 software to work out planting dates (the programming was developed by program technicians. Users

We met with several organizations who consistently use AGRHYMET national services data (either in the form of their ten day bulletins, monthly bulletins, or raw data about different stations. Among the most active users of these data are the DEP (Division des Etudes et Plannification) people at the Ministry of Agriculture, who take the lead in the GTP (Multi-disciplinary Working Group set up by AGRHYMET). This group meets regularily every ten days throughout the growing season with various statistics, reports, data they have been able to obtain for the preceding period. These data include NAC data, as well as qualitative reports from GTP members who consistently visit all parts of the country every 10 day period to meet their network of local contacts (in 9 Rural Development Organizations), who themselves have completed a short form on their local area. The form, labeled "Fiche Suivi Agrometeorologique des cultures" is filled out each 10 days by these "extension agents" for all the major crops, conditions of their development, pests, evaluation of the activities taking place on farms (plowing, planting, weeding), total 10 day rainfall, seasonal anomalies, and a subjective evaluation for the area. These data are coded and analyzed by GTP members, and combined with national data sets to produce their ten day assessment for the country.

APPENDIX E

Mauritania Situation Report

Date of Interviews: March 8-10, 1988 Nouakchott, Mauritania
April 25, 1988 Niamey, Niger

Interviews

Gandega Yelli
Ingenieur Argo meteorologiste
Coordonnateur National du Projet AGRHYMET
R. I. Mauritanie

Bill Thomas
ADO Office
USAID/Mauritania

Jeff Coupe
FEWS Project
Mauritania

Walter Boehm
Deputy Director
USAID/Mauritania

Background

This report is a summary of conversations the Requirements Needs Analysis (RNA) team held with Mr. Yelli in Niamey, Niger and of a visit by Mr. Gray Tappan, USGS/EROS Data Center, to Mauritania in March of 1988.

Data Collection

They have thirteen (13) synoptic stations, ten (10) agricultural stations and sixty (60) rainfall stations. These stations have been collecting rainfall data anywhere from ten (10) to sixty (60) years. The sixty rainfall stations are manned by only one (1) person and only for three (3) months during the year. The level of training for the people manning these stations varies, but in general is not very good.

One concern at this point is the need to improve the communications network between the NAC and the field stations in the various regions of Mauritania. Presently, they have five (5) Single Side Band (SSB) radios for reporting information to the NAC. They do experience problems with the generators and batteries for the SSBs, but they work most of the time. The SSBs have a high operating cost however, gasoline and new batteries, and they would prefer solar SSB radios or Data Collection Platforms (DCPs). DCPs are preferable given the large area and inaccessibility of the remote stations in Mauritania.

For the majority of stations, they must rely on information gathered by the Ministry of Interior, and this is often late. Thus, Mr. Yelli stresses the need for a more comprehensive radio communications network between the NAC and the field stations.

Data Processing

Mauritania has not received their PDP 11/34 computer yet from the AGRHYMET Regional Center (ARC). Their facilities are ready, but the installation cost would be prohibitive and they would rather wait for the Phase III computer purchase and receive "newer" technology.

They have received the DEC Rainbow 100s, and these have been used for word processing, but since they run on a CP/M operating system, instead of MS-DOS, they cannot exchange data with other Ministries in the government.

The Rainbows are not used for data processing, due to limited memory capability, the lack of software and the lack of trained staff in operating and maintaining the systems. They are presently archiving, processing and reporting meteorological data manually. This is a major constraint in providing timely reports to users, as is the inadequate communications network with the field.

The Rainbows, printers and UPS systems do not always work properly. Mr. Yelli was not sure what software was available on the Rainbow, or any of the other computers in his government.

They have one person who is being trained in the United States on general computer operations and maintenance. Mr. Yelli hopes this person would be able to provide all the

support his group would need. There are also several private groups which could provide support in Mauritania.

They current staffing level at the NAC is approximately sixteen (16) people.

NAC Products

Their primary product is the decadal bulletin produced during the growing season. They do not use any ARC data for their decadal reports, but they do supply the decadal bulletins to the ARC.

Mr. Yelli feels that the meteorological (rainfall, soil moisture, evaporation, insolation, wind), seasonal vegetation, crop condition, and hydrological data and assessments that they currently provide the ARC and various users are satisfactory and should continue. Mr. Yelli did, however, point out the fact that their monitoring and assessments of the vegetation biomass condition are problematic. They base their assessments largely on NOAA satellite NDVI data provided by the ARC. These have typically been late in coming from the ARC (three to four weeks) and in the past year, 1987, they have not received these data at all. The NDVI data they receive from the ARC is also too coarse of resolution to be useful. They prefer the higher resolution, one-kilometer, data which can be used for crop and rangeland vegetation assessments.

Other products are associated with their research programs which are currently linked with the research at the Kaedi Research Center. Current research focuses on establishing crop calendars for various crops, investigating optimum planting dates, and monitoring of the planting schedules. By working in collaboration with the Kaedi Research Center, they have direct contact with the farmers.

Users

Mr. Yelli mentioned the following as regular users of the decadal bulletins: UNDP, PAM, FED, USAID, various NGOs (eg. KARITAS), all Departments of the Ministry of Rural Development, and FAO. They currently send out eighty decadal bulletins every ten days.

Agricultural extension personnel translate the bulletins for the local services, which broadcast the bulletins on the radio. This is used to tell farmers information like how successful they might be if they plant their crops on certain dates.

USAID makes regular use of the data in the decadal bulletins, particularly the rainfall data. USAID is, however, very skeptical about the reliability of the data. They indicated that the rainfall data comes to AGRHYMET from a secondary source (ASECNA), which is not known for collecting reliable data. Recently, USAID did an in-house audit of the Mauritania AGRHYMET rainfall data for June, July, August, and September 1987, and found that 48.3% of the cumulative monthly totals were incorrect, and did not correspond to the summarization of reported decade rainfall figures. This discrepancy was attributed to the data update program being used by AGRHYMET to fill in gaps in decadal data when it becomes available at any point in time. Thus, USAID staff find it very difficult to base grasshopper/locust control decisions, as well as famine warning systems work, on these data. Secondly, the reports USAID receives are often quite late. This is a major obstacle, considering the need for timely data for such projects as FEWS and grasshopper control. Mr. Boehm feels that AGRHYMET/Mauritania is not ready at this time to collect, process, and distribute meteorological data that are reliable and timely. USAID staff feel that there is a definite need for an AGRHYMET-type service in Mauritania, but that the basic data collection, analysis and reporting functions of AGRHYMET must be reviewed and strengthened.

USAID has not used the ARC-furnished vegetation index data generalized to a one by half degree block basis. They have used the vegetation index data furnished by the USAID/USGS Pilot Project and feel that this type of product is very useful for monitoring seasonal vegetation conditions. To date, USAID uses of "greenness" data have been in support of grasshopper and locust control efforts.

Needs

Mr. Yelli suggests the need for much more technical support from the ARC in the form of training, consultations, and monitoring of activities of the NAC's to ensure that they (the NAC's) are on-track and that the data being collected and processed are consistent with the needs of the ARC. In particular, Mr. Yelli feels that the data processing hardware

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and software systems and approaches should be similar or compatible with those of the ARC. Their tasks must parallel those of the ARC, the main difference being their scope (national versus regional).

According to Mr. Yelli, ARC should provide the following services/products:

- Provide technical expertise for training, both in data gathering, and analysis.

- Investigate new hardware and software and provide it to the NAC's when and where appropriate. Their first priority is to receive an IBM or IBM-compatible computer. An IBM microcomputer could be used for creating a meteorological database on the computer that is now being kept on paper, drawing isolines of temperature and rainfall which is now done by hand, and using the microcomputer in preparing and publishing their decadal bulletins.

- Insure data compatibility and standardization between NAC's.

- The AVHRR receiving station at ARC should provide quick turn around of products such as the ones provided by the USGS/EROS Data Center, for example, NDVI maps for crop forecasting. ARC should provide more training of his staff in the use of AVHRR data. They would like to know what other products can be produced from these data.

Other

They have found the NDVI maps provided by the USGS in 1987 to be very beneficial. They were useful too many Ministries in particular the livestock service. Their country is too large to have stations everywhere and the AVHRR data would give them a synoptic view of their country. These NDVI maps were available two to three weeks before the ARC-furnished index data. Furthermore, they felt the one-kilometer spatial resolution of the data was considerably more useful than the one degree by half degree NDVI provided through the ARC. Thus, they made regular use of these "greenness" maps in their decadal bulletins, using the data as indicators of crop condition and vigor, and for rangeland condition assessments. These data were used in conjunction with field observations and soil moisture regimes to make an overall assessment.

Mr. Yelli feels that the format and timing of the greenness maps should continue and should be considered as a product to be provided in the future by the ARC. The monitoring of NDVI on a departmental, and if possible, on an arrondissemont basis would greatly facilitate their present task. The NAC staff were aware of the possibility of using the one-kilometer spatial resolution AVHRR data through their interactions with NOAA at Columbia, Missouri, but became convinced of the importance of using these data through the EDC NDVI mapping project.

APPENDIX F

Chad Situation Report

Date of Interview: March 24, 1988

Interviews: Bagdra Gag
Chad AGRHYMET Coordinator
Chad Direction of Water Resources

M. Betoloum Neasmiangodo
Chef de la Climatologie
Chad Ministry of Agriculture and Rural Development

Kurt Fuller
Agricultural Development Officer
USAID/Chad

A. Yacoub
Assistant Agricultural Development Officer
USAID/Chad

Charlotte Sharpe
FEWS Field Representative
USAID/Chad

Background

The Chad National AGRHYMET Center was one of the last NAC's to be organized and have facilities installed by ARC. They have several problems that make it difficult for them to be effective.

Users

The key user of the Chad NAC is the inter-ministerial multi-disciplinary working group (GTP). The Chad GTP meets every 10-days starting in April. Other Government of Chad (GOC) users are the Ministry of Agriculture, the Ministry of Animal Husbandry (Elevage), and the Ministry of Food Security. Extension agencies, development projects, and various consultants also use these data.

In addition, Chad agrometeorological data are provided to such international donors as USAID, FAO, UNDP, FAC, and ORSTOM. Many of the NGOs in Chad are regular users.

USAID is a regular user of AGRHYMET data. They prepare a summary report on rainfall and other parameters from each decadal bulletin during the growing season, and send the information to USAID/Washington. The data are used in specific programs in Chad, particularly for the grasshopper/locust control efforts and for the FEWS program. In the past, USAID has been disappointed with the data, particularly with the major gaps in the data.

NAC Products

The Chad NAC collects data from 12 synoptic stations, 20 climate stations, and 9 agrometeorological stations. Then many more totaling 132 reporting stations. In addition, there are 41 hydrological stations which monitor lake and river levels. Because of poor communications, usually only 20 stations report every 10 days.

The available data are analyzed and interpreted manually, and sent to the ARC for their use. Concurrently, decadal bulletins are prepared immediately following each ten-day reporting period. Within two days after the bulletin is drafted, they are sent to users. Thus, the reporting and distribution of the data to users is timely, but the major constraints are the frequent gaps in data in the decadal reports. The third decade of each month is somewhat more complete in that it provides monthly summaries of rainfall and other data, and many of the reports from the field stations which do not appear in the previous bulletins, are included in the monthly summaries. Over 200 decadal bulletins are printed and distributed.

The NAC decadal bulletins are are also read over public radio. This has not been entirely successful because of a lack of people that can interpret technical French into local dialects. NAC is now trying to tap into the rural radio system. The bulletins could be explained to farmers who would then explain the situation in their own words to the farmers in the area.

At the end of each year, a "Bulletin Climatologique" is published which presents a monthly summary of agrometeorological and hydrological data. It is quite comprehensive and most of the data gaps are filled.

Chad has received weekly grid NDVI from AGRHYMET, NOAA, and USAID. The NAC used it for decadal assessments for following crop and pasture development. The Chad Veterinary

Service uses the data to estimate were good pastures are and estimate were the herds are. They then use the information to set up livestock vaccinations. Two people manually analyze the data.

Needs

Chad has not received much help from the ARC and thus has many needs. The only real help they have received is training. They underlined the need for basic logistic and material support to accomplish their basic data collection, analysis and reporting tasks.

The main problem facing the NAC is in receiving and sending information from the field to the NAC. Very frequently, data from many of the stations do not arrive at the NAC in N'Djamena in time for their inclusion into the decadal bulletins. Chad has yet to receive working radios. Four are to come but this is too few for such a large country. Communications with the field stations must be improved through an extensive radio communications network. Sending information from the decadal reports to users in the field (crop protection service agents, extension services, and ultimately, the farmers is also difficult and slow for the same reason. Finally, the Niamey-ASECNA channel frequently does not work which makes communication with ARC sometimes impossible.

The NAC is in need of an improved computer facility. The PDP does not work and there have been problems with the DEC Rainbows. The two existing computers are not being used at the present time. In addition, they do not have the trained staff to make use of these systems. However, two trainees are presently in the U.S., one is specializing in hardware and computer maintenance, the other is studying programming and software applications. They are expected to bring the computer systems at the NAC into operation, and to automate a number of data archives and analysis tasks.

In the meantime, the NAC has started developing a meteorological data base with the assistance of the USAID FEWS program. FEWS has trained staff in data entry, graphing, and reporting. All work done in the Chad NAC this past year was on the FEWS computer. Chad will need to transfer data encoded by FEWS to the new system.

Thirdly, there is a need for additional staff training in a number of areas. These include intermediate-level training in hydrology, meteorology, agronomy, and remote

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sensing. The director would like to have all technicians trained in the use of microcomputers in their work. The FEWS/Chad program has proposed training the AGRHYMET staff in basic word processing and spreadsheet skills in the interim until the return of the trainees.

The NAC received AVHRR-derived vegetation index data from the ARC until some time last year. These one degree by half degree NDVI data were not included in the decadal bulletins because of their tardy arrival. However, the staff regularly used the data in their seasonal vegetation assessments and found the data useful as indicators of crop and rangeland vegetation conditions. They were used specifically as indicators of crop emergency in known agricultural areas, as a general indicator of crop phenology, and as an indicator of rangeland resources.

They did not receive the data during 1987. As a result, they have had to rely on field reports and rainfall data for these assessments. If the ARC could provide these data in a regular and timely fashion, they would be very useful to Chad NAC. They indicated that a product modeled on the 1-kilometer resolution NDVI maps produced for the USAID locust campaign would be of great value to the program for the uses outlined above. They envisioned receiving either hardcopy maps or digital data on diskettes from the ARC on a decadal basis, assuming a rapid method of receiving the data could be found. They want to have the flexibility of displaying, printing and analyzing the NDVI data themselves, and would thus prefer the digital format. They repeated their request for training in the use of AVHRR data in order to better determine what specific products might be useful to them.

They also indicated a need to map and monitor seasonally intermittent water bodies, such as temporary lakes and inundated floodplains. These represent water sources for livestock in the early and mid-dry seasons. They believe that satellite data with appropriate resolution would be a valuable tool, and could complement their hydrological data on lake and river levels.

Finally, the Chad NAC want a mechanism to exchange research information with other groups in the region and country. Publications and methodologies are needed.

Other

FEWS/Chad has been working closely with AGRHYMET for over a year, and has provided much of the missing data to USAID as it becomes available from the field stations. FEWS is quite complementary of the AGRHYMET staff, their motivation, and efforts to make the program successful. This is part of her effort to construct a 30-year historical database on rainfall and other parameters for Chad, in order to better monitor trends in rainfall and agricultural production. This database will serve as a basis for future research and to better serve the needs of both FEWS and AGRHYMET monitoring tasks.

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APPENDIX G

Senegal Country Report

Date of Interview: March 21, 1988

Interviews: Bassirou Diop, Director and AGRHYMET Coordinator
Senegal National Meteorological Center

Sory Diallo, Deputy Director
Senegal National Meteorological Center

Wayne Nilsesteun, Agricultural Development Officer
USAID/Senegal

Moribadjan Keita, Agricultural Development Office
USAID/Senegal

Background

AGRHYMET/Senegal activities are currently coordinated by a committee composed of members of three Government of Senegal (GOS) organizations:

Direction of Agriculture
Direction of National Meteorology
Direction of Hydrological Studies

A proposal has been drafted to give the Direction of National Meteorology the lead role in coordinating AGRHYMET activities, which Diallo believes will improve their effectiveness.

Users

The Senegal NAC views its purpose to collect, analyze and distribute agrometeorological data to various users, both internationally and within Senegal. For example, the multi-donor, multi-ministry grasshopper control team made extensive use of NAC rainfall data in 1987, planning field surveys, in part, on the basis of rainfall distribution.

USAID staff rely on assessments produced by the NAC. They believe the AGRHYMET service is very important. Both consider the rainfall and other data are reliable, and the bulletins arrive in a timely fashion.

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NAC Products

The key product developed by the Senegal NAC are decadal bulletins produced duri g the rainy season. They contain rainfall and crop development information at a national scale. The data are further used to prepare monthly rainfall summaries and crop assessment reports. Both reports include an examination of current rainfall with the historical averages.

Needs

They indicated that if products were to be sent to Senegal, the data transmission lines would have to be improved. The cable network between Niamey and the NAC is apparently unable to accommodate the presently heavy usage.

The NAC has a need for timely vegetation condition information. In previous years, they received NDVI values averaged over a one by half degree cell. They made little use of the data because they felt that they were not meaningful and did not correspond well with the overall vegetation conditions within a cell. Furthermore, the vegetation index data from the ARC were typically late, even though the data came by telex. Instead, they relied primarily on field reports and rainfall data to assess seasonal conditions. The NAC did not receive the AVHRR-based vegetation index data from the ARC in 1987.

The NAC received AVHRR vegetation index maps with 1 kilometer resolution from the USAID/USGS Pilot Project in 1987. There is interest in learning about the various options, potentials and limitations, of using AVHRR-based products for agrometeorological applications, but they feel ill-equipped to make specific recommendations on desirable future products. They were impressed with the one-kilometer and indicated that such a product would be a major asset to their program provided they could receive it in a regular and timely manner. Tentatively, Mr. Diallo and Mr. Diop made one suggestion for AVHRR-based products: an end of season maximum vegetation index composite, which they envisioned as having numerous applications such as drought-area assessment, for fire hazard mapping, and to estimate areas susceptible to wind erosion (where herbaceous cover is inadequate).

Other

The Direction of National Meteorology currently receives NOAA-10 and METEOSAT data through a satellite data receiving system installed by the French Centre de Meteorologie Spatiale. This is used primarily by ASECNA for furnishing up-to-date weather information for aircraft. The reception and digital to analogue conversion system is a French-made CIT Alcatel system. Geographic coverage of the NOAA data, which are produced as single-band images for interpretation of weather phenomena, is typically 5 degrees south to 40 degrees north, and 0 degrees to 25 degrees west, though the east-west coverage shifts considerably as a function of orbit position. The Senegal NAC uses the image data intermittently for monitoring rain-producing cloud formations in the wet season, and for determining the position of the Intertropical Convergence Zone.

APPENDIX H

COMPUTER HARDWARE AND SOFTWARE SPECIFICATIONS

The hardware and software needed for Phase III can be divided into two groups. The first, microcomputers, should be purchased following a full and open competitive bidding process. The second procurement includes all equipment related to the VAX upgrade and supporting peripherals needed for the generation of AVHRR products. A non-competitive procurement is recommended because of the need for compatibility with existing facilities and the unique, integrated nature of the system.

1.0 PROCUREMENT OF MICROCOMPUTER HARDWARE, SOFTWARE AND PERIPHERALS

1.1 Special Instructions

The computer systems should meet the descriptions provided in Section 1.2 and 1.3. All equipment listed is intended for use in West Africa and that the native language is French and the power requirements are for 220V/50hz. Vendors are asked to ensure that proposed computer systems have French keyboards and appropriate power supplies. In addition, vendors asked to propose French software and documentation whenever it is available in the requested product. If a vendor has an alternative recommendation for specific software requirements, it should be clearly identified. However, most of the specified products are integral to the requirements of the project and are not substitutable.

1.2 Itemized Hardware Specifications

1.2.1 Computers

Quantity	Description	Specifications
38	286 Personal Computers with 40 MB HD	As specified in 1.3.1
9	286 Personal Computers with 80 MB HD	As specified in 1.3.1

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1.2.2 Peripherals

Quantity	Description	Specifications
22	2400BPS Modem	External, Hayes Compatible
32	Epson LQ1050	As specified in 1.3.2
11	Plotter	4 Pen, HP driver set compatible
11	Extel Communications	As specified in 1.3.3
10	UPS	As specified in 1.3.4
1	Label Printer	Dot Matrix, 120 CPS, serial printer with IBM emulation
20	Switch (ABC)	Parallel
1	Laminator	Plastic covering of up to 36" x 34" paper maps
11	Mouse	Microsoft-compatible 2-button serial mouse
1	Digitizer	34- by 44-inch digitizing tablet and puck (cursor) attached to RS-232 async communications port

1.2.3 Software

Quantity	Description	Specifications
44	MS-DOS, Ver. 3.3	
11	DataEase, Ver. 2.5	DataEase International
22	DBASE III Plus	Ashton Tate
11	GrafMatic	
11	Fortran	Microsoft
11	FORLIB+	
11	COSORT	
22	Norton Utilities	Peter Norton
11	Keyworks	Alpha Software
22	Lotus 1-2-3	Lotus Development
33	WordPerfect, Ver. 5.0	WordPerfect
20	Procomm	DataStorm Technologies
14	ATLAS*GRAPHICS	STSC, Inc.
14	Surfer	Golden
1	SPSS/PC	SPSS, Inc.
1	T-Graf	Grafpoint

1.3 Detailed Specifications

1.3.1 Computers

The personal computers should meet or exceed the following specifications:

- 80286 12-MHz 0-Wait-State Central Processor with a 80287 math coprocessor
- 1-MB at least 120-nanosecond-access-time RAM
- Phoenix BIOS Revision 2.3 or better
- VGA or EGA compatible graphics card, downward compatible to CGA
- 1 1.2 MB 5.25 inch built-in diskette drive capable of reading and writing 360 KB format
- 40 MB with 28 msec or better access time
- At least 8 IBM compatible expansion slots, with minimum 2 16-bit expansion slots, and 2 8-bit slots
- 1 serial port, 1 parallel port
- Memory expansion up to 8 MB
- Time/date clock with battery backup
- 101 keys keyboard, French
- Minimum 200 watts, 220 VAC 50 Hz power supply, preferred switchable
- Diagnostics and installation guide (preferably in French)

The 80 megabyte systems should contain two 40 MB hard disks which are identical to the specified 40 MB drives.

1.3.2 Printers

The printers should meet the following specifications:

- 24-wire matrix print head

- 200 cps print speed in draft text mode
- Pin-feed continuous forms integral tractor
- 15-inch-wide carriage
- Minimum 6-KB print buffer
- 6-, 10-, 12-cpi, and proportional pitch
- 220 VAC 50 Hz power supply

1.3.3 Extel Communications Interface

The Extel Communications Interface should meet the following specifications:

- ComProcessor Concurrent Telecomm Adapter
- Auto send/receive, auto answer, auto dial
- Compatible with 5-level Telex Baudot code
- Foreground/background operation - immediate
- Internal microprocessor
- 200-KB RAM user-data file storage
- Realtime clock
- Touchtone or pulse dialing
- Full/half duplex
- Built-in Bell 103-compatible 50-baud modem
- Compatible with IBM 286 PC
- 220 VAC 50 Hz power supply

1.3.4 UPS

The UPS should meet or exceed the following specifications:

- 500-VoltAmpere 220-VAC 50-Hz (input & output) inverter

- Sufficient battery capacity for 15-minute full-power operation

- Non-switched operation (battery always in parallel)

- Packaged for office environment

2.0 PROCUREMENT OF VAX-RELATED HARDWARE, SOFTWARE AND PERIPHERALS

2.1 Special Instructions

The computer equipment for the VAX upgrade should be purchased from Digital Equipment Corporation under GSA Schedule contract GS-00K88AGS-5918. The computer systems should meet the descriptions provided. It must be recognized that all of the equipment listed is intended for use in West Africa, where the native language is French, and that the power requirements are for 220V/50hz. The power supplies must be compatible. When possible, French keyboards and documentation should be supplied.

The equipment listed in this section will augment an existing VAX 11/780 and MicroVax II. The following deletions to the current VAX 11/780 configuration will occur in conjunction with the installation of new equipment:

- Four 1-MB memory boards installed in CPU

- Three RA-60 205-MB disk drives installed in three-high cabinet

- All RS-232 async communications lines attaching user's terminals to DMF-32 comm. adapter

- Any existing DZ-16 non-DMA async communications adapters

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2.2 Itemized List VAX Equipment

Product #	Cost Qtl	Qty	SPDSCNT%	Cost	Description
MS780-JA	3861.00	8	1 35.25	22499.98	8MB Memory Board
RA82-AD	17000.00	2	1 20.25	40672.50	662MB Disk
DMF32-AA	1134.00	1	0 20.25	904.37	Async Adapter, 8 line
CK-DMF32-LD	1460.00	1	0 20.25	1164.35	Cabinet Kit
TU81E-AB	28665.00	1	0 20.25	22860.34	Tape Drive
DSRVB-AB	3806.00	2	1 20.25	9105.86	DS200 RS232 TRMSV
H4000	315.00	4	2 20.25	1507.28	Ethernet Tranceiver
BNE2A-MC	1645.00	1	0	1645.00	Cable E backbone 117M
12-19816-01	23.00	2	0	46.00	COAX Terminator
12-24664-02	37.00	1	0	37.00	Tool Kit
BNE3L-05	126.00	1	0	126.00	CBL 5M IEEE802
BNE3L-10	189.00	3	0	567.00	10M IEEE802 CBL
BC22E-25	66.00	6	0	396.00	25FT Cable Async
LN03S-A3	3995.00	1	30.25	2786.51	Laser Printer
DL-VT320-CP	495.00	2	30.25	690.53	Terminal
DELUA-M	3964.00	1	20.25	3161.29	Ethernet Int 780
CK-DELUA-KM	236.00	1	20.25	188.21	Cabinet Kit
DELQA-M	2500.00	1	20.25	1993.75	Ethernet Int Kit
QED04-UZ	2625.00	1	20.25	2093.44	DECNET VAX License
QZD05-UZ	2662.00	1	20.25	2122.95	DECNET VAX License
QZ015-UZ	2840.00	1	20.25	2264.90	DEC C-lang Compiler
LN03X-AC	83.00	10	0 0	830.00	Laser Printer
LN03X-AD	198.00	6	0	1188.00	LN03 Maintenance Kit
CK-DELQA-YB	150.00	1	20.25	119.63	Cabinet Kit

2.2.1 Description of Equipment

All VAX equipment must be AC-powered, 220-240 V., 50 Hz. The following new equipment must be procured for the VAX 11/780:

- Eight 8-MB memory boards into the CPU (MS780)
- Three RA82 622-MB disk drives installed in the three-high cabinet (one drive to remain powered off as spare)
- One Unibus expansion cabinet/chassis - five additional slots (CK-DMF32-LD)
- One TU-81E 25-ips 1600/6250-bpi tape drive attached to Unibus expansion chassis
- One DMF-32 communications adapter (to drive Versatec page printer, required only if one not already installed)
- One DELUA Ethernet interface adapter installed in the Unibus expansion chassis and attached via transceiver cable to an H4000 Transceiver on the Ethernet cable
- One licensed copy of DECnet end-node software to provide DECnet/Ethernet TDC/IP network interface control
- One 109-meter Ethernet cable routed from the operations/equipment room, through the production room, and ending in the microcomputer/training room
- Four H4000 Ethernet transceivers clamped to the Ethernet cable, with two located in the operations/equipment room connected to two DELUA's, one located in the operations room connected to a DECconnect 200 terminal server, and one in the microcomputer/training room connected to a DECconnect 200 terminal server
- One LN03+ plain-paper laser Xerographic 8-pp/min page printer attached to RS-232 async communication port and located in production room
- Two DECconnect 200 8-port terminal

server/concentrators attached to the Ethernet co-ax cable, to which up to eight RS-232 user displays are attached (DSRVB-AB). One to be located in the production room with three user terminals and the LN03+ attached, and the other located in the microcomputer/training room with up to eight terminals attached

- Two VT320 computer terminals networked to VAX computers

Equipment needed for the MicroVAX II are:

- One DELQA Ethernet interface adapter installed in the MicroVAX CPU chassis and attached via transceiver cable to an H4000 Ethernet transceiver on the Ethernet cable

- One licensed copy of DECnet full-function software to provide DECnet/Ethernet TDC/IP network interface control

- One licensed copy of a DEC C-language compiler for MicroVAX II, to be used via Ethernet for occasional program compilation of the ADAPS software on the U.S. VAX 11/780 computer

In subsequent years, plans call for the purchase of additional equipment for the VAX network, including:

- One color graphics display terminal for use with above equipment, attached to RS-232 async communications port (vendor: Tektronics 4207 or equivalent. Could be 286-based microcomputer and T-Graf software package)

- One medium-resolution color film (8- by 10áinch Polaroid) image recorder attached to general-purpose color display system (vendor: Matrix or perhaps Kodak will have a product offering by fall). This item is not essential, and procurement could be delayed for one year.

2.3.2 Software

The following software licenses are needed for the VAX 11/780:

- ARC/INFO Version 4.0 geographic information system software from Environmental Systems Research Institute, Redlands, California
- IMSL Math Subroutines

2.3.3 Non-DEC Peripherals

Calcomp Electrostatic Color Plotter

- Model 5835 36-inch-wide roll-fed 4-color electrostatic plotter
- 220 VAC, 50 Hz power supply option
- RS-232 19.2 Kbps communications interface for data transfer
- Driver and interface software compatible with VAX VMS operating system
- Software to perform merge of vector plot files with raster image data
- Training for two persons for a minimum one week at factory school (hardware)
- Call-in phone support for software problems

Calcomp Thermal Plotter

- Model 5912 thermal transfer plotter
- Four color, 11" x 17" output
- Software/plot file compatibility with Calcomp 5835
- Call-in phone support for software problems

International Imaging Systems Display Station

General Description includes the following capabilities and characteristics:

- Image Viewing and Analysis Station (IVAS) Model IVAS-RM with -OP option to provide 220 VAC 50 Hz power compatibility with 3 x 8-bit image memory planes and video DAC's
- 1,024-line x 1,024-sample display resolution
- 4 x 1-bit 1,024 x 1,024 graphics planes
- 1X-16X integer zoom
- Realtime interactive point processor

Specific equipment models must include:

- Model -IF1 Unibus interface to DEC VAX (1 hex slot)
- Model -CBA15 Parallel Interface Cable
- Model -MM2 Digitizing Tablet of 11 x 17 inch active area, with model 2014-01 4-button cursor and 3-m RS-232 interface cable
- Model -CBB10 10-meter Interface Extension Cable for above tablet
- Model -CM1 19-inch High-Resolution Color Monitor
- Model -MCB10 10-meter Video Cable set for above

Adage Color Display System

- Image Memory model DR64 or DB256 512 x 512 x 8 x 2- or 4-planes (2 is minimum required -- 1 for B&W image and 1 for graphics overlay)
- Frame Buffer Controller with pan, scroll, zoom, programmable sync, programmable frame rate, and non-interlaced display mode
- Color Lookup Tables and 8-bit Video Output DAC's

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- 19-inch Color Display Monitor with 35 kHz horizontal scan frequency

- DMA Host Interface to DEC Unibus (DR-11 type)

- Host-resident Software to include AIDS diagnostic program and Fortran driver for VMS Version 4.7; supplied on 9-track, 1600- or 6250-bpi, ANSI-format magnetic tape

NBS Clock and Parallel Interface

- Trutime (or equivalent) NBS Timecode Receiver for European relay of WWV radio transmission. Can be equipped for 50-bit parallel or RS-232 serial data transfer to the host. Host must be the French-supplied MicroVAX II computer. Parallel interface card should be a DEC DSS-11A 48-bit parallel PIO for Q-bus. If not available, must add Unibus expansion chassis and MDB Q-verter card. Or, if development staff are available, determine time differential between bus and serial versions of input, and use serial interface if delta time is 80 milliseconds or less (serial will be slower). This hardware must be used in conjunction with special software developed by USGS that computes and stores the time differential between the satellite clock (each image line is time tagged as scanned) and NBS time. Accurate time-tagging allows images to be used without precision correction, in many cases, with geodetic accuracy of 1-2 pixels over the scene.

2.3.4 Site-Related Facilities

The following are required for the initial upgrading of ARC facilities:

- Metal tape storage racks approximately 10-feet long, spaced with 4-foot aisles, sufficient to contain approximately 4000 10.5-inch magnetic tapes, and located in the small room adjacent to the operations/equipment room

Later in the project, it is desirable to add:

- Halon-gas fire suppressant system installed in the operations, archive, and production rooms. Or,

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alternatively, water sprinkler system with heat sensors and water sprinklers in the rooms specified above

- Door interlock timing system for the two entrance doors into the production room, to not allow the inner door to be opened until a 20-second interval has elapsed from the opening of the outer door

2.3.5 Consumable Supplies

- 10.5-inch 2400-foot magnetic tape (certified) 1000 reels
- Plotting paper for D-sized color raster large-format plotter 20 rolls
- Cyan, Magenta, Yellow, and Black color toners for plotter, sufficient quantity of 5.6-liter bottles 20 rolls
- White 20-lb. bond paper for laser printer 10 cases
- White 20-lb. 9.5- and 14-inch-wide fan-fold pin-feed printer paper for microcomputer printers 20 cases
- Self-processing color paper packs for Polaroid camera on Matrix film recorder 50 10-sheet packs (delayed buy)
- Ribbons for microcomputer dot-matrix printers 30 qty
- Ribbons for dot-matrix tape-label printer 5 qty
- Sheet mylar for lamination of maps 5 rolls
- 36-inch-long 4-inch-diameter cardboard mailing tubes 250 qty

3.0 Shipping Instructions

The specified equipment should be sent to the AGRHYMET Regional Center, Niamey, Niger, attention USAID/Niger.

4.0 Evaluation

Vendor proposals for equipment will be evaluated based on the following algorithm:

- Price - 75%
- System Evaluation - 25%
  - Appearance - 5%
  - Keyboard - 5%
  - French Versions - 5%
  - Peripherals - 5%
  - Enhanced Performance - 5%
    (Performance above that required)

Vendors whose proposals meet the technical requirements of the system will be asked to demonstrate their products for evaluation in Washington, D.C.

APPENDIX I

Details of Procurement Services Contract

Objective

A procurement services contract will provide the AGRHYMET Program with a U.S.-based logistics support organization for:

1. The procurement delivery of spare parts for electronic, computer, and meteorological equipment.

2. The reception, forwarding, repair, and return of failed equipment or components.

3. The procurement and delivery of small quantities of microcomputer equipment and peripherals.

4. The procurement and delivery of related supplies and consumables.

5. The procurement and delivery of temporary technical service for the installation and repair of specific equipment and for on-site and factory training n the operation and maintenance of specific equipment.

Expected Outputs

Outputs of this contract will include:

1. Timely procurement and delivery of consumables.

2. Timely procurement and delivery of new microcomputer hardware, software, and peripherals.

3. Timely procurement and delivery of replacement parts for the following types of equipment: Data processing, communications, electronics, uninterruptable power supply, and air conditioning.

4. Timely procurement and provision of technical services.

5. Timely forwarding and payment for repair or replacement of failed spare parts and return to AGRHYMET.

6. Appropriate tracking, recording, and accounting of all transactions with respect to federal government regulations.

Scope of Work

The technical procurement services contract is expected to provide communications and a liaison between the AGRHYMET Program and specialized manufacturing, sales, or service organizations worldwide. The services, supplies, and components that are expected to be procured are valued at under $400,000 per year or $1.6 million over the four-year duration of the contract. The estimated value is $300,000 per year.

In order to provide this service, the contractor will establish a system with USAID/Niger and ARC for ordering and payment of commodities and services, accounting of funds available and spent, and tracking of requisitions, orders and returns for repair. Specific responsibilities will include:

1. Provide proficient French speaking point-of-contact for interface with AGRHYMET.

2. Maintain up-to-date catalogue information and a parts number library on all equipment used by the program with U.S. funds.

3. Insure specific and proper part numbers accompany orders for equipment and/or spare part purchases or repairs.

4. Receive and process requisitions from the ARC for equipment, supplies, and repair and returns of non-functioning equipment.

5. Receive and forward to the correct repair facility non-functional equipment or modules and insure their return to the proper African center.

6. Track requisitions for repair, procurement, and shipping as well as the maintenance and submission of periodic status reports to the ARC and USAID.

7. Pay manufacturer for equipment, supplies, and services and account for all funds designated for this purpose according to acceptable U.S. Government procedures.

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8. Engage appropriate factory or qualified technical assistance for 1) the installation and/or repair of U.S. provided equipment, and 2) short training courses for field personnel in the operation and maintenance of U.S.-provided equipment.

9. Receive and forward to appropriate repair facilities failed equipment and modules and insure their return to the proper post.

10. Maintain an up-to-date and complete listing of equipment catalogs, part numbers, etc. at the home office and insure that the ARC also has a complete up-to-date set of documentation to insure correct ordering.

11. Perform part and part number research as required to insure that correct equipment and parts are ordered upon receipt of requisitions from AGRHYMET.

12. Maintain accurate records of all requisitions, orders, transactions, and costs for both AGRHYMET records and billing purposes.

13. Purchase any new parts and equipment requisitioned by AGRHYMET and ship to appropriate African locations.

14. Provide management representation at least once a year at technical implementation review meeting in Europe or Africa as requested by USAID.

15. Act as AGRHYMET's liaison in soliciting for, and procurement of factory representative or competent independent assistance for on-site maintenance, training, and/or installation of all existing and future program equipment.

16. Maintain effective lines of communication with AGRHYMET in order to provide a single coherent direction for the overall management of the contract. Communication will be oral, written, telex, or French.

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Reporting Requirements

The contractor must provide monthly procurement and financial status reports to the ARC and USAID, of the entire program, for the purpose of financial and technical management. Each report must include: 1) requisition status (reference numbers, dates received, and action taken); 2) procurement status (reference numbers, dates received, action taken, expected ETA, and costs); and 3) repair and returns (reference numbers, dates notified/received, action taken, costs incurred, and ETA).

Relationships and Responsibilities

The ARC is staffed with a U.S. Program Manager, a Technical Services director, and a Director General, who will have delegated responsibility for direct communications with the contractor for day-to-day information exchange, repair and return of requisition/shipments, and receipt of monthly status reports. The ARC Logistics Coordinator will compile yearly consumable orders for the entire program and communicate a consolidated order to the contractor with the concurrence of USAID/Niger. The ARC Technical Service Director, through the Logistics Coordinator and with the concurrence of USAID/Niger, will place orders for necessary items to the contractor. USAID/Niger, with the concurrence of the ARC, will notify the contractor of any schedule or equipment changes required. The contractor will acknowledge receipt of all communications from the ARC and USAID/Niger by telex or direct automatic computer link within five days of receipt indicating action taken and time to complete. The contractor will submit monthly or quarterly billing documentation to USAID/Niger which will insure verification and payment. The contractor may be requested to make at least one site visit to the ARC per year.

Priority Service

Depending on the urgency of the procurement, three priorities of delivery schedules have been identified:

1. Immediate, required in two weeks or less
2. Required in six weeks or less
3. Required in 90 days or less

Priority 1 will be used when a part is required for immediate operations. Priority 2 will be used when existing AGRHYMET inventories have been depleted and restocking is necessary to insure continued operations. Priority 3 will be used primarily for consumables and components required to replenish inventories.

Terms of Performance

The contract will begin upon the last date of the signature page of the contract and will end on January 1, 1993 or earlier for the convenience of the Government. The contract can be amended or extended with the concurrence of both parties.

Contract Type

The contract is recommended to be awarded as a fixed fee contract with incentive. The incentive will be allowed if the contract provides the following: 1) 95% of the services required within the specified service level time; and 2) 100% of the services required within 30 days after the specified service time of the service request.

Proposal Format

Proposals should include the following:

1. A statement of corporate capabilities and relevant experience.

2. A statement of how the support will be managed and implemented.

3. Resumes of personnel who will be involved in providing services.

4. A statement of the fees. This should include the fixed monthly fee which supports priority 3 service, and additional fees for priority 1 and 2 service.

Proposal Evaluation

Proposals will be based on the submission of proven and documented experience in the procurement, ongoing maintenance support and distribution of electronic equipment,

telecommunication equipment, computer systems, spare parts, consumables and other related equipment in developing countries, preferably in Africa. Specific proposal format with maximum points awarded per section follows:

Corporate Capabilities and Experience	25 pts

Verifiable and demonstrated past working relationships with:
- Digital Electronics Corporation
- Alden Electronics
- Trane Refrigeration
- Scientific Radio Systems
- Consumable manufacturers/suppliers

Volume of Business
Language Capabilities
Automated data processing facilities
Description of office facilities

Proposal	25 pts

Demonstrated understanding of U.S. Government procurement regulations
Description of proposed procurement procedures
Description of proposed payment procedures
Guaranteed requisition turnaround and delivery times
Travel capabilities

Personnel	20 pts

Description of permanent staff and their qualifications, including
- Accountant
- Depot Manager
- Secretarial Pool
- Communications Manager
- Office Manager

Language capabilities
Travel capabilities

Cost	40 pts

Fixed fee
Fee for priority 1 service
Fee for priority 2 service

Total	100 pts

APPENDIX J

MANAGEMENT FOR INVENTORY, ORDER PROCESSING, AND MAINTENANCE

The Logistics Division, an element of the Technical Services Department at the AGRHYMET Regional Center (ARC), serves an important role both in the successful maintenance of computer equipment as well as in the overall function of computer services. To date, it appears to have performed that function both reliably and efficiently. It has been assisted in its job by the on-site NOAA Advisor and his supporting staff resident in the U.S. With the departure of the NOAA Advisor, the Division's responsibilities will increase substantially during the interim period that a logistical support contract (a procurement services contract) is being implemented via a competitive procurement. Such a contract should be completed in approximately three to four months. Longer term, the Logistics Division will have the assistance of the U.S.-based support contractor to replace, hopefully, all of the services currently provided via the NOAA PASA for hardware procurement, component parts repair and replacement, and consummables procurement. This last function has been provided by WMO for the past three years. However, overall its responsibilities will increase because of several reasons:

1) Logistics will have to work directly with the contractor to arrange for repair services and procurement;

2) Logistics will have a large volume and diverse mixture of consummables to stock, inventory, and distribute;

3) It is being recommended in this RNA that Logistics assume responsibility for being the central supply and repair depot for all of the AGRHYMET centers.

To assist in its supply role, the Logistics Division has an inventory control program, written in BASIC, that operates on the PDP-11/60 computer. That will have to be enhanced and moved to another computer. Depending on one's philosophy, that computer could be either the VAX 11/780 or a PC microcomputer. The latter would be convenient, but it is not essential. The program needs to be expanded in function to better assist the increased responsibility being placed on the Division. Suggested additions could consist of a more complete description of the depot parts, to include vendor, full part stock-number, unit in which installed, designation of Center where installed, most-recent purchase or repair price, and confirmation numbers between the contractor and the ARC as well

as between the ARC and the National AGRHYMET Centers (NAC's). The program's current desirable functions such as reorder point, reorder volume, current inventory quantity, current order status, etc. should be retained.

It is desirable that the Logistics Division's role be expanded to include full logistical support for the NAC's as well as for the ARC. As currently conceived, the NAC's will have a spare module or complete replacement unit for each of the components that are installed. For example, the microcomputers will be backed up by one each of a 5.25-inch diskette drive, 5.25-inch hard drive, keyboard, monitor, video adapter, serial adapter if separate, computer memory if separate, and power supply. Associated peripherals to have spares will include the printer, modem, mouse, peripheral switch, and in the case of the Hydrology Service, an uninterruptable power supply. The Logistics Division will maintain an inventory of all the parts for the ARC-owned microcomputers, and in addition, it will maintain an inventory and status of all parts at each NAC. It will also arrange for the repair or replacement of failed equipment returned to the Division by the NAC representative. It will reorder consummables according to the requirements stated by each NAC.

The Division will need to implement a procedure of written (preferably Telexed) notification of failed parts. The designated NAC logistics representative will notify the ARC Logistics Chief, who should in turn acknowledge his intention to order the component or list of consummables with a confirmation number. Experience suggests that reliance on verbal requests and responses leads to lapses in the resupply process. The process may be less complicated by virtue of having the NAC return the failed component to the ARC, that being the stimulus to initiate the reorder process.

There currently may not be a designated Logistics representative at each NAC. Individuals at the NAC's must be appointed to fulfill this essential role. An underlying assumption in the recommendation to place microcomputers at the NAC's is to achieve greater program functionality and to assure the highest computer availability possible. This objective will not be achieved unless the flow of spare parts can be maintained without breaks in the pipeline. It may be possible to add the responsibility of logistics coordination to those already given to the hardware technician. However, this decision must be carefully considered because of the past practice of a separation of responsibilities between the Maintenance and Logistics divisions.

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The list of consummables at the NAC's is quite short, if the recommendations of the Requirements Needs Analysis are implemented. They would simply consist of 5.25-inch diskettes, 8.5- and 14-inch-wide tractor-feed computer paper, and printer ribbons. The ARC would have, in addition, 2400-foot reels of 0.5-inch-wide certified magnetic tape, 8.5 x 11-inch bond paper, toner kit for laser printer, 34-inch-wide rolls of paper for the color plotter, and cyan/magenta/yellow/black dyes for the color plotter.

Consummables should be ordered at least six months in advance of requirements to permit lower surface shipment costs. It would help the Logistics Division if each NAC representative were to estimate their requirements six months in advance. Inventories should be taken at least once per year and quantities reconciled between the ARC and each NAC.

The Maintenance Division will have to work closely with Logistics, initially helping to create the inventory data base, and then assisting with the verification that equipment returned for repair indeed are defective. Over time the Maintenance Division personnel will develop knowledge and skills in isolating and correcting defects in equipment that otherwise would have to be returned to the U.S. for repair. Printers, color monitors, keyboards, and uninterruptable power supplies (UPS) are the most likely candidates for such repair. Because increasingly unique, very large scale integration (VLSI) chips and surface mount packaging are being used in state-of-the-art microcomputers, repair of many modules is outside the capabilities of anyone except the original vendor. It is recommended that the Maintenance Division be given one microcomputer on which to conduct maintenance training for users as well as for its personnel. In addition, the microcomputer should be used to verify that components returned for repair/replacement are, in fact, defective.

Maintenance Division, in cooperation with the maintenance technicians at the NAC's, would be the ideal personnel to install proper instrumentation-spec wiring at the NAC's. Such wiring should include use of U.S.-type 60 Hz. polarized plugs, a convention initiated by the NOAA Advisor. Probably all but one of the microcomputers will be installed near UPS power and adjacent to adequate air conditioning, if they are located in the terminal and operator's offices prepared earlier for minicomputer installation. The importance of proper wiring lies with the need to install 220 V. receptacles that have a separate ground circuit (wire).

It is recommended that the current archive area be devoted entirely to tape archive use, which will require new tape storage racks to be installed. That small area will be adequate to hold both currently held tapes and tapaes likely to be created during the next year. By the end of the 1989 rainy season, assuming new vegetation-index-map software is installed in March, 1989, the archive tape storage area will likely need to be expanded.

It is further recommended that the 11/780, at least, and perhaps the microcomputers as well, be left operating (that is, powered up) 24 hours per day, seven days per week. In order to protect equipment and tapes from damage in the highly unlikely event of a fire resulting from a short-circuit or power supply failure, the computer area and tape archive should have a Halon-gas fire-suppressant system installed. The reduced maintenance on the 11/780 and the French-supplied MicroVAX over 5-10 years will pay for the expense of the Halon system. The archive tapes themselves represent an extremely valuable resource, as will be the CLICOM data base tapes and diskettes, that merit fire protection based solely on their historical value. By the end of 1989, a microcomputer-based tape archive inventory computer will be essential for the efficient management of the archive. It may be wise to implement such a system prior to the start of the 1989 rainy season.

The increased complexity of the ARC computer systems, and the increased responsibility of producing NDVI image maps for the users at the eight NAC's, imposes a much greater responsibility for the Maintenance and Operations staffs. Increased training will be required on the new components installed, and management training for the Maintenance Division chief is a necessity. It cannot be stressed too strongly that the production requirements will be greater than ever, and these deadline-induced pressures will be felt very acutely by the Maintenance Division. In fairness to those personnel, increased management and technical training must to be given to better equip them for the new demands to be placed on them.

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APPENDIX K

REGIONAL AGROMETEOROLOGICAL BULLETIN EXAMPLE

CILSS / PNUD / OMM
PROGRAMME AGRHYMET

CILSS / UNDP / WMO
AGRHYMET PROGRAMME

CENTRE RÉGIONAL DE FORMATION ET D'APPLICATION EN AGROMETEOROLOGIE ET HYDROLOGIE OPÉRATIONNELLE

Adresse postale
CENTRE AGRHYMET
B.P. 11011, NIAMEY, Republique du Niger

Telephones 73 39 87 Direction
73 31 16 Autres services

Telegrammes : AGRHYMET NIAMEY
Telex : 5448 NI
Bureaux : Rive droite

BULLETIN AGRO-HYDRO-METEOROLOGIQUE DECADAIRE REGIONAL
POUR LES PAYS DU CILSS
NR 13/87 (1ERE DECADE DE SEPTEMBRE 1987)

DEBUT DE BULLETIN

AAA SITUATION METEOROLOGIQUE

SITUATION CARACTERISEE PAR UNE DEPRESSION SAHARIENNE EN PLEINE ACTIVITE DU 1ER AU 6, FAVORISANT LA REMONTEE DU FIT SUR LE SAHEL. JOURNEE DU 7 MARQUEE PAR UN ANTICYCLONE DES ACORES ACTIF, S'ETENDANT SUR L'EUROPE ET LE MAGHREB, PROVOQUANT UNE SITUATION DEFAVORABLE A LA PENETRATION D'AIR HUMIDE SUR L'OUEST DU SAHEL. EN FIN DE DECADE CETTE ACTIVITE S'EST ATTENUEE.
LE FIT A OCCUPE UNE POSITION NORMALE ET A OSCILLE AUTOUR D'UNE LIGNE NORD NOUAKCHOTT-NORD ATAR-KIDAL-SUD AGADEZ-SUD BILMA-CENTRE-NORD TCHAD. L'EPAISSEUR DE LA MOUSSON A ETE COMPRISE ENTRE 900 ET 1500 METRES. DES FOYERS PLUVIO-ORAGEUX LOCAUX ET QUATRE LIGNES DE GRAINS ONT ETE OBSERVEES DONT UNE IMPORTANTE AYANT BALAYE UNE ZONE S'ETENDANT DE L'OUEST DU NIGER AU SUD DU SENEGAL.

BBB PLUVIOMETRIE

LES PLUIES ONT ETE SUPERIEURES A 20 MM AU SENEGAL, AU SUD DE LA MAURITANIE, AU MALI SAUF AUTOUR DE NIONO, TOMBOUCTOU, SAN ET GAO, AU BURKINA FASO SAUF AUTOUR DE BOBO DIOULASSO, OUAGADOUGOU ET DORI, AU SUD-OUEST, AU SUD, AUTOUR DE BANKILARE, AYOROU ET TILLABERY, LOCALEMENT AU SUD-EST DU NIGER ET AU SUD DU TCHAD.
DES PLUIES SUPERIEURES A 100 MM ONT ETE ENREGISTREES A SAINT LOUIS (162 MM) ET A LOUGA (105) AU NORD-OUEST, AU CAP SKIRRING (245 MM) AU SUD-OUEST DU SENEGAL ET A BOUGOUNI (101 MM) AU SUD DU MALI.
AILLEURS, LES PLUIES ONT ETE NULLES OU FAIBLES ET LOCALISEES.

LA PLUVIOMETRIE CUMULEE EST DEFICITAIRE DE PLUS DE 100 MM PAR RAPPORT A LA MEDIANE INTERANNUELLE (1951-1980):
- AUTOUR DE ROSSO EN MAURITANIE.
- AU CENTRE, LOCALEMENT AU SUD-OUEST, A L'EST ET AU SUD-EST DU SENEGAL, AU SUD ET AU SUD-EST DE LA MAURITANIE, DANS TOUT LE MALI AGRICOLE SAUF AUTOUR DE MOPTI, AU BURKINA FASO SAUF AU SUD ET AU CENTRE-SUD, DANS TOUT LE NIGER AGRICOLE ET PROBABLEMENT AU SUD ET AU CENTRE-SUD DU TCHAD AINSI QUE DANS SA ZONE SAHELIENNE.
DES DEFICITS DE PLUS DE 200 MM SONT OBSERVES DANS LES ZONES DE:
- BAMBEY AU SENEGAL.
- KEDOUGOU AU SENEGAL ET KENIEBA, KAYES, KITA, BOUGOUNI, SIKASSO ET SEGOU AU MALI.
- OUAHIGOUYA, DORI ET FADA N'GOURMA AU BURKINA FASO ET TILLABERY, NIAMEY, GAYA, OUALLAM, FILINGUE ET DOUTCHI AU NIGER.
- MARADI, TESSAOUA, GAZAOUA, ZINDER, MIRRIAH ET MAGARIA AU NIGER.

CCC SUIVI DE LA BIOMASSE VEGETALE

SELON LES DONNEES PARVENUES AU CENTRE AGRHYMET JUSQU'AU 6 SEPTEMBRE, IL APPARAIT QUE LES INDICES DE VEGETATION NORMALISES DE FIN AOUT DEBUT SEPTEMBRE SONT STABLES DANS L'ENSEMBLE, EN LEGERE AUGMENTATION SUR LA ZONE SAHELIENNE DU NIGER ET LE SUD DE LA MAURITANIE ET EN HAUSSE NOTABLE SUR L'EST DE LA ZONE SAHELIENNE DU TCHAD AINSI QUE DANS UNE LARGE BANDE S'ETENDANT DE KITA (MALI) A GAOUA (BURKINA FASO) ET INTERESSANT TOUT LE SUD EST DU MALI ET LE SUD OUEST DU BURKINA FASO.

DDD SITUATION AGRICOLE

I. LES CULTURES SONT EN 4EME DECADE DE VEGETATION DANS LES ILES DU SUD AU CAP VERT (FOGO, SANTIAGO) ET UN PEU PLUS EN RETARD AILLEURS. DANS LES ILES DU SUD, LES STADES DE 10EME A 15EME FEUILLES POUR LE MAIS ET RAMIFICATION POUR LES HARICOTS ET NIEBES, SONT SIGNALES; LES 2EMES SARCLAGES SONT GENERALISES ET LES CONDITIONS HYDRIQUES SONT SATISFAISANTES. DANS LES ILES DU NORD (S. ANTAO ET S. NICOLAU) DES STRESS HYDRIQUES SONT OBSERVES. DES PLUIES NORMALES SERAIENT SOUHAITABLES JUSQU'A MI OCTOBRE, AFIN D'OBTENIR DES RENDEMENTS SATISFAISANTS.

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2. LES CULTURES ONT EN GENERAL MOINS DE 2 MOIS DE VEGETATION, DANS UNE ZONE SITUEE AU NORD DE LA LIGNE LOUGA (SENEGAL) - DJIGUENNI (MAURITANIE) - SUD HOMBORI (MALI) - NORD DORI (BURKINA FASO) - BIRNI N'KONNI - MATAMEYE (NIGER) - NORD N'DJAMENA - NORD BARO (TCHAD). ELLES ONT SOUFFERT DE LA TRES MAUVAISE REPARTITION ET DE L'INSUFFISANCE DES PLUIES. LES STRESS HYDRIQUES SONT MARQUES :
- EN MAURITANIE : BOUTILIMIT, AIOUN, KIFFA, NEMA, ROSSO, ENTRE AUTRES STATIONS
- A L'EXTREME NORD DU SENEGAL : PODOR
- AU NORD DE LA BOUCLE DU NIGER : TOMBOUCTOU ET GAO (MALI)
- A L'EXTREME NORD DU BURKINA FASO : DORI,
- DANS DE NOMBREUSES ZONES DU CENTRE ET DU NORD DU NIGER AGRICOLE : BANKILARE, BANIBANGOU, AYOROU, OUALLAM, FILINGUE, CHIKAL, TAHOUA, ABALAK, MAYAHI, GUIDAN-ROUNDJI, TESSAOUA, TANOUT, MIRRIAH, GOURE, MAINE-SOROA, DIFFA ET N'GUIGMI
- DANS LA ZONE SAHELIENNE DU TCHAD.

DANS TOUTE CETTE ZONE, LES RENDEMENTS DES CULTURES DEVRAIENT ETRE TRES MEDIOCRES. LE NIEBE POURRAIT LIMITER LE DEFICIT VIVRIER A PREVOIR, A CONDITION QU'IL PLEUVE BIEN JUSQU'A FIN SEPTEMBRE, CE QUI A MAL COMMENCE; QUANT AU MIL SES RENDEMENTS SONT TRES COMPROMIS A CAUSE DE LA SECHERESSE GENERALISEE FIN MONTAISON, DEBUT EPIAISON, POUR LES CULTURES LES PLUS AVANCEES.

3. LES CULTURES SONT INSTALLEES DEPUIS 6 A 10 DECADES DANS LA ZONE INTERMEDIAIRE COMPRISE ENTRE LA LIGNE NORD PRECISEE EN 2 ET LA LIGNE SUD : BANJUL (GAMBIE) - TAMBACOUNDA (SENEGAL) - BAMAKO (MALI) - OUAGADOUGOU (BURKINA FASO) - DIOUNDIOU (NIGER) - MANDE ET SARH (TCHAD). L'EPIAISON POUR LES MILS ET SORGHOS, LA FLORAISON POUR LES LEGUMINEUSES, SONT FREQUEMMENT OBSERVEES SUR LES VARIETES HATIVES REPANDUES AU NORD DE CETTE ZONE. SUR LES VARIETES TARDIVES CULTIVEES PLUS AU SUD, DES DEBUTS DE FLORAISON SUR LES CEREALES ET DES DEBUTS DE FORMATION DES GOUSSES POUR LES LEGUMINEUSES SONT FREQUENTS.

LES CHANCES DE REUSSITE SONT MOYENNES POUR LES VARIETES HATIVES (PLUS FAIBLES VERS LA LIMITE NORD) ET POUR LES VARIETES TARDIVES. POUR LES CULTURES LES MOINS AVANCEES (6 DECADES POUR LES HATIVES ET 9 A 10 POUR LES TARDIVES) DE BONNES PLUIES SERAIENT NECESSAIRES JUSQU'EN FIN SEPTEMBRE - DEBUT OCTOBRE.

DANS CETTE ZONE INTERMEDIAIRE, LES STRESS HYDRIQUES ONT ETE SURTOUT OBSERVES : A THIES ET TAMBACOUNDA (SENEGAL), OUAHIGOUYA ET KAMBOINSE (BURKINA FASO), TERA, NIAMEY ET AGUIE (NIGER).

COMPTE TENU DES SEMIS TARDIFS, LA SITUATION AGRICOLE EST SURTOUT PREOCCUPANTE POUR LA PARTIE NIGERIENNE DE CETTE ZONE OU LA PROBABILITE D'AVOIR DES PLUIES PERMETTANT DE BOUCLER LE CYCLE VEGETATIF EST TRES FAIBLE. DES INFORMATIONS PLUS DETAILLEES SONT ATTENDUES PAR AILLEURS POUR LE TCHAD.
SI LES RESERVES HYDRIQUES SONT APPRECIABLES DANS LE SUD DE CETTE BANDE, (SENEGAL, MALI ET BURKINA FASO), ELLES SONT BEAUCOUP PLUS FAIBLES AU NIGER.

4. AU SUD DE LA DERNIERE LIGNE DECRITE EN 3 (BANJUL - TAMBACOUNDA - BAMAKO ...) LES CULTURES SONT ENCORE PLUS AVANCEES (10 A 12 DECADES) LES VARIETES HATIVES (MOINS REPANDUES) ARRIVENT AU STADE DE RECOLTE CE QUI EST IMPORTANT POUR LES VIVRES "DE SOUDURE", ALORS QUE LES VARIETES TARDIVES (PLUS REPANDUES) PHOTO-SENSIBLES SONT EN EPIAISON POUR LES CEREALES ET FORMATION DE GOUSSES POUR LES LEGUMINEUSES. LE MAIS EST GENERALEMENT EN COURS DE RECOLTE POUR LA CONSOMMATION "EN VERT". ON N'OBSERVE PAS DE STRESS HYDRIQUE DANS CETTE ZONE ET LE PLUS SOUVENT, LES RESERVES EN EAU SONT EGALES OU SUPERIEURES A 60 MM, CE QUI DONNE DE 12 A 15 JOURS DE SECURITE, EN CAS D'ARRET PRECOCE DES PLUIES. LES CHANCES DE BONNE RECOLTE SONT GRANDES, AU VU DES CONDITIONS D'ALIMENTATION HYDRIQUE.

EEE SITUATION DES PATURAGES

LE COUVERT HERBACE N'EVOLUE PRESQUE PLUS DANS LA PLUPART DES ZONES PASTORALES SITUEES DANS LE CENTRE NORD DE LA MAURITANIE, DU MALI, DU NIGER ET DU TCHAD, CAR A LA RARETE DES PLUIES S'AJOUTE LA FIN DE LA PERIODE ACTIVE DE DEVELOPPEMENT.

CEPENDANT DANS CERTAINES ZONES AGROPASTORALES ET PASTORALES LE COUVERT VEGETAL POURSUIT ENCORE SON DEVELOPPEMENT NORMAL.
IL S'AGIT DE: L'EXTREME SUD DE LA MAURITANIE,
PRESQUE TOUT LE SENEGAL, LA GAMBIE, LE SUD DU MALI,
LE BURKINA FASO SAUF LA ZONE DE DORI, LE SUD DU NIGER ET DU TCHAD.

AU CAP VERT, LA SITUATION CONTINUE A S'AMELIORER DANS LES ILES DU SUD (FOGO, SANTIAGO) AVEC UN DEVELOPPEMENT GENERALISE DU COUVERT VEGETAL. LA SITUATION EST MOINS BONNE A CAUSE DES STRESS HYDRIQUES DANS LES ILES DU NORD (SAN ANTAO ET SAN NICOLAU)

FFF SITUATION ACRIDIENNE

SOURCE DES INFORMATIONS : SERVICES NATIONAUX DE PROTECTION DES VEGETAUX ET ANTENNE DE BIOMODELISATION PRIFAS.

MAURITANIE : LES PREVISIONS POUR LA MAURITANIE SONT ISSUES D'EXTRAPOLATIONS FAITES A PARTIR DES PAYS VOISINS, LES DONNEES ETANT TRES INCOMPLETES DEPUIS PRES D'UN MOIS, SURTOUT POUR LE SUD-EST DU PAYS.
DANS L'EXTREME SUD, LES ADULTES AUTOCHTONES DE SECONDE GENERATION SONT MELANGES A DES ALLOCHTONES G2 VENANT DU SENEGAL ET DU MALI ET A DES LARVES G3.
LA G1, APPARUE A DES LATITUDES SEPTENTRIONALES, A SUBI UNE MORTALITE IMPORTANTE DUE A LA SECHERESSE.

SENEGAL : DANS LE SUD-EST, AU NIVEAU DU 13EME PARALLELE, LES LARVES G3 POURSUIVENT LEUR DEVELOPPEMENT.
DANS L'EST, AU NIVEAU DES 14EME ET 15EME PARALLELES, LES ADULTES G2 PONDENT PUIS MEURENT ; LES PREMIERES ECLOSIONS G3 COMMENCENT. ON PEUT AVOIR DES CHEVAUCHEMENTS DE COHORTES, COMME ENTRE MATAM ET BAKEL, OU 180 HECTARES SONT INFESTES PAR DES LARVES ET DES ADULTES, AVEC DES DENSITES VARIANT DE 15 A 20 INDIVIDUS AU M2.
A L'OUEST, DANS UNE ZONE COMPRISE ENTRE LE 14EME ET LE 15EME PARALLELE ET LIMITEE A L'EST PAR DIOURBEL ET KAOLACK, DES LARVES DE SECONDE GENERATION COTOIENT DES ADULTES G2 VENUS DU SUD. LES G1 ONT PRATIQUEMENT DISPARU.

MALI : DANS L'OUEST, AU NIVEAU DES 13EME ET 14EME PARALLELES, LES LARVES G3 SE DEVELOPPENT DANS DE BONNES CONDITIONS ET LES ADULTES G2 CONTINUENT DE PONDRE.
AU 15EME PARALLELE, LES LARVES G2 POURSUIVENT LEUR DEVELOPPEMENT.
AUX 16EME ET 17EME PARALLELES, ON OBSERVE LES LARVES G1 ECLOSES FIN AOUT.
L'EXCES D'HUMIDITE DE CERTAINES ZONES, GENANT POUR LES ADULTES QUI Y REPONDENT PAR DES DEPLACEMENTS, NE PERTURBE PAS TROP LES LARVES QUI S'EN ACCOMODENT MIEUX QUE D'UN EXCES DE SECHERESSE.

BURKINA FASO : LE CRIQUET SENEGALAIS SE RENCONTRE SURTOUT DANS LA MOITIE OUEST DU PAYS. AU NIVEAU DES 11EME ET 12EME PARALLELES, DES LARVES G3 DISPERSEES SE DEVELOPPENT ; ELLES COTOIENT DES FEMELLES PONDEUSES AU 12EME PARALLELE. AU 13EME PARALLELE, LES ADULTES G2 PONDENT ET MEURENT ; AU 14EME, LES LARVES G2 ECLOSENT.

NIGER : LES EVENEMENTS OBSERVES LA DECADE PRECEDENTE SE POURSUIVENT MAIS NE CONCERNENT QUE DES EFFECTIFS LIMITES DE CRIQUETS SENEGALAIS ; DANS LE SUD DU PAYS, LES LARVES G3 COTOIENT LES DERNIERS ADULTES G2. LES DEVELOPPEMENTS LARVAIRES SE TERMINENT AU 14EME PARALLELE POUR LES G2, AU 15EME POUR LES G1. LES LARVES G1, ECLOSES AU NIVEAU DU 16EME PARALLELE ET AU-DELA, SUBISSENT LA SECHERESSE ET MEURENT.

TCHAD : LES AIRES FAVORABLES A OSE SE REDUISENT ET ON ASSISTE A DES CONCENTRATIONS DE CRIQUETS SENEGALAIS ENTRE LES 12EME ET 13EME PARALLELES, LA OU DES ECOULEMENTS D'EAU MAINTIENNENT LA VEGETATION EN ETAT DE TURGESCENCE.

GGG SITUATION HYDROLOGIQUE

COURS D'EAU DE LA COTE SUD OUEST:
UNE ONDE DE CRUE EST PASSEE AU COURS DE LA DECADE SUR LA CASAMANCE AVEC UN DEBIT MAXIMUM DE 7,5 M3/S A KOLDA. LA SITUATION EST MOINS BONNE QUE CELLE DE L'AN DERNIER A LA MEME DECADE, OU LE MAXIMUM AVAIT ATTEINT 10,1 M3/S.

BASSIN DU FLEUVE SENEGAL:
A BAKEL LE DEBIT A MONTE DE 550 A 1240 M3/S. L'ANNEE PRECEDENTE UNE CRUE PLUS IMPORTANTE EST PASSE PENDANT CETTE DECADE AVEC DES DEBITS COMPRIS ENTRE 1320 ET 3200 M3/S.

BASSIN DU FLEUVE GAMBIE:
LA SERIE DES CRUES S'EST POURSUIVIE SUR LA GAMBIE. A KEDOUGOU LES DEBITS ONT VARIE ENTRE 182 ET 428 M3/S, SITUATION LEGEREMENT MEILLEURE QUE CELLE DE L'AN DERNIER OU CES VALEURS SE CHIFFRAIENT ENTRE 129 ET 357 M3/S.

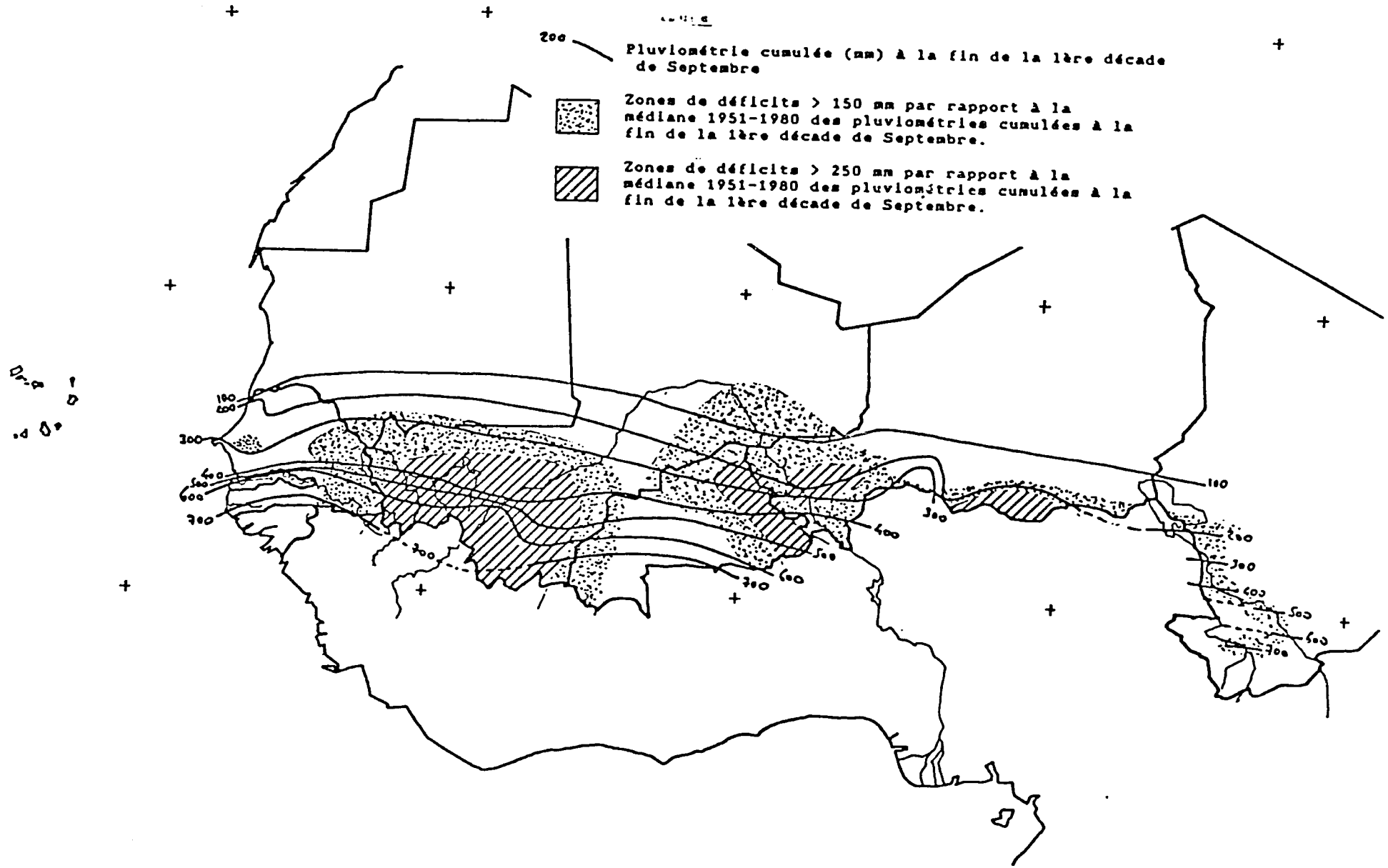
BASSIN DU FLEUVE NIGER:
SUR LE COURS SUPERIEUR DU FLEUVE LES DEBITS SONT RESTES ENCORE PLUS FAIBLES (1927 A 2070 M3/S) QU'EN 1986 A LA MEME PERIODE (2400 A 2730 M3/S).
UNE PHASE DE TARISSEMENT A ETE OBSERVEE SUR LES PETITS AFFLUENTS DE LA RIVE DROITE EN AMONT DE NIAMEY, AVEC DEBIT NUL EN FIN DE DECADE SUR LA SIRBA A KORIZIENA ET 50 M3/S SUR LE GOROUOL A GARBE KOUROU.
EN 1986 LES DEBITS AVAIENT VARIE DE 10 A 21 ET DE 84 A 140 M3/S RESPECTIVEMENT POUR LES DEUX STATIONS.
PAR CONSEQUENT LES DEBITS SONT RESTES TRES FAIBLE A NIAMEY, VARIANT ENTRE 418 ET 567 M3/S AU LIEU DE 558 A 785 M3/S EN 1986 A LA MEME EPOQUE.

HHH AUCUNE INFORMATION SUR LA DECADE NE NOUS EST PARVENUE DE LA GAMBIE NI DE LA GUINEE BISSAU.

AVERTISSEMENT: LES ANALYSES CI-DESSUS RESULTENT DE L'EXPLOITATION DES INFORMATIONS CONCERNANT LA PREMIERE DECADE DE SEPTEMBRE 1987 ET RECUES AU CENTRE AGRHYMET DE NIAMEY NIGER JUSQU'AU 16 SEPTEMBRE.

FIN DE BULLETIN =

CENTRE AGRHYMET
NIAMEY



CILSS/OMM/FAO/PNUD
CENTRE AGRHYMET
NIAMEY

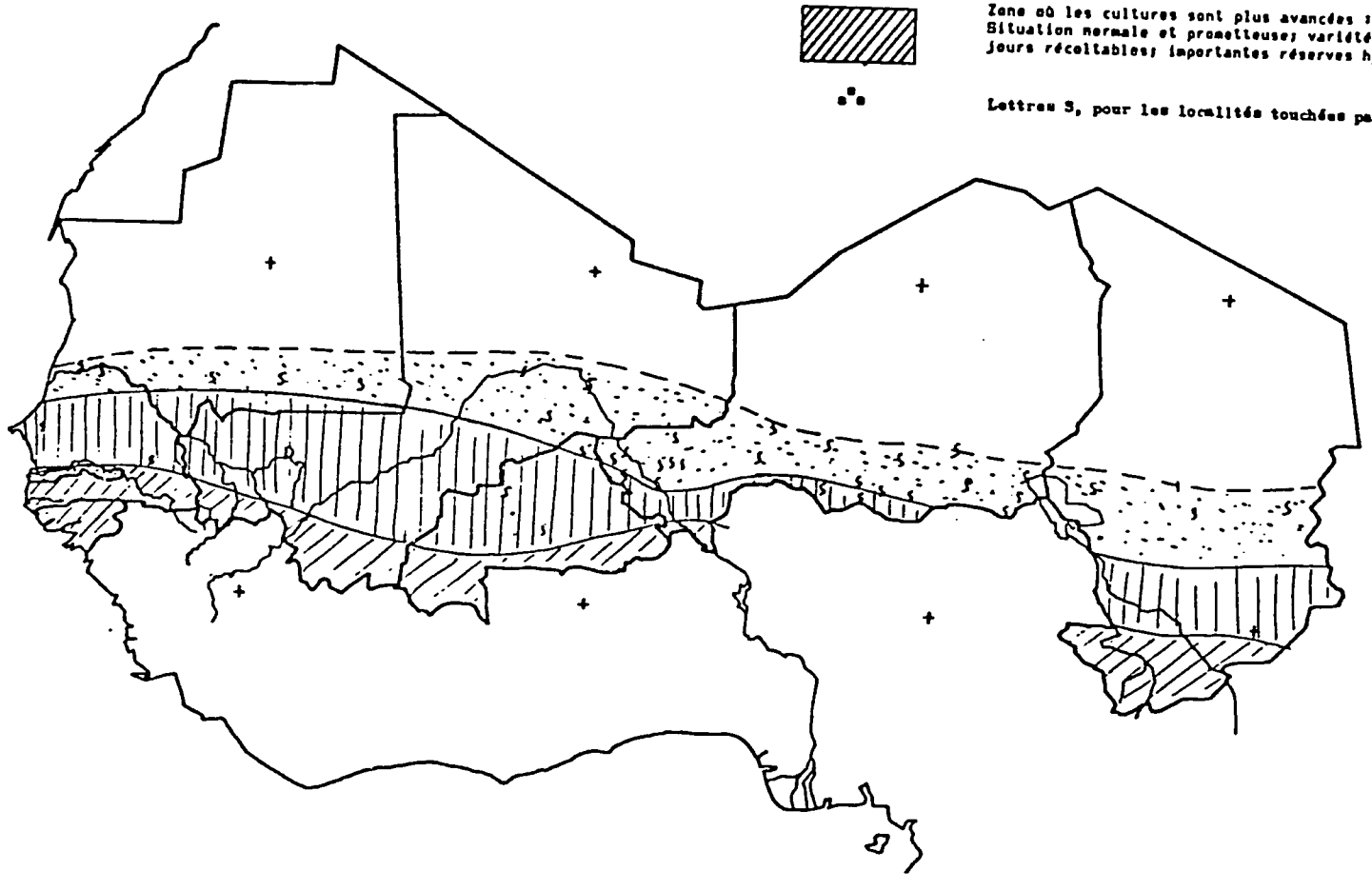
Situation des cultures le 10 Septembre 1987.

Zone où les cultures sont compromises sauf dans les Iles du Sud du Cap Vert : retard, irrégularité et insuffisance des pluies, resemis etc... cultures en place depuis 3 à 6 décades au maximum. Le niébé peut localement atténuer le déficit vivrier prévisible.

Zone où les cultures sont installées depuis plus de 6 décades et moins de 10. Chance moyennes de récolte satisfaisante si les pluies se maintiennent en Septembre, pour les variétés hâtives du Nord et les tardives du Sud de cette zone. Grandes chances de succès pour les variétés hâtives cultivées au Sud.

Zone où les cultures sont plus avancées : 10 à 12 décades. Situation normale et prometteuse; variétés de moins de 100 jours récoltables; importantes réserves hydriques.

Lettres S, pour les localités touchées par la sécheresse.



Résumé du mois de Juillet

L'analyse de la carte d'isohyètes de Juillet 1986 conduit à quelques observations :

1. Les hauteurs d'eau recueillie varient entre 52 mm et 395 mm.

2. Cette répartition spatiale de la pluviométrie ne présente pas une structure zonale évidente mais décroit grosso-modo du Sud au Nord.

3. Parallèlement à l'allure générale décrite au point 2, l'irrégularité de la distribution quantitative des pluies fait apparaitre des noyaux de fortes ou de faibles pluviométries contrastant avec le milieu environnant :

a. Dans l'O.R.D de la Comoé un noyau de faible pluviométrie centré sur Mangodara (60 mm), alors qu'autour, les hauteurs d'eau sont de l'ordre de 200 à 250 mm, voire plus de 300 mm (Orodara: 395 mm, Batié: 301 mm).

b. Dans la région comprise entre Ouahigouya-Tougan-Didyr et Tikaré, on a également une zone de faible pluviométrie (<100 mm). Centré sur l'axe Maré - Kaya on observe un noyau de faible pluviométrie dans un environnement où la côte moyenne est comprise entre 160 et 130 mm.

c. Toute la partie du pays située d'une part, au Nord de l'axe Ouagadougou - Bani - Tougouri - Sebba, et d'autre part, au Sud de l'axe Djibo - Markoye constitue une zone à très faible pluviométrie (<100 mm).

d. Un noyau de faible pluviométrie centré sur Fada N'gourma contraste avec un noyau d'une relative forte pluviométrie (côte moyenne 200 mm) situé entre Ouagadougou - Kombissiri - Garango - Lantaogo - Boulsa.

D'une facon générale, la situation pluviométrique de Juillet 1986 constitue une nette amélioration par rapport à celle de Juin 1986: l'isohyète 50 mm a disparu alors que l'isohyète 300 mm a fait son apparition. L'isohyète 150 mm se trouve par 12o30 à 13o Nord en moyenne avec cependant des zones telles le Sud de la Kossi, le Sud-ouest du Mouhoun et la région de Fada N'gourma qui présentent une pluviométrie inférieure à 150 mm.

Quand on compare la situation pluviométrique de Juillet 1986 à celle de Juillet 1985 il ressort que:

1. La plus grande partie du pays est déficitaire à très déficitaire; il s'agit essentiellement des O.R.D. du Yatenga, du Mouhoun, des Hauts Bassins, du Sud de la Comoé, de la moitié Nord des O.R.D. du Centre, et du Centre Ouest d'une part, d'autre part l'O.R.D. du Centre-Est, le Nord de l'O.R.D. de l'Est, et le Sud de l'O.R.D. du Sahel (voir carte no)

2. Le reste du pays est normal à exédentaire: à l'exeption de quelques forts noyaux ca et là (Nord du Sahel).

La comparaison de la pluviométrie de Juillet 1986 avec celle de la moyenne 71 - 80 présente une toute autre physionomie:

1. Toute la moitié du pays au Nord de l'axe oblique orienté Sud-Ouest - Nord-Est c'est à dire Koloko - Vallée du Kou - Safané - Boromo - Ouagadougou - Boulsa - Bogandé est déficitaire à très déficitaire, le déficit étant plus prononcé vers le Nord.

2. La partie située au Sud de l'axe précédemment cité est grosso modo normale à exédentaire (<100 à plus de 150 %),à l'exception de quelques zones.

3. Au Sud de l'axe situé au point 1 il existe d'autres zones déficitaires (<100 %) telles que celles de Bérégadougou - Mangodara - Ouo - Sidéradougou dans la Comoé d'une part, et la région de Zabré - Tenkodogo - Fada d'autre part.

La situation contrastée de la pluviométrie au cours du mois de Juillet a eu pour conséquence un développement inégal de la végétation et des cultures.

Ainsi l'analyse de l'évolution des cultures au cours du mois de Juillet à l'aide de l'imagerie satellitaire (Indice de Végétation Normalisé, NVI) montre clairement la progression du front de verdure vers le Nord en même temps que l'accroissement de la couverture végétale dans les zones Sud du pays.

Les valeurs des NVI sont comprises entre 0.25 et 0.025, les plus faibles valeurs étant au Nord.

A la quatrième semaine on note une baisse dans l'Ouest et le Sud-ouest du pays de la valeur des NVI. Ceci est dû au stress hydrique et non à une diminution de la biomasse.

La colonisation progressive du Sahel et du Nord par le front de verdure apparait nettement d'une semaine à l'autre (voir cartes).

A ces valeurs des NVI correspondent des productions de biomasse estimées par ajustement linéaire. Ainsi on estime la production de biomasse par unité de surface (ha) : respectivement pour les valeurs de NVI égaux à 0.25 et comprises entre 0.025 et 0.050 à la fin du mois de Juillet l'on a des productions respectives de plus de 2000 kg et de 200 à 400 kg.

A la fin du mois de Juillet 86 les principales cultures céréalières (mil/sorgho) sont au stade tallage à montaison sous de bonnes conditions hydriques.

APPENDIX L

BURKINA FASO NATIONAL AGRHYMET CENTER
AGROMETEOROLOGICAL BULLETIN

BURKINA FASO
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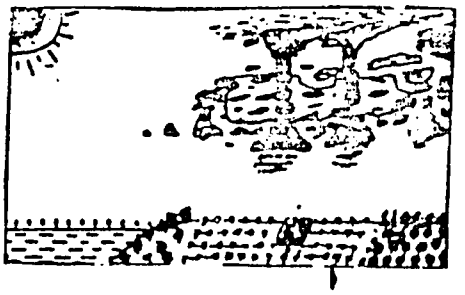
LA PATRIE OU LA MORT,
NOUS VAINCRONS !
-=-=-=-=-=-
MINISTERE DES TRANSPORTS
ET DES COMMUNICATIONS



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BULLETIN AGROMETEOROLOGIQUE

No 15

PERIODE DU 21 AU 31 AOUT 1986

COMMENTAIRE

La troisième décade du mois d'Août a connu une intensification de l'activité de la mousson : plusieurs systèmes pluviogènes locaux et organisés ont interessé simultanément ou partiellement le pays (voir tableau 1). Cette décade se caractérise par une meilleure répartition spatio-temporelle des pluies. Les hauteurs d'eau recueillies varient entre 38.0 mm à Dori et 131.2 mm à Bérégadougou. On a enregistré en moyenne une pluie tous les deux jours. Les quantités d'eau recueillies sont en général supérieures à celles de la deuxième décade bien qu'inférieures aux moyennes interannuelles (1951-80).

Le cumul pluviométrique (depuis le 1er Avril) est inférieur à la normale sauf à Saria (+105.7 mm), Gaoua (+14,7 mm) et Bazéga. Comparé à celui de l'année dernière il est déficitaire à Dori (-127.6 mm), Fada N'gourma (-191.6 mm), Bobo Dsso (-417.8 mm), Boromo (-42.1 mm), Gaoua (-71.9 mm) et excédentaire dans les autres localités en particulier dans le centre du pays.

Les températures extrêmes et moyennes restent voisines des moyennes interannuelles sauf à Dori, Ouagadougou et Fada où elles sont en légère hausse. Il en est de même pour la durée d'insolation moyenne.

La demande évaporative climatique (ETP) est en moyenne égale à 54mm dans le Nord et le Sahel, 45 mm dans le Centre, 42 mm à l'Ouest et le Sud-Ouest. Le bilan climatique DFEX (SOMD - ETP) est partout positif sauf à Dori (-19.6 mm) alors que le déficit de saturation (DS) est en général inférieur à 10 mb à l'exception de Dori, Ouagadougou et Ouahigouya.

Sur le plan agricole les principales cultures céréalières (Mil et Sorgho) connaissent un développement et une croissance satisfaisants. Elles sont au stade de montaison à l'Ouest et au Sud-Ouest et en épiaison dans les autres régions. Le niébé est en floraison généralisée tandis que le mil hâtif est en maturation principalement à l'Est du pays. Les réserves en eau du sol permettront de satisfaire les besoins hydriques de la décade prochaine sauf à Dori où la situation pluviométrique est peu satisfaisante.

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TABLEAU PLUVIOMETRIQUE DECADAIRE

3eme DECADE — MOIS D'AOUT 1986

HAUTEURS DES PLUIES RELEVEES (en mm)

TABLEAU 1	D A T E S											
POSTES	21	22	23	24	25	26	27	28	29	30	31	TOTAL
DORI	7.9	15.7		10.2	.	.	.	.	1.1	.	3.1	38.0
OUAHIGOUYA	.	41.4	.	.	.	0.7	14.4	.	.	.	.	56.5
DI-SOUROU	.	46.1	.	.	.	19.5	26.8	0.5	.	.	.	92.9
DEDOUGOU	.	6.4	.	.	19.4	17.1	12.2	1.0	.	.	5.1	61.2
TCHERIBA	.	.	.	.	3.7	15.1	36.0	.	.	.	12.1	66.9
TIBGA	-	-	-	-	-	-	-	-	-	-	-	76.0
OUAGADOUGOU	.	32.6	.	.	.	9.4	.	16.1	.	3.0	.	61.1
KAMBOINCE	.	19.5	.	.	.	12.0	10.0	.	.	.	3.2	44.7
TANGHIN-D.	.	.	.	.	4.8	5.3	45.9	.	.	.	.	56.0
SARIA	.	18.0	18.0	.	4.7	27.0	21.0	.	.	.	3.0	91.7
KOUDOUGOU	.	26.4	4.8	.	1.4	23.3	29.0	.	.	0.3	2.5	87.7
KOKOLOGHO	.	23.1	1.5	.	2.4	2.5	23.5	.	.	.	0.3	53.3
BOROMO	.	1.5	2.3	.	1.5	10.5	53.6	6.5	.	5.9	0.3	82.1
FADA N'GOURMA	2.3	0.1	5.0	.	35.3	.	10.5	.	.	6.7	.	59.9
YAMBA	-	-	-	-	-	-	-	-	-	-	-	44.4
KOMBISSIRI	.	2.7	0.2	.	1.3	7.5	.	28.4	.	.	5.7	45.8
DAZEGA	2.3	.	38.4	.	.	17.7	16.8	.	.	0.8	1.6	77.6
TOECE	.	.	13.4	.	9.5	6.1	24.3	.	.	9.1	2.5	64.9
N'DOROLA	-	-	-	-	-	-	-	-	-	-	-	82.2
BOBO-DIOULASSO	.	18.7	1.3	.	5.6	7.9	5.9	30.4	.	10.2	4.8	84.8
BEREGADOUGOU	8.5	9.5	7.4	.	14.9	12.2	30.5	23.9	.	24.3	.	131.2
PO	.	.	12.8	.	.	4.9	12.7	.	30.0	.	.	60.4
GAOUA	10.2	20.2	4.2	.	0.9	27.0	0.6	0.4	.	19.9	3.0	86.4

. = Neant tr = traces - = Donnees manquantes

BULLETIN DECADAIRE

3eme DECADE — MOIS D'AOUT 1986

TABLEAU 2 Edite le STATIONS	PLUVIOMETRIE				BILAN HYDRIQUE						
	SOMD mm	NP j	SOMS mm	ESAP mm	ETP mm	DFEX mm	LC j	RES mm	P=E %	ND d	ISE %
OUAGADOUGOU *	61.1 -32.6	4.0 -3.0	583.9 -74.9	+61.2	52.1	+9.0		50	100		100
DORI *	38.0 -30.7	5.0 -0.9	285.7 -155.3	-127.6	57.6	-19.6		28	71		76
DI-SOUROU *	92.9 -	4.0 -	494.5 -	+94.6	47.1	+45.8		80	100		100
OUAHIGOUYA *	56.5 -17.8	3.0 -2.6	441.5 -76.3	+87.2	50.4	+6.1		60	100		95
DEDOUGOU *	61.2 -32.5	6.0 +0.4	614.3 -47.7	+21.0	45.8	+15.4		80	100		100
SARIA *	91.7 -6.2	6.0 -0.2	740.7 +105.7	+280.8	42.5	+49.2		50	100		100
FADA N'GOURMA *	59.9 -26.1	6.0 -0.9	405.5 -292.8	-191.6	50.1	+9.8		73	100		100
BOBO DIOULASSO *	84.8 -22.9	8.0 +0.4	621.8 -191.8	-417.8	40.8	+44.0		80	100		100
BOROMO *	82.1 -14.0	8.0 +0.9	623.8 -70.6	-42.1	42.8	+39.3		80	100		100
PO *	60.4 -35.3	4.0 -1.0	661.1 -25.6	+8.9	42.0	+18.4		80	100		100
GAOUA *	86.4 +12.7	4.0 -1.6	757.1 +14.7	-71.9	39.5	+46.9		80	100		100
BAZEGA *	77.6 -	6.0 -	819.3 -	+361.4	42.5	+35.1		50	100		100
KAMBOINCE *	44.7 -	4.0 -	540.1 -	+101.2	44.7	0.0		50	100		100
BEREGADOUGOU *	131.2 -	8.0 -	-	-	41.7	+89.5		80	100		100
KOUDOUGOU *	87.7 +0.7	7.0 +1.6	633.9 -	+42.8	43.2	+44.5		50	100		100

SOMD Somme pluviometrique decadaire
NP Nombre de jours de pluie (>0.1mm)
SOMS Cumul de SOMD depuis la premiere decade du mois d'AVRIL
ESAP Ecart de SOMS par rapport a l'annee precedente
ETP Evapotranspiration potentielle, total decadaire
DFEX Surplus ou deficit pluviometrique
LC Longueur du cycle MIL-SORGHO
RES Reserve theorique en eau dans le sol

BULLETIN DECADAIRE

3eme DECADE — MOIS D'AOUT 1986

TABLEAU 3 Edite le STATIONS	TEMPERATURES (DEGRES CELSIUS)							VENT	
	TN	TX	TM	TNE	TXE	TN_{10}	TN_{50}	F_{2M} m/s	F_{2X}
OUAGADOUGOU *	23.9 +2.3	32.8 +2.4	26.3 +0.5	19.3	33.5			1.5 -0.1	12.6
DORI *	23.4 +0.7	34.5 +1.5	28.1 +0.9	21.0	38.0			0.9 -	-
DI-SOUROU *	22.1 -	30.1 -	26.1 -	20.3	33.1			1.2 -	-
OUAHIGOUYA *	22.3 -0.1	31.5 -0.2	26.8 +0.2	20.0	34.0			1.5 +0.2	-
DEDOUGOU *	22.0 -	30.0 -	25.0 -	20.0	33.0			1.5 -	-
SARIA *	22.3 -	30.1 -	26.2 -	20.5	32.7			1.0 -	-
FADA N'GOURMA *	21.6 +0.1	31.2 +1.2	25.9 +0.5	19.0	34.0			1.3 -	-
BOBO-DIOULASSO *	20.2 -0.5	29.2 -0.2	23.9 -0.6	19.0	31.7			1.5 -0.6	9.6
BOROMO *	21.4 -0.1	30.0 -0.5	25.4 -0.4	20.0	33.0			0.7 -0.1	-
PO *	21.6 -	29.8 -	25.1 -	19.4	32.0			0.7 -	-
GAOUA *	21.1 0.0	29.9 +0.3	24.3 -0.6	20.0	31.0			0.4 -0.7	-
BAZEGA *	21.7 -	30.8 -	26.2 -	20.0	32.8			1.0 -	-
KAMBOINCE *	21.6 -	30.6 -	26.1 -	19.7	33.0			1.5 -	-
BEREGADOUGOU *	20.1 -	29.4 -	24.8 -	19.0	32.0			2.0 -	10.0 -
KOUDOUGOU *	21.5 -	30.3 -	25.9 -	20.1	33.0			1.0 -	-

TN Temperature minimale moyenne
TX Temperature maximale moyenne
TM Temperature moyenne
TNE Temperature minimale extreme
TXE Temperature maximale extreme
(*) Ecart par rapport a la moyenne interannuelle 1951-1980

TN_{10} Temp. mini a 10 cm au-dessus du sol
TN_{50} Temp. mini a 50 cm au-dessus du sol
F_{2M} Vitesse moyenne du vent a 2 m
F_{2X} Vitesse maximale du vent a 2 m
\- Donnee manquante

1-12

BULLETIN DECADAIRE

3eme DECADE — MOIS D'AOUT 1986

TABLEAU 4	RAYONNEMENT			HYGROMETRIE				EVAPORATION	
Edite le :	I	I %	RG	UN	UX	EM	DS	BAC	PICHE
STATIONS	h	%	j/cm2	%	%	mb	mb	mm	mm
OUAGADOUGOU *	7.2 +1.2	58	16174	59	93	26.3 -0.6	12.3	57.8 -5.6	27.5 -2.2
DORI *	8.9 +0.5	72	18123	46	85	25.5 -1.7	14.4	73.3 +0.7	35.4 +2.4
DI-SOUROU *	7.9 -	64	16979	76	94	27.1 -	6.7	70.2 -	32.2 -
OUAHIGOUYA *	7.6 -0.7	61	16633	51	92	24.9 -2.1	10.5	69.8 +12.6	45.1 +15.4
DEDOUGOU *	6.9 -	56	15832	65	97	26.6 -	7.0	62.6 -	18.3 -
SARIA *	6.5 -	53	15375	56	98	29.2 -	4.6	49.0 -	25.5 -
FADA N'GOURMA *	8.6 +2.1	69	17783	61	96	27.1 0.0	7.3	56.1 +13.2	20.2 -0.7
BOBO-DIOULASSO *	5.7 +0.6	46	14443	66	99	25.6 0.0	5.5	47.3 -3.3	12.8 -12.5
BOROMO *	6.8 +0.3	55	15715	62	96	26.7 -0.5	6.3	36.4 -	17.0 -3.9
PO *	6.5 -	53	15362	63	98	27.1 -	5.9	51.3 -	17.5 -
GAOUA *	5.7 0.0	46	14434	62	99	26.3 +0.3	6.3	42.5 -	15.7 -4.1
BAZEGA *	6.0 -	48	14794	57	98	27.7 -	4.8	34.4 -	14.1 -
KAMBOINCE *	7.2 -	58	16174	69	99	26.7 -	7.1	48.2 -	24.8 -
BEREGADOUGOU *	5.6 -	45	14328	72	97	25.7 -	5.5	29.9 -	17.4 -
KOUDOUGOU *	6.5 -	53	15375	60	95	27.0 -	6.4	49.0 -	17.0 -

I Duree d'insolation moyenne
I% Insolation relative
RG Rayonnement global, total decadaire (T=valeur theorique)
UN Humidite minimale moyenne
UX Humidite maximale moyenne
EM Tension moyenne de vapeur d'eau
DS Deficit de saturation
BAC Evaporation du bac A, Total decade
PICHE Evaporation Piche Total decade
\- Donnee manquante

BULLETIN DECADAIRE

3eme DECADE MOIS D'AOUT 1986

TABLEAU 5 Edite le STATIONS	TEMPERATURES TSN	TSX	TSNE	TSXE	T-10	T-20
	Degres C					
OUAGADOUGOU	21.2	36.8	19.2	42.4		
DORI	23.7	40.6	19.9	45.2		
DI SOUROU	21.0	37.6	18.2	42.1		
OUAHIGOUYA	20.7	36.8	18.6	40.5		
DEDOUGOU	20.7	36.2	18.6	42.4		
SARIA	19.2	36.2	14.2	41.6		
FADA N'GOURMA	21.2	41.3	18.0	45.6		
BOBO-DIOULASSO	18.5	35.1	17.5	41.0		
BOROMO	20.9	36.4	19.0	41.3		
PO	21.0	36.1	18.9	40.2		
GAOUA	20.6	37.9	19.4	40.2		
BAZEGA	20.7	37 5	19.4	41.2		
KAMBOINCE	22.0	36.5	20.5	39.5		
BEREGADOUGOU	15.0	41.0	-	-		
KOUDOUGOU	19.2	36.2	14.2	41.6		

TSN Temperature minimale moyenne au sol
TSX Temperature maximale moyenne au sol
TSNE Temperature minimale extreme au sol
TSXE Temperature minimale extreme au sol
T-10 Temperature minimale moyenne a 10 cm dans le sol
T-20 Temperature minimale moyenne a 20 cm dans le sol

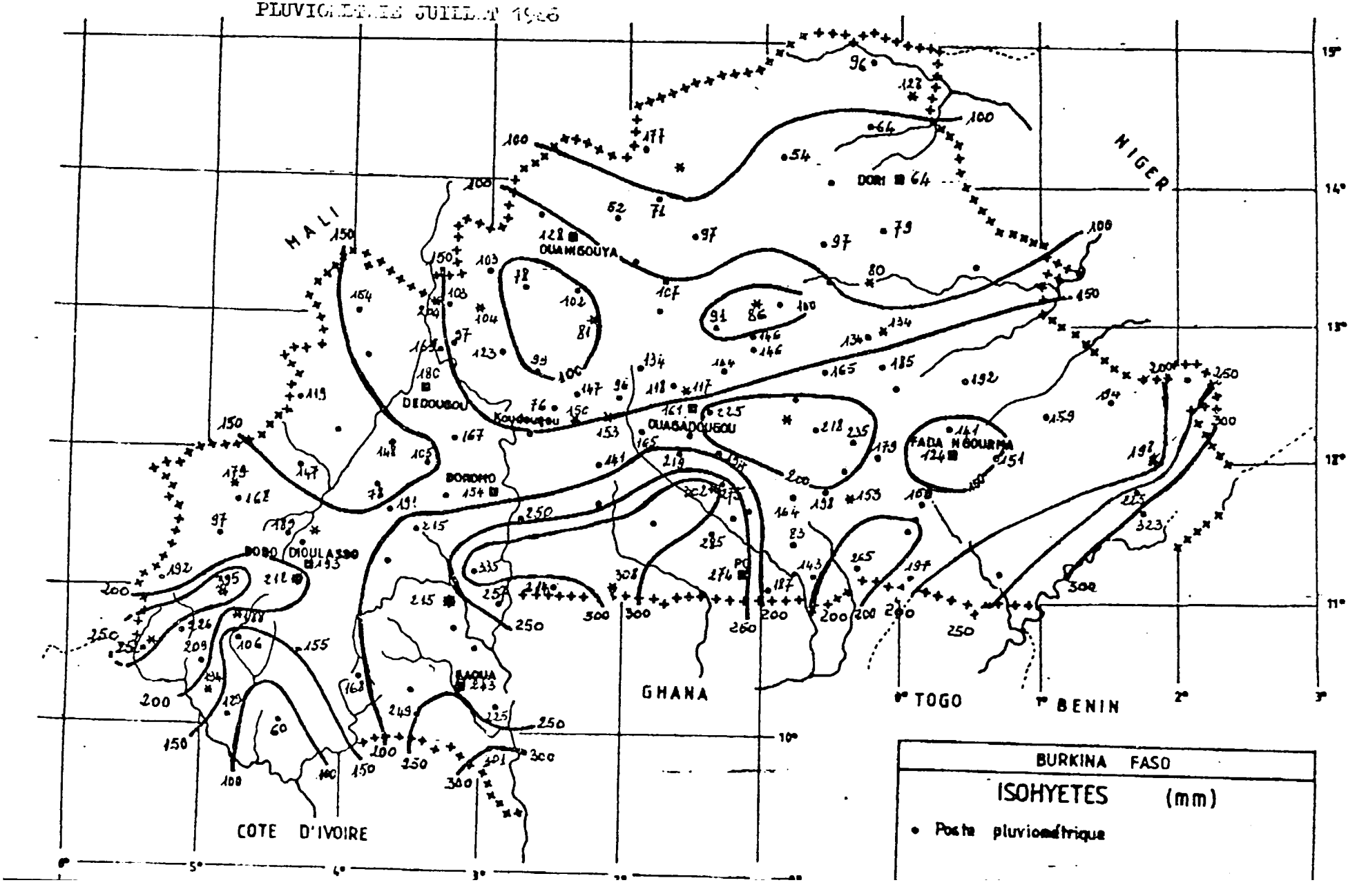
3eme Decade

BULLETIN DECADAIRE

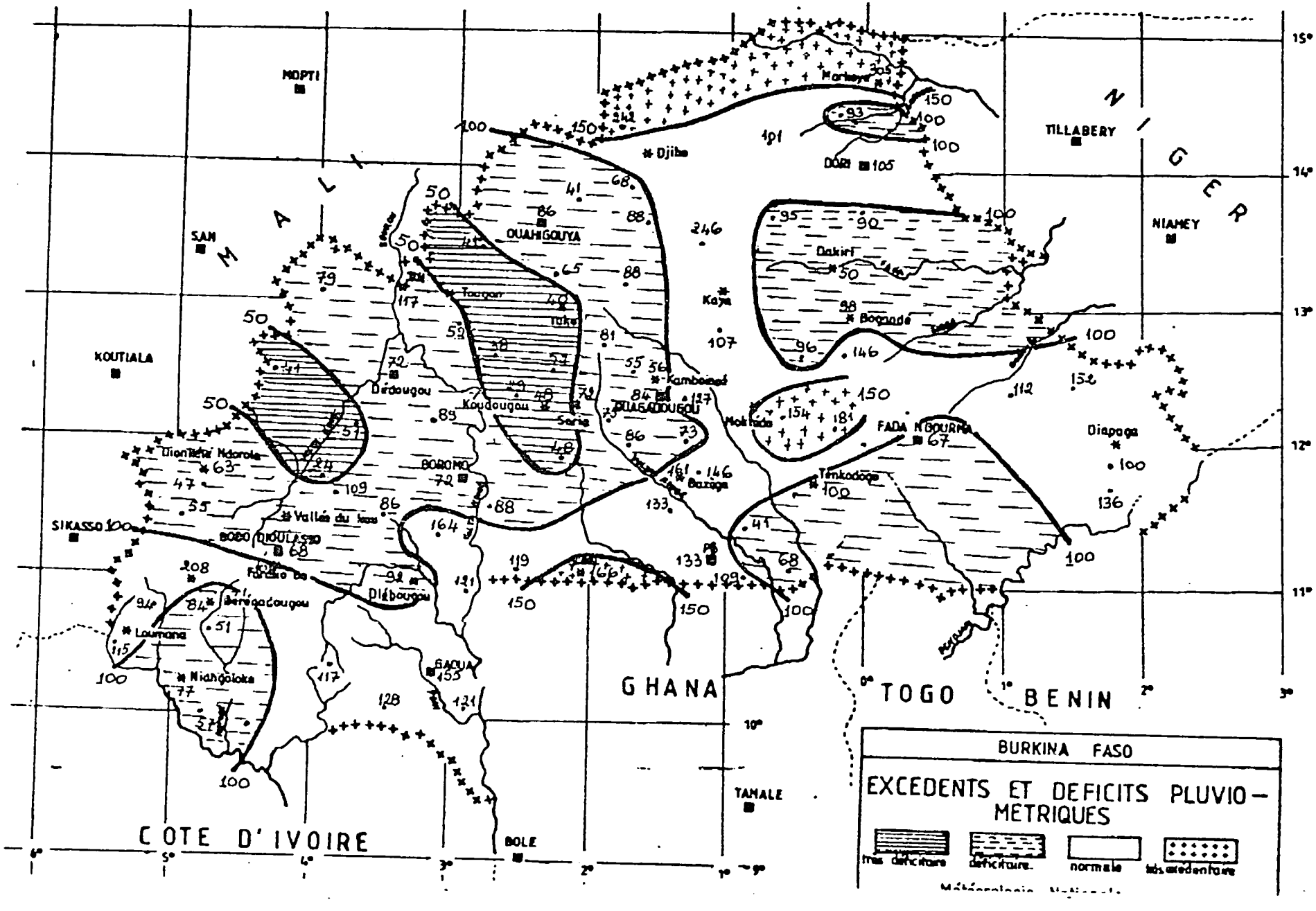
Mois d'AOUT 1986

TABLEAU 6 Edite le : STATIONS	SUIVI DES CULTURES						BILAN HYDRIQUE		
	CULTURES	DS mb	PHASE DEV	ENNEMIS CULTURES	DEGATS SECH	ASPECT GENERAL CHAMPS	RES mm	ISE %	P=E %
DORI	MIL/SORGHO	14.4	Epiaison	Neant	Neant	Moyen	28	76	71
OUAHIGOUYA	"	10.5	"	"	"	"	80	100	100
DEDOUGOU	"	7.0	"	"	"	Bon	80	100	100
OUAGADOUGOU	"	12.3	Mont/Epi.	"	"	"	50	100	100
KAMBOINCE	"	7.1	Epiaison	"	"	"	50	100	100
TANGHIN-DASSOURI	"	-	"	"	"	"	-	-	-
SARIA	"	4.6	"	"	"	"	50	100	100
KOUDOUGOU	"	6.4	"	"	"	"	50	100	100
DOROMO	"	6.3	"	"	"	"	80	100	100
FADA-N'GOURMA	"	7.3	Mont/Epi.	"	"	Moyen	73	100	100
KOMBISSIRI	"	-	"	"	"	Bon	-	-	-
BAZEGA	"	4.8	"	"	"	"	50	100	100
TOECE	"	-	"	"	"	"	-	-	-
BOBO-DIOULASSO	"	5.5	Montaison	"	"	"	80	100	100
PO	"	5.9	Epiaison	"	"	"	80	100	100
GAOUA	"	6.3	Montaison	"	"	"	80	100	100
BEREGADOUGOU	"	5.5	"	"	"	"	80	100	100
KOKOLOGHO	"	-	Epiaison	"	"	"	-	-	-
DI-SOUROU	"	-	Mont/Epi.	"	"	"	80	100	100

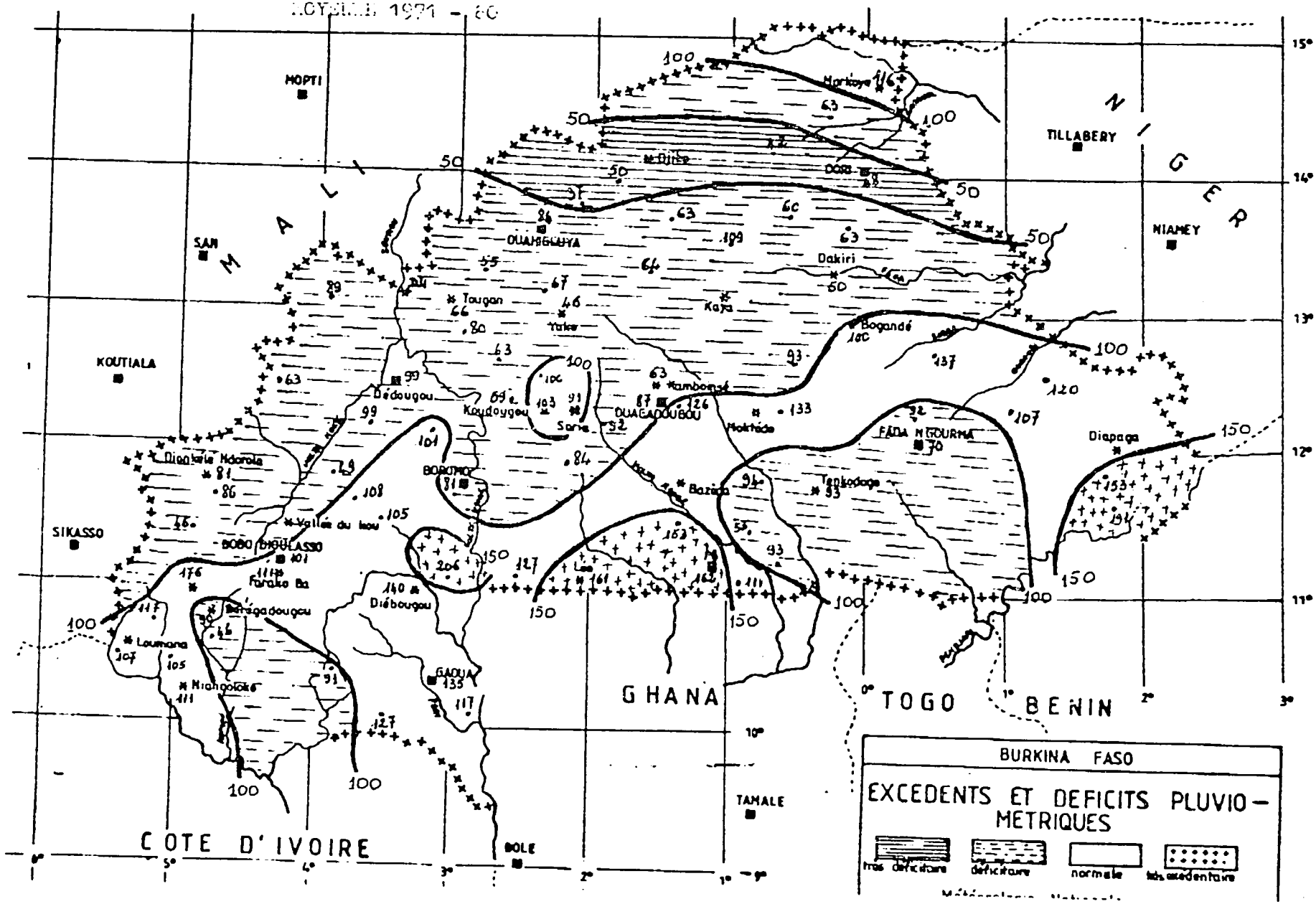
LC	Longueur du cycle MIL SORGHO	jours
DS	Deficit de saturation	mb
PHASE DE DEV	Phases de developpement	
ENNEMIS CULTURES	Ennemis des cultures	
DEGATS SECH	Degats de secheresse	
ASPECT GENERAL	Aspect general des champs	
RES	Reserve theorique en eau dans le sol	mm
ISE	Indice de satisfaction en eau pour semis observe	%
P=E	Proba de satisfaire les besoins en eau de la decade suivante	%
MONT/EPI.	Montaison-Epiaison	


PLUVIOMETRIE JUILLET 1986
MALI
NIGER
GHANA
TOGO
BENIN
COTE D'IVOIRE
DORI
OUAHIGOUYA
DEDOUGOU
Koudougou
OUAGADOUGOU
FADA N'GOURMA
BOBO DIOULASSO
BOROMO
BAGUA
BURKINA FASO
ISOHYETES (mm)
Poste pluviométrique

JUILLET 1986: POURCENTAGE PAR RAPPORT A 1985



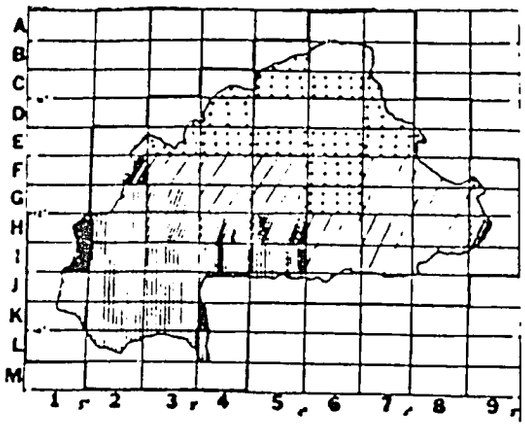
JUILLET 1986 : POURCENTAGE PAR RAPPORT A LA
MOYENNE 1971 - 80



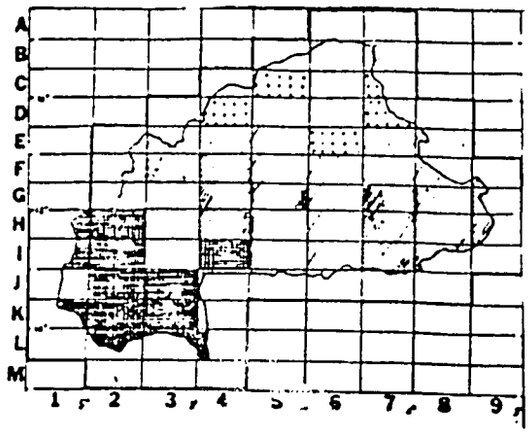
175

BURKINA FASO

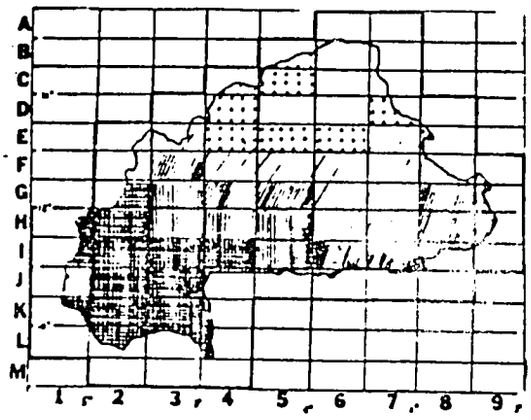
01 au 06 Juillet 86



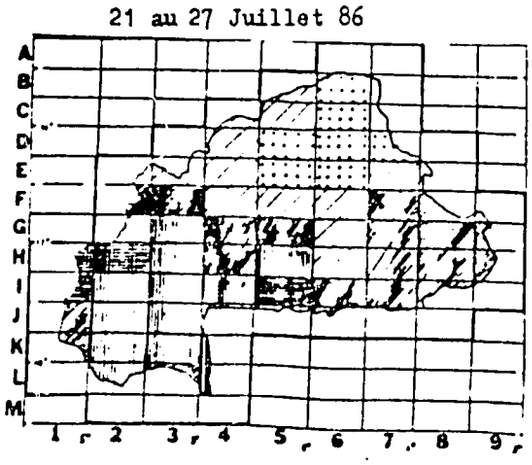
07 au 13 Juillet 86



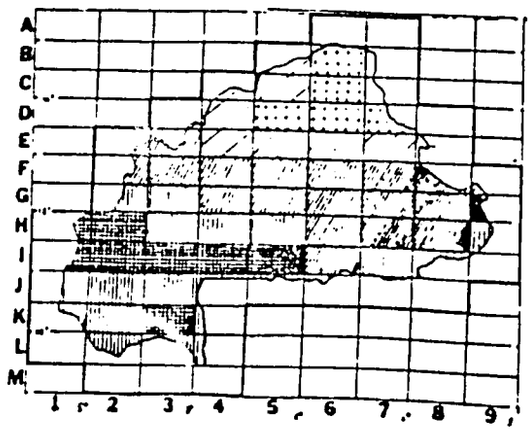
14 au 20 Juillet 86



21 au 27 Juillet 86



28 Juil. au 03 Août 86



Echelle de l'Indice de Végétation Normalisé (NVI)

→ Verdure croissante

0 0.025 0.050 0.10 0.15 0.20 0.25 >0.25