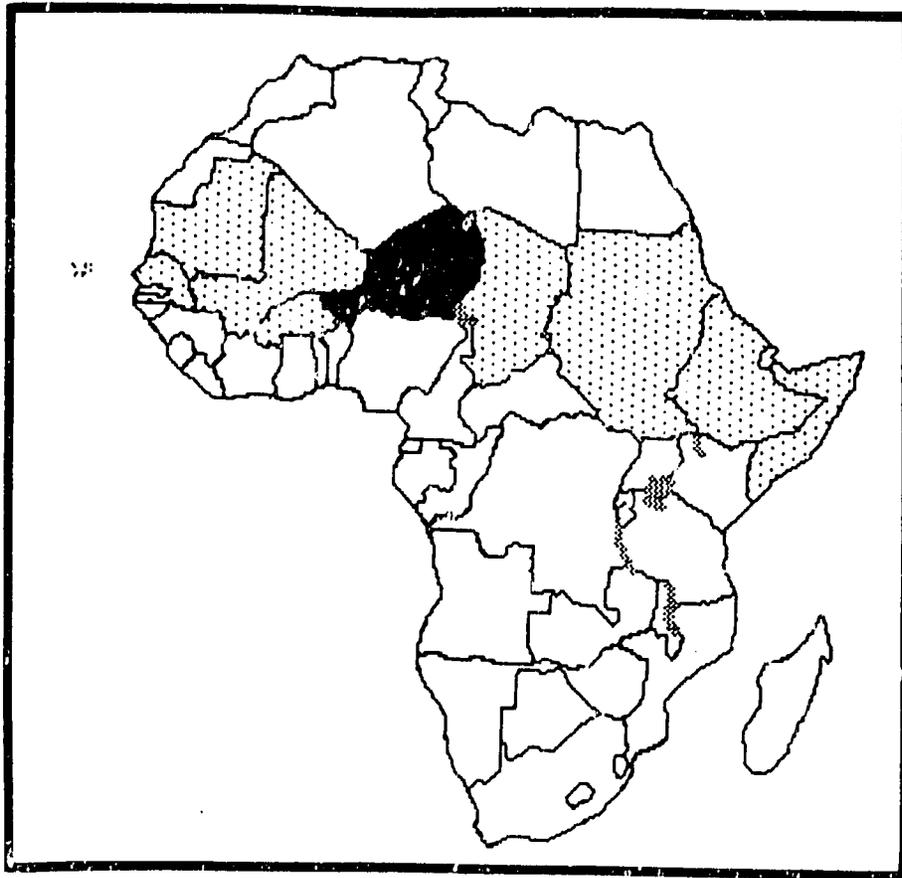


# SPECIAL CLIMATE IMPACT ASSESSMENT

## NIGER



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)  
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE (NESDIS)  
ASSESSMENT AND INFORMATION SERVICES CENTER (AISC)

PREPARED IN SUPPORT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

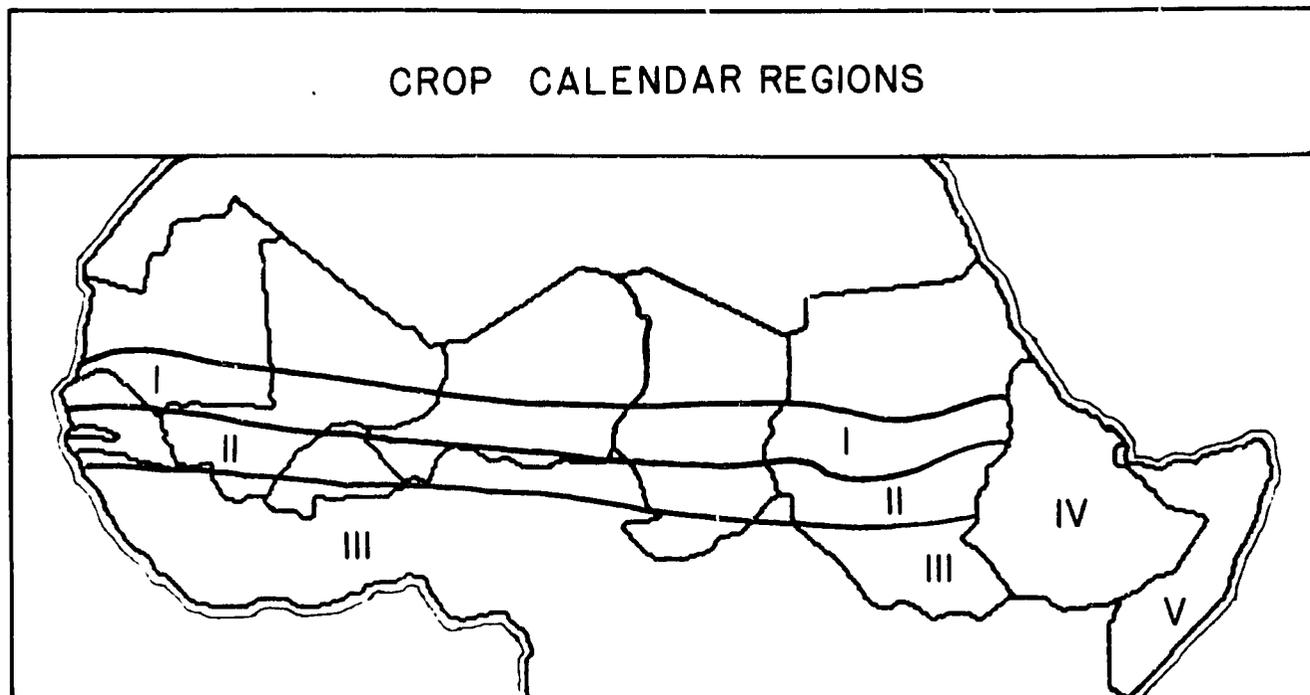
MAY - JULY 1985

ISSUED ON AUGUST 9, 1985

VOLUME 1, NUMBER 2

# USUAL PLANTING/HARVESTING DATES

## ( SUB-SAHARAN AFRICA )



### SAHEL/HORN MAIN SEASON CROP CALENDAR

Zone	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Rainfall
I. Sahel			////	----	-----	0000000				250 - 600 mm
II. Soudan			////	----	-----	000000000				600 - 1,000 mm
III. Soudano Guinean		////	----	-----	-----	000000000				>1,000 mm
IV. Ethiopia <sup>1</sup>			///////	----	-----	-----	0000000000			400 - 1,800 mm
V. Somalia <sup>2</sup>	////	----	-----	-----	000000000					250 - 600 mm

// Planting    -- Growing    00 Harvesting

This table illustrates the expected planting and harvesting periods for non-irrigated cereals during the main growing season in the Sahel/Soudan zones and in Ethiopia and Somalia. Planting and harvesting dates may vary widely from year to year, depending on the timing of the rainfall. Planting usually begins when the rainy season begins.

- 1 Secondary season crops planted late Feb. to early Apr. and harvested late Jun. thru July.
- 2 Minor season crops planted Oct. to early Nov., harvested late Jan. to early Mar.

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# INTRODUCTION

This is the second in a series of monthly Climatic Impact Assessment Reports issued for the Sahel/Horn countries of Africa during the crop growing season by the NOAA/NESDIS Assessment and Information Services Center (AISC). These special reports are based on state-of-the-art techniques to: (1) use daily meteorological satellite and weather station data for determining rainfall patterns and vegetation/biomass conditions, (2) detect drought and assess weather impacts on agriculture, and (3) present this information in a format that is useful for both non-technical and technical users. They are part of a USAID sponsored program designed to significantly improve the capability of the Sahelian countries, Sudan, Somalia and Ethiopia to assess the impact of weather on agriculture (food crops and rangeland) and use the assessments as input for decision making.

These reports are intended to provide advanced warning of drought induced crop failures and should facilitate early planning for food crisis amelioration and drought/famine relief.

The special assessments, which are air-expressed or hand-carried to U.S. Missions in the field, contain satellite images, narrative analyses of all pertinent data, crop and rangeland maps, and various tables and maps depicting weather impacts on agriculture and containing rainfall statistics.

Rainfall amounts used in these reports are preliminary estimates and may vary greatly from values published elsewhere. The quality of the data received via the WMO Global Telecommunications System (GTS) ranges from good in Senegal, Burkina, and Niger to non-existent in Chad and Sudan. Rainfall data from Somalia, Gambia, and Cape Verde are extremely scarce. Data from Mali, Mauritania, and Ethiopia range from fair to poor. Satellite cloud imagery from Meteosat is used to estimate rainfall where surface reports are missing or appear inaccurate or unrepresentative. Satellite vegetation images from NOAA-9 are used to further adjust the rainfall data. The term "normal rainfall" generally refers to 1951-83 mean rainfall. Readers should keep in mind that rainfall amounts have averaged 15 to 25 percent less since the late 1960's in the Sahel zone.

The AISC Special Assessment Reports will be updated every 10 days by cable. Assessment of quantified weather impacts on 1985 millet and sorghum yields (by major administrative region) will be provided by cable about August 20, 1985. AISC's quantified assessments focus only on weather factors affecting yield, not such non-weather factors as seed availability for planting, losses due to pests/diseases, affects of fertilizer, or farmer's decisions which determine planted area or shifts from one crop to another. Such information can best be determined in the field.

This assessment represents the synthesis and evaluation of all available data. Although some of the pertinent input data are included for use by other analysts, all data sets are modified in some way by AISC and no single data set can be used alone. Apparent discrepancies between data sets or between the enclosed data and the analysis can result from the analysis process, which combines all data and analyst experience to produce the best possible assessment.

AISC welcomes comments or suggestions on these reports. Feedback from U.S. Missions is appreciated and has already helped to improve this assessment service. Contact: Douglas LeComte E/AI42, NOAA/NESDIS/AISC, Page Bldg. #2, Room 13C, 3300 Whitehaven St., NW, Washington, D.C. 20235, Phone (202) 634-1822.

# REGIONAL ANALYSIS

# OVERVIEW

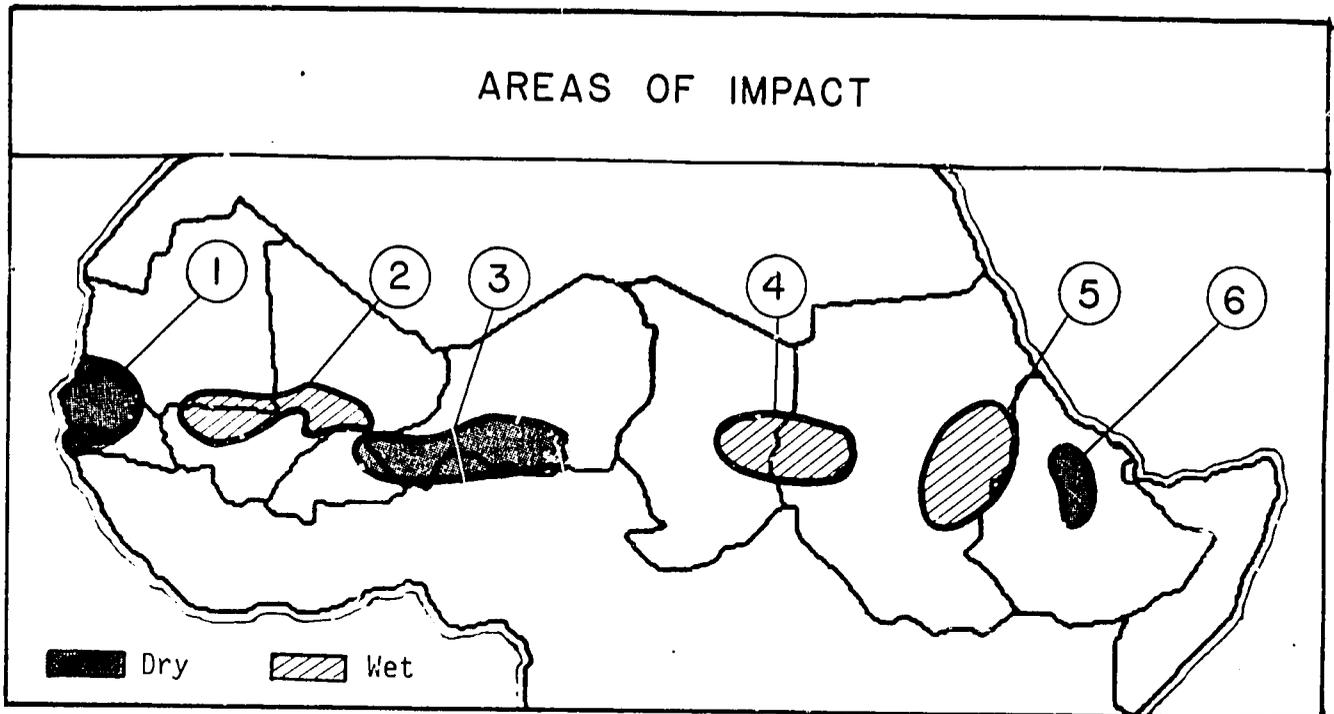


Figure 1

Crop and pasture conditions are much improved over the previous two years across the Sahel/Horn region, as July rainfall helped to offset earlier dryness. Normal to above-normal rainfall in Chad, Mali, Burkina Faso, and Sudan hampered food relief efforts but increased crop yield potential, suggesting an easing of food shortages late this year. Pasture conditions throughout the region improved markedly from June, though they remain below normal in Niger, Senegal, and Gambia. Crop conditions are normal to above normal in Mali, Burkina, Chad, and Sudan. Conditions in Mauritania, Senegal, Gambia (fig. 1, No. 1), and Cape Verde are somewhat unfavorable due to a late beginning of the rainy season, but plentiful rainfall throughout the remainder of the season would produce average crop yields. In Ethiopia, heavy rains have benefitted crops in western areas, but more rain may be needed in some central and northern areas (fig. 1, No. 6). Overall rainfall across the Sahel/Horn region (fig. 3) ranges from 80 to 120 percent of the long-term mean so far this year, except for parts of Niger, Senegal, Gambia, and Mauritania, where rainfall is 60 to 80 percent normal. The Intertropical Discontinuity (fig. 2) was south of normal in April and May, accounting for the slow start of the rainy season in West Africa. During July, the ITD moved sharply northward to the 20th parallel, bringing much heavier rains to the region compared to last year. The ITD remained south of normal throughout the important growing period in 1984, resulting in one of the worst droughts this century.

The following paragraphs briefly describe areas highlighted in figure 1. Note that 1984's AVHRR image (fig. 5) has a 20-km resolution, whereas the 1985 image (Global Area Coverage, or "GAC") has a 5-km resolution. GAC coverage is not available for last year.

Area 1. In Senegal, Gambia, and adjacent areas of Mauritania, below normal June rainfall delayed planting to some extent, but near normal July rainfall improved prospects in most areas. Satellite indices (fig. 4) and imagery (fig. 6) suggest unfavorable biomass conditions, except in extreme southeast Senegal. Cloud "contamination" makes this year's image in figure 6 difficult to interpret, but "greening" appears to be farther north in the 1984 image (fig. 5).

Area 2. The 1985 satellite image (fig. 6) shows a marked improvement in biomass in Sahelian areas of Mali and adjacent areas in Mauritania compared with last month. Note, especially, the bright yellow hue along the Mali-Mauritania border.

Area 3. Overall crop and livestock prospects remain below average in Niger, though better than last year. Higher rainfall and lower temperatures in July boosted cereal and pasture growth following hot, dry weather in June.

Area 4. Normal to excessive rains interfered with surface transport of relief aid to drought victims in Chad and Sudan, though the moisture should ensure improved crop production this year (subject to availability of seeds). Heavy showers damaged roads in Sudan's Darfur province, hindering food supplies shipped by truck.

Area 5. Satellite data show substantial biomass improvement this year in eastern Sudan (figs. 4, 5 and 6), where the bulk of the country's cereals are grown. Crop yields should be much greater than 1984's drought-reduced levels.

Area 6. Abundant rains have favored main season crops over much of Ethiopia, especially in the west, but satellite biomass conditions do not appear good in parts of Wollo and Tigray in the north, as well as Shoa and Sidamo in the center. Cloud "contamination" may be a problem in interpreting the image. This area should be monitored closely for signs of dryness in August.

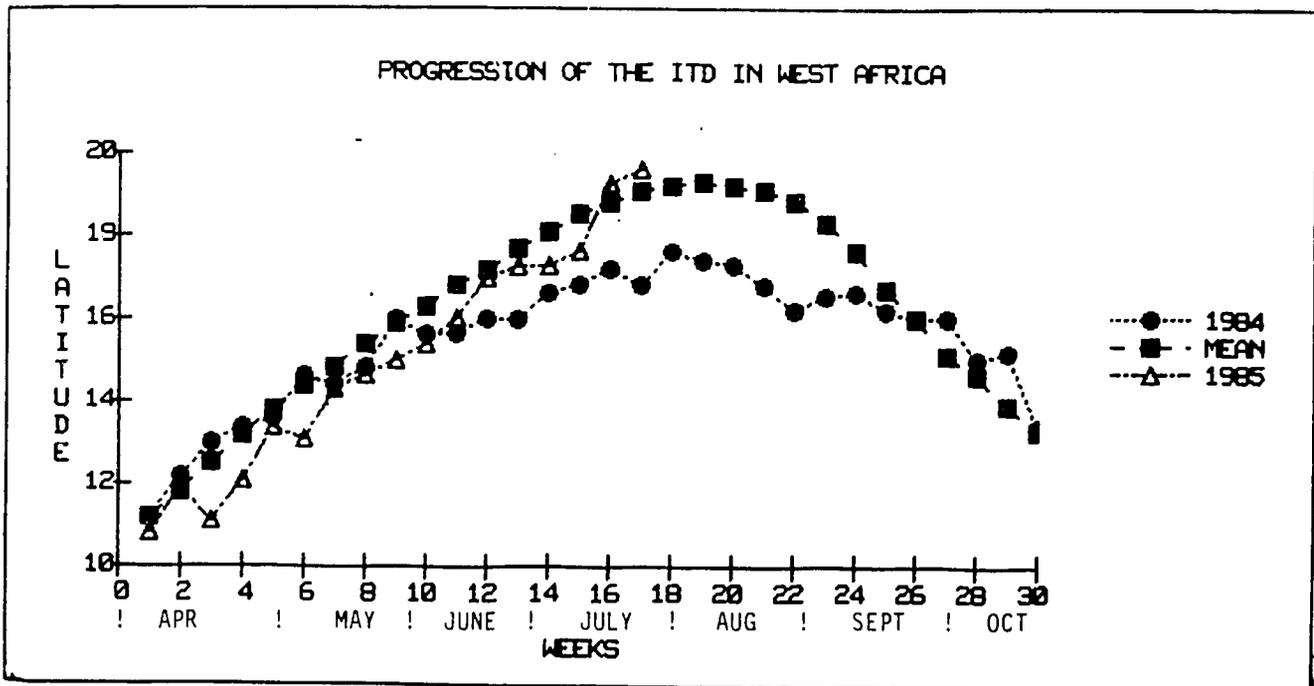
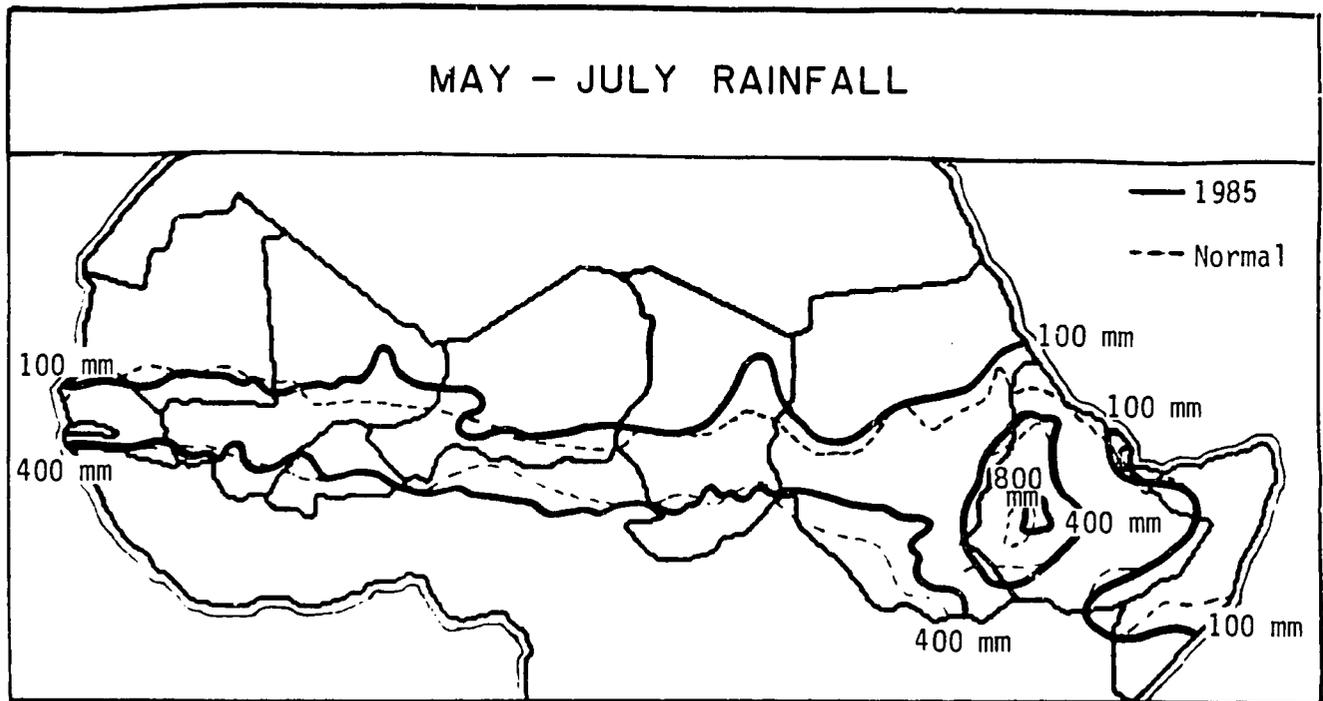


Figure 2



**Figure 3**

The northern edge of the rains (100 mm isoline) was south of normal in Mauritania, but north of normal in Mali, parts of Niger, eastern Chad, and Sudan. Heavier rains (400 mm) were north of normal in southwest Burkina and southern Sudan.

# NOAA SATELLITE VEGETATION/BIOMASS INDEX NORMALIZED AVHRR DATA

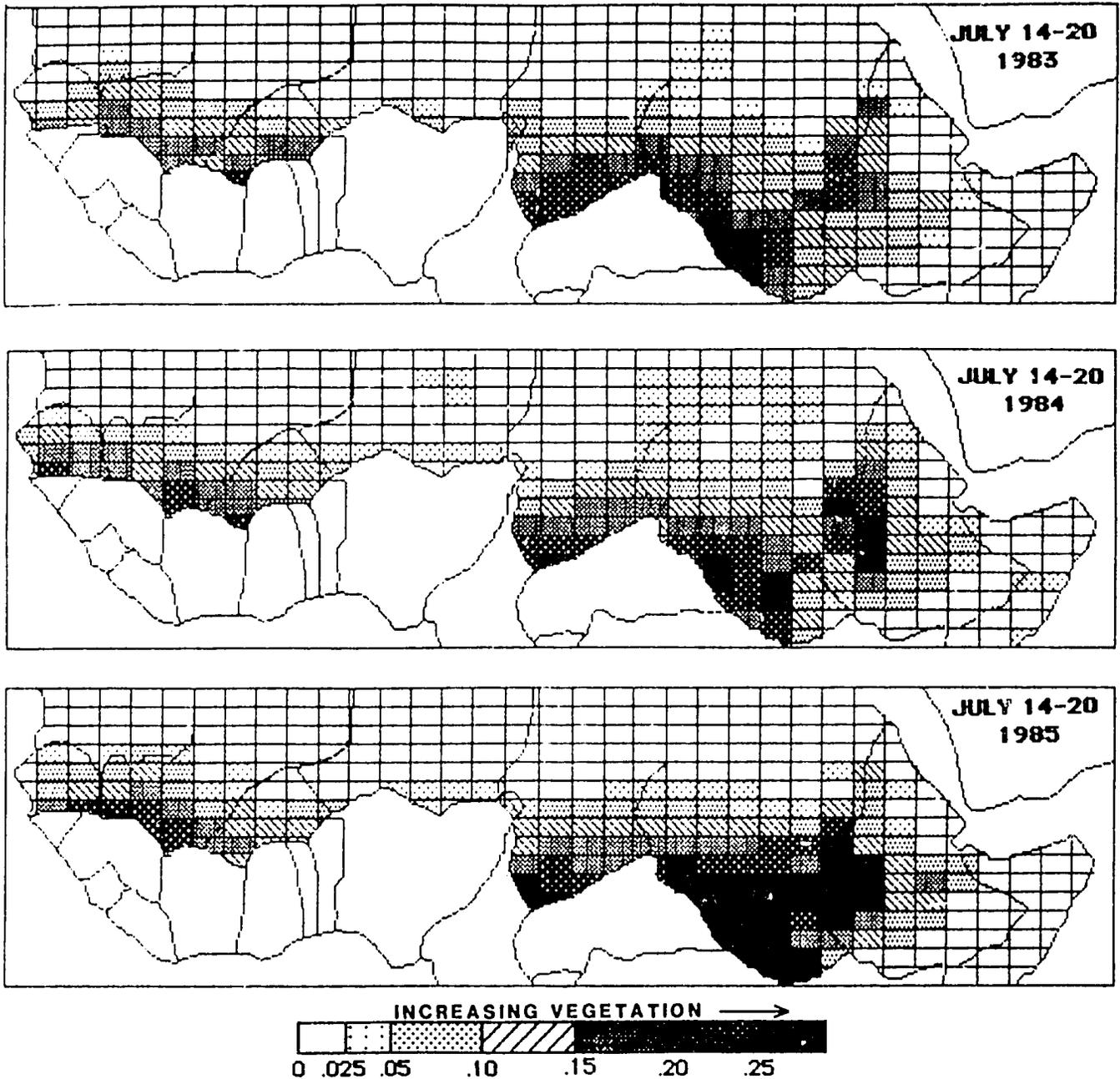


Figure 4

NOAA AVHRR IMAGE 1984

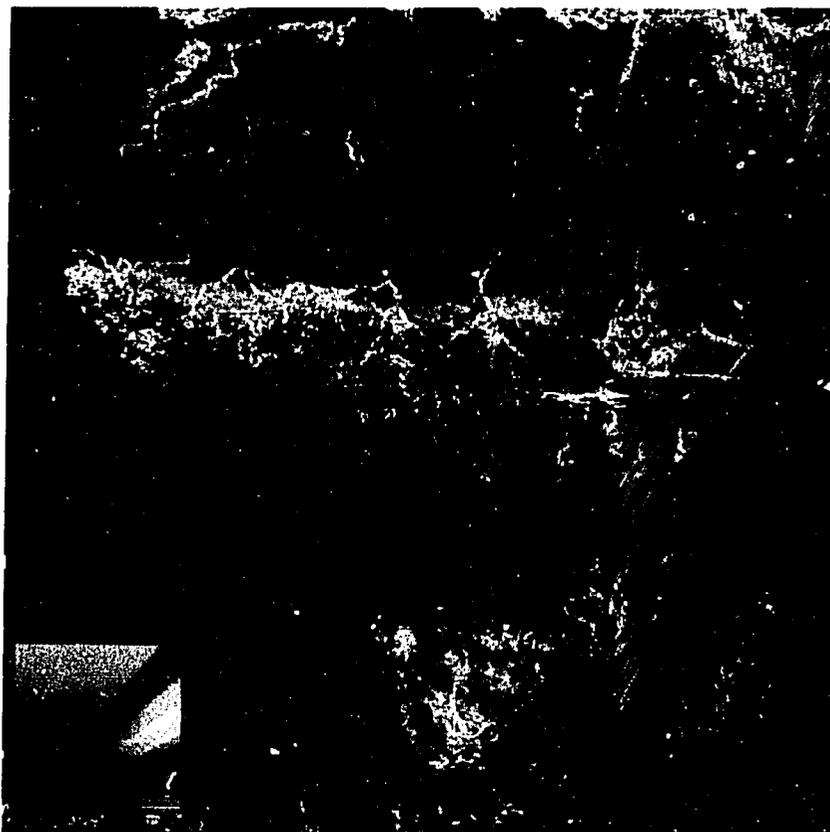


Figure 5

NOAA AVHRR IMAGE 1985



Figure 6

NOAA AVHRR IMAGE 1985

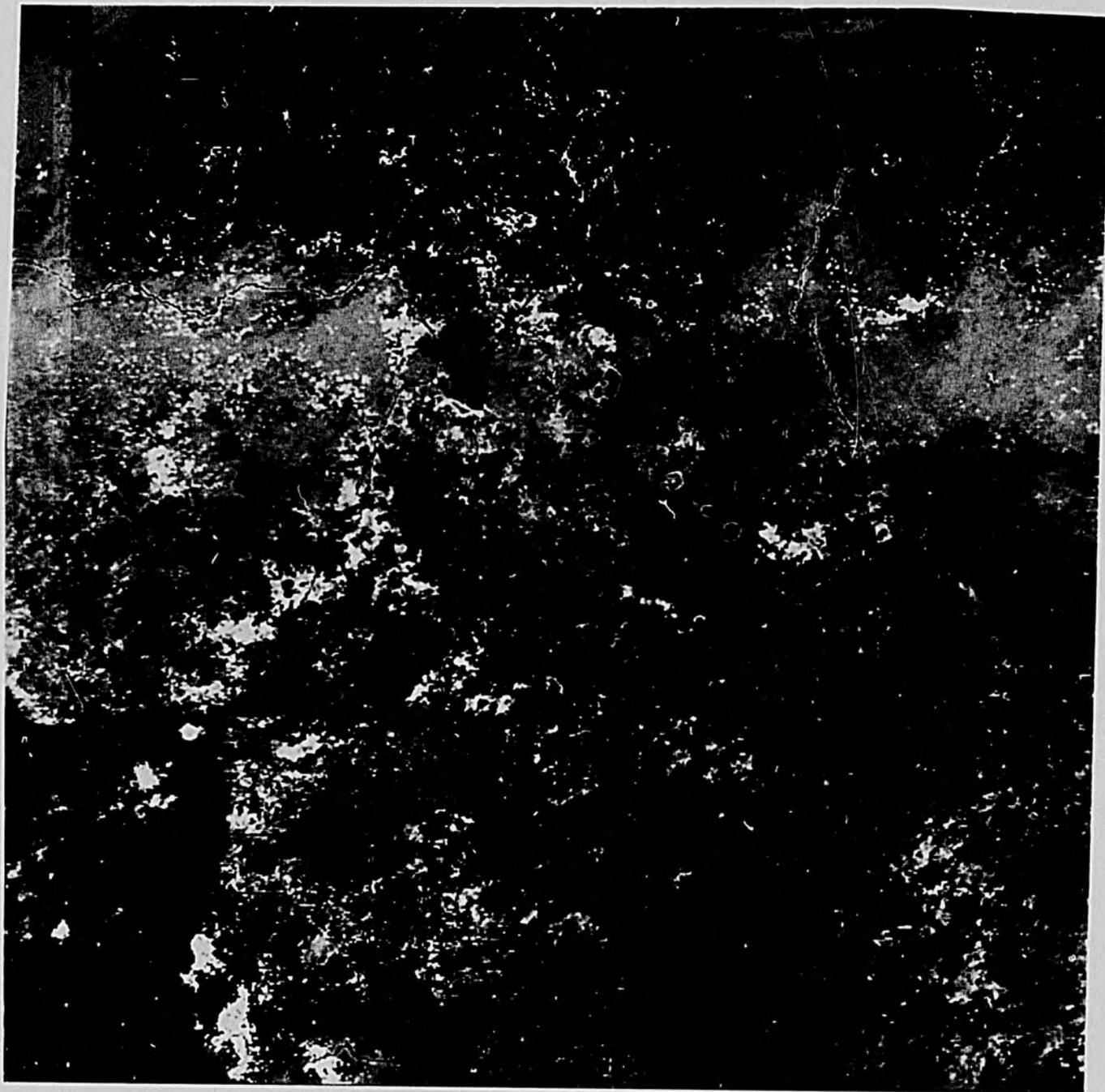


Figure 6

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# BACKGROUND ON ASSESSMENT METHODS

## DATA

The NOAA/NESDIS Assessment and Information Services Center (AISC) uses a combination of meteorological satellite products and weather data as the primary inputs for these Special Climatic Impact Assessments. Operational rainfall reports are received daily through the WMO Global Telecommunications System (GTS) and ten day reports are received from some host-countries and the Regional AGRHYMET Center in Niamey. AISC uses data from ESA's Geo-stationary Meteorological Satellite (METEOSAT) and the NOAA-9 daily polar orbiting satellite. METEOSAT photographs are used as one method to assess regional rainfall and to monitor large-scale weather patterns, e.g., the Inter-tropical Discontinuity (ITD). NOAA-9 data are used to assess vegetation/biomass patterns and to estimate rainfall.

## NOAA SATELLITE ANALYSIS

The NOAA satellite provides daily data from the Advanced Very High Resolution Radiometer (AVHRR) which has a spatial resolution of one kilometer. The satellite receives radiation signals (e.g., from the ground and clouds) and immediately re-transmits one kilometer resolution data which can be received by local field stations as the satellite passes in the vicinity. The satellite can also record a limited amount of the one kilometer data; recorded data are termed LAC for Local Area Coverage. As they are received, the one kilometer radiation signals are sampled to obtain four kilometer resolution data (termed GAC for Global Area Coverage) which is stored internally.

The NOAA satellite products for 1985 in these special assessments are primarily based on 1985 GAC data (as available, AISC will include special LAC scenes). The 1984 and 1983 satellite images have a more coarse resolution on the order of 20 kilometers. Although these images have larger pixels, users can still compare 1985 conditions with those of previous years.

AISC obtains daily four kilometer resolution GAC data consisting of three radiation channels: Channel I (visible reflected solar radiation), Channel II (near infrared reflected solar radiation) and Channel IV (thermal infrared radiation). These three channels are composited over 10-15 day periods to remove most of the clouds from the image and produce the color-coded NOAA satellite images and vegetation/biomass index products contained in this report.

## NOAA Satellite Images

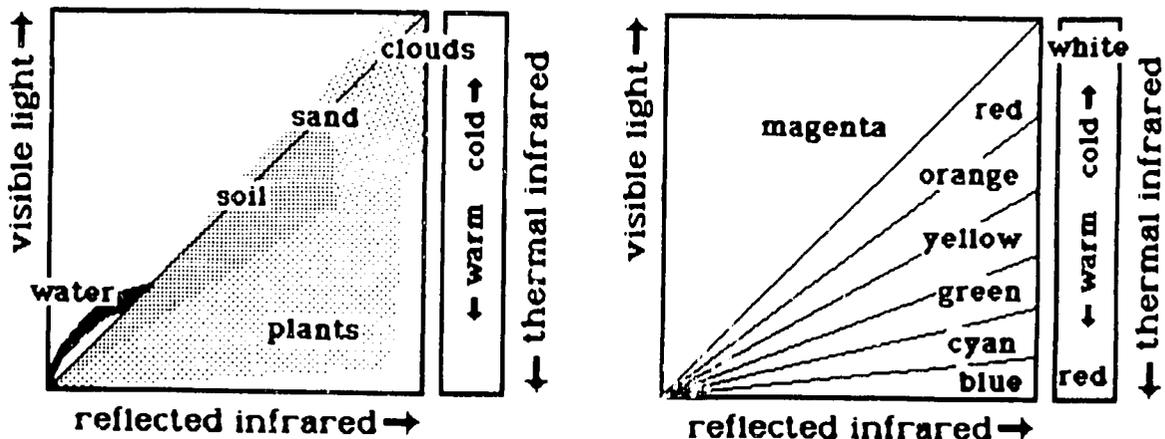
The Ambroziak Color Coordinate System (ACCS), used to produce the satellite images in this assessment, shows the health of the vegetation using colors designed to maximize the information content and minimize the analysis time. Different hues (red-orange-yellow-green-cyan-blue) separate vegetation and water from soil and clouds using the visible and the infrared portions of the sunlight reflected from the surface. Saturation (red-pink-white) is used to identify clouds using the emitted thermal infrared radiation. Clouds are usually colder than the surface and they become white when the saturation of the colors is reduced for pixels with low temperatures.

The colors of the ACCS display a continuum of hue and intensity which matches both the data and the mind's perception system. Sharp boundaries on the image, shown as large changes in hue, indicate actual sharp changes in surface vegetation. The colors can be generally interpreted as follows:

<u>HUE</u>	<u>INTENSITY</u>	
	<u>Dark</u>	<u>Bright</u>
red	wet or dark soil*	sand or low clouds
yellow	emerging or sparse plant cover over wet or dark soil*	emerging or sparse plant cover over sand or under scattered clouds
green	very healthy plants combined with standing water or forest	healthy field crops or similar plants
cyan (greenish-blue)	dense forest	dense forest, maize, or rice cover
magenta (purplish-red)	clear shallow or slightly turbid water	highly turbid, very shallow, or partially cloud covered water
<b>COLORS WITHOUT HUE</b>		
black	clear deep water or dark shadow	
white	clouds, snow, or colder high terrain	

\*Dark reds, oranges, and yellows are shades of brown.

### Ambroziak Color Coordinate System colors and meanings



## Vegetation/Biomass Index Products

The Vegetation/Biomass Index products contained in this assessment are derived from the following formula:

$$NVI = \frac{\text{Channel II} - \text{Channel I}}{\text{Channel II} + \text{Channel I}}$$

where: NVI stands for the Normalized Vegetation Index

Vegetation/biomass index values are calculated for each day of the week and cloud-free pixels are averaged to produce a weekly mean vegetation index. Weekly values are further averaged for one degree latitude and two degree longitude areas. The NVI is a measure of the amount of vegetation or biomass on the ground. The index ranges from 0 (no vegetation) to +1 (intense vegetation); however, for areas assessed in this report, the highest NVI value was +.365. These indexes can show the progress of vegetation/biomass conditions through the growing season. Conditions at any one time within the season can be compared to those at the same time in previous years. The index can be placed on a map or graphed as a time-series.

## ASSESSMENT PROCESS

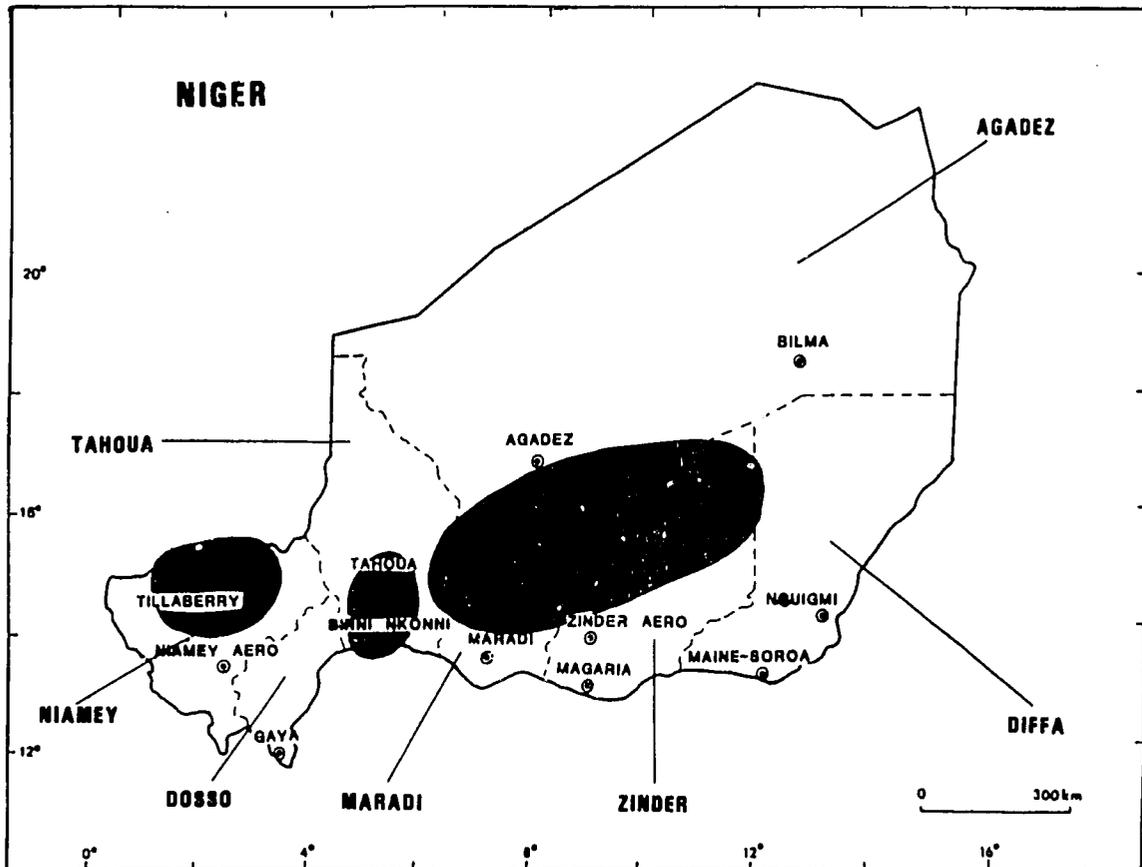
NOAA/NESDIS AISC uses all available satellite products and weather station reports to assess climatic impacts on agriculture (crops and rangelands). AISC focuses on the weather factors which affect crop yield, not non-weather factors that may also be important such as effects of fertilizer or losses due to pests and disease. AISC does not measure planted or harvested crop area.

The AISC Assessment Process involves: 1) estimation of daily rainfall, 2) analysis of rainfall patterns, and 3) assessment of weather impacts on crops and rangelands. Rainfall assessments are based on daily weather reports, METEOSAT photographs, NOAA-9 photographs and AISC/ACCS color-coded satellite images. Ten day and monthly rainfall amounts are determined for weather reporting stations and crop regions. Ten day, monthly and seasonal rainfall are analyzed for the current crop season and with respect to conditions during the previous 30 years. AISC uses various agroclimatic and satellite models to assess the impact of rainfall on crops and rangelands. These include ten day, monthly and seasonal agroclimatic/crop condition models used in combination with each other; the NOAA satellite images; and vegetation/biomass index products.

The assessments in this report are subdivided into four components: 1) Overview, 2) Rangeland Vegetation/Biomass Conditions, 3) Agricultural Crop Conditions and 4) Rainfall Analysis.

# COUNTRY ANALYSIS

# CURRENT ASSESSMENT



Overview

Figure 1

Agricultural crop and rangeland/vegetation conditions for 1985 are generally improved over those in 1984. After a delay in the beginning of the 1985 rainy season, satellite imagery for July (fig. 2) clearly shows rangeland and vegetation patterns throughout the country. Rangeland conditions are very poor in northern Niamey Department, central and northern portions of Maradi and Zinder Department and southern Agadez Departments (fig. 1). Rangeland conditions in Tahoua and southern Niger are comparable to those in 1984. Except for drought stressed crops in northern Niamey Department and southern Tahoua Department, agricultural crops look generally good throughout most of southern Niger. In addition to arriving late, seasonal rains are still below normal and rainfall during July was erratic. The success of the 1985 crop season in Niger is going to be heavily dependent on good rainfall during August and early September. This is especially true for late planted crops in the western portions of the country.

## Rangeland Vegetation/Biomass Conditions

For the first time this year, satellite imagery (based on daily data from the period July 11-24) clearly shows the development of vegetation patterns within southern Niamey Department, Dosso Department, Tahoua Department, and across the southern portions of Maradi, Zinder and Diffa Departments. The delay in the beginning of the rainy season (until late June and early July) is evident in weekly satellite derived vegetation indexes (fig. 3) for Tahoua, Dosso and Niamey Departments, i.e., 1985 vegetation indexes for these regions were well below indexes for 1983 and 1984 until the third week of July this year. As of July 14-20, satellite derived vegetation/biomass indexes for southern Niger are comparable to those in 1984, but worse than those in 1983. The 1985 biomass conditions in central Niamey and Dosso Departments are worse than those in 1984. Satellite images (fig. 2) show an appreciable lack of vegetation in northern Niamey Department, major portions of central and northern Maradi and Zinder Departments, and southern Agadez Department up to the city of Agadez. Because rainfall arrived very late in northern Niamey Department (favorable crop

planting conditions did not exist until late July), there has been insufficient time for "greenup" to be detected by the satellite. Rangeland conditions for 1985 near Agadez are worse than those in 1984 according to vegetation indexes. Satellite derived rainfall totals suggest potential drought problems in the aforementioned low biomass regions of Agadez, Maradi and Zinder Departments. Finally, analysis of satellite imagery and satellite derived vegetation/biomass indexes is consistent with rainfall analysis based on reports from 1983 through 1985.

### Agricultural Crop Condition Analysis

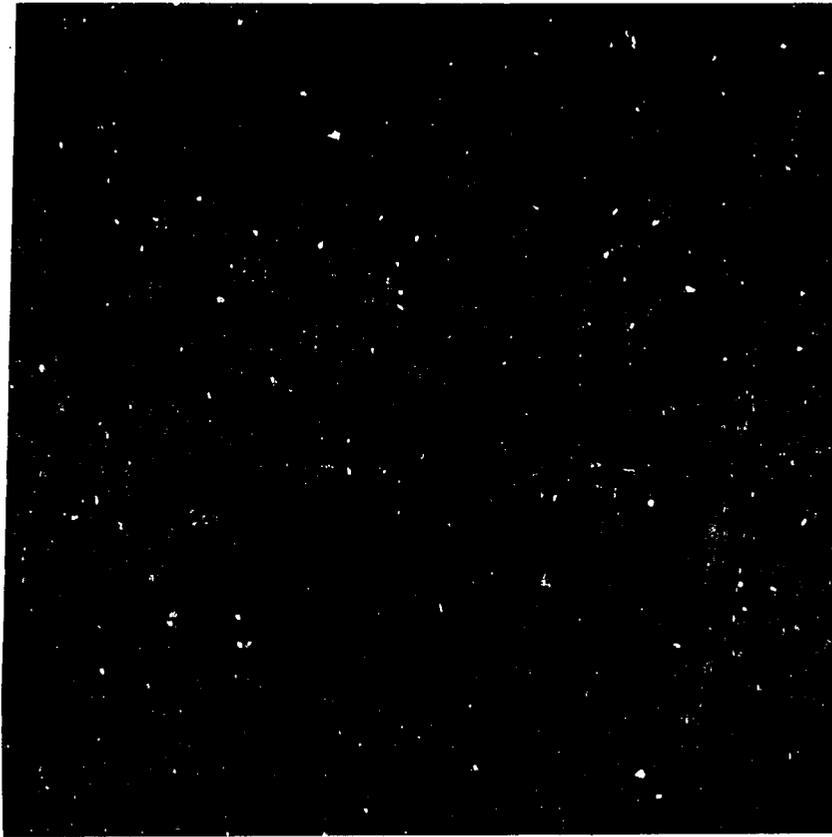
Agricultural crops are experiencing drought induced water stress throughout the northern portions of Niamey Department (Tillabery to Filingue and to the north) and throughout southern Tahoua Department (Birni Nkonni and Tahoua). Crop conditions are generally good throughout the other regions in southern Niger except for localized drought problems. Because the 1985 rainfall season began late and season totals are generally below the 30 year mean, agricultural crops are going to be critically dependent on adequate rainfall during August. In Niamey Department, favorable planting conditions were not realized in the northern areas (e.g., Tillabery) until the last decade of July. Although this is an improvement over last year, early planted crops have experienced water stress and late planted crops are vulnerable to an early end of the rainy season. Crop conditions near Niamey are average for early June planted crops and excellent for late June planted crops. Crop conditions in the southern areas of Niamey Department look very favorable (late May planting). Crops in the Dosso Department have benefitted from good rains since June. In Tahoua Department, early to mid-June planted crops have experienced moisture stress due to low rainfall. However, crops planted in early July look good. Crop conditions throughout southern Maradi, Zinder and Diffa Departments have benefitted from generally favorable rainfall during July.

### Weather Analysis

Overall rainfall conditions as of the end of July 1985 are improved over those in 1984, but there are still indications of drought. July rainfall was essentially normal throughout Niger (Table 1) except in the central portion of the country defined by the triangular region determined by Birni Nkonni, Tahoua and Magaria. July rainfall was 60 percent of normal at these locations. The 1985 seasonal rains did not begin until late June and rainfall has been spotty and erratic, particularly in the aforementioned central region. Decadal rainfall analysis indicates 100-200% normal rainfall during the first ten days of July for southern Niger to the east of Birni Nkonni. Rains during July 1-10 were only 40-60% normal at locations to the west and north: Tillabery, Niamey and Tahoua. Except for Niamey (142% normal), Gaya (90% normal), and Maine-Soroa (124% normal), rainfall during July 11-20 at other locations was only 40-60% normal. Assessed rainfall for the last decade of July was 40-60% of normal at most locations except for near normal rains at Tillabery, Maradi, Nguigmi and Maine-Soroa. July rainfall percentile ranks in the 20-30th percentile range within the Birni Nkonni, Tahoua and Magaria triangle suggest moderate drought and unfavorable crop growing conditions. July rainfall percentile ranks in the 40-50th range (i.e., normal conditions) may be misleading because of the uneven distribution through the month. Because of the delay in the beginning of the rainy season and continued dryness into July, seasonal rainfall for the May-July period (Table 2) is well below normal at Tillabery (21st percentile), Niamey (30th percentile), Birni Nkonni (8th percentile) and Magaria (20th percentile). Near normal seasonal rainfall conditions existed at other locations. However, the 1985 seasonal rainfall through July is still much better than 1984, when May-July cumulative rainfall was extremely low and in the 10-20th percentile range throughout the entire country except near Maine-Soroa and Nguigmi.

# NOAA AVHRR IMAGES

1984



1985

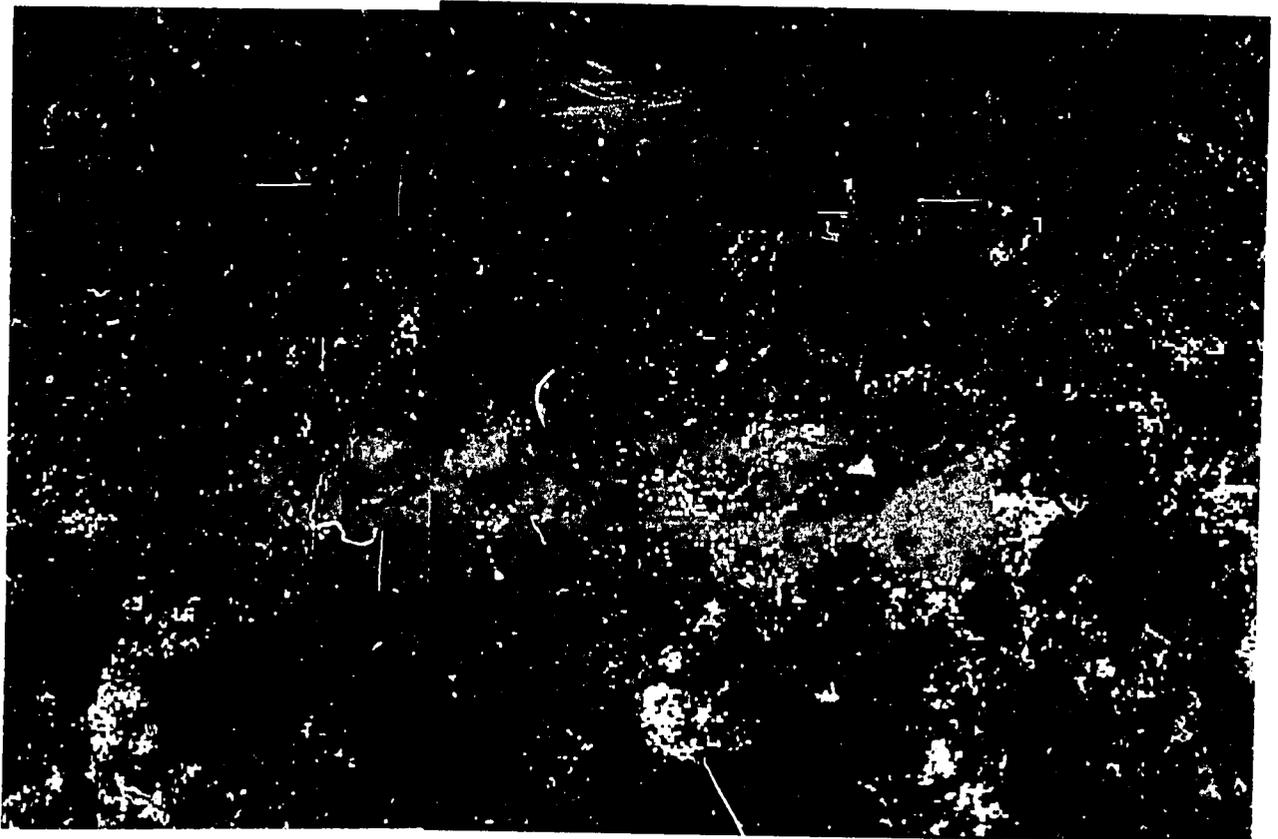


Figure 2

# NOAA SATELLITE VEGETATION/BIO MASS INDEX NORMALIZED AVHRR DATA THIRD WEEK OF JULY NIGER

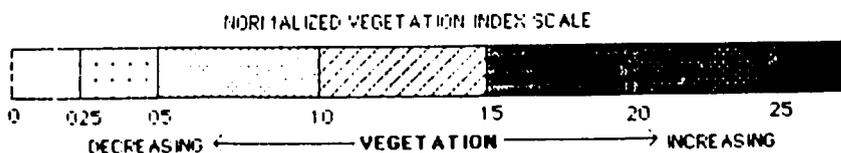
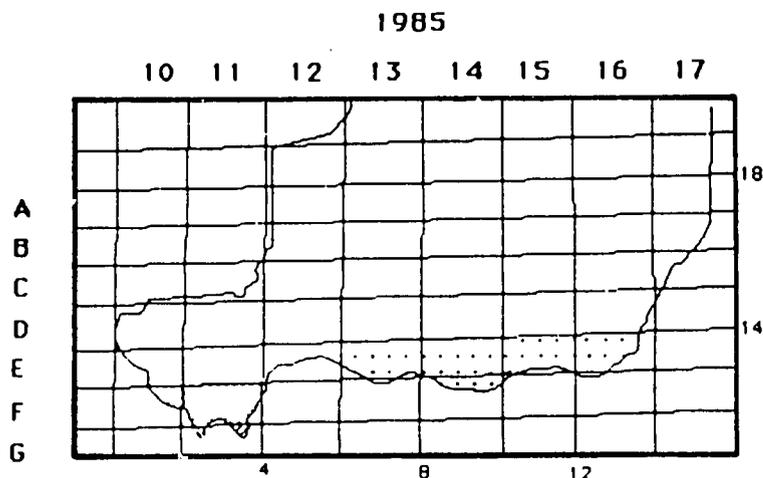
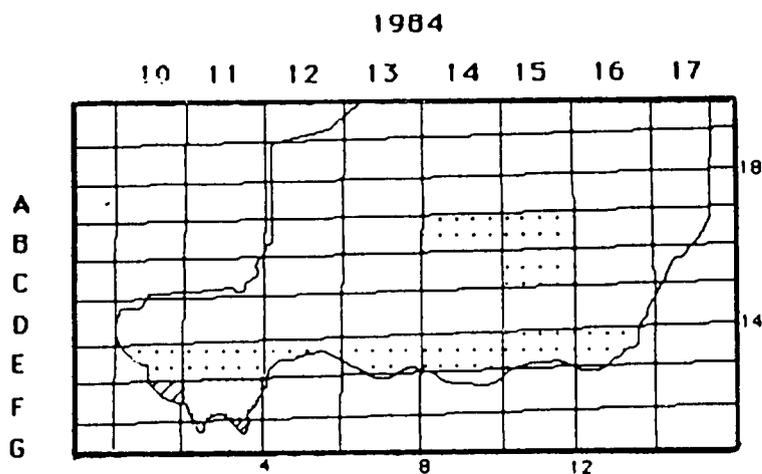
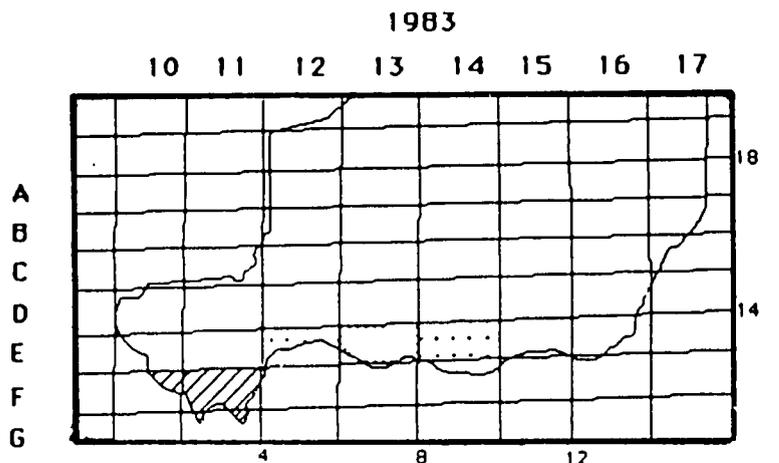


Figure 3

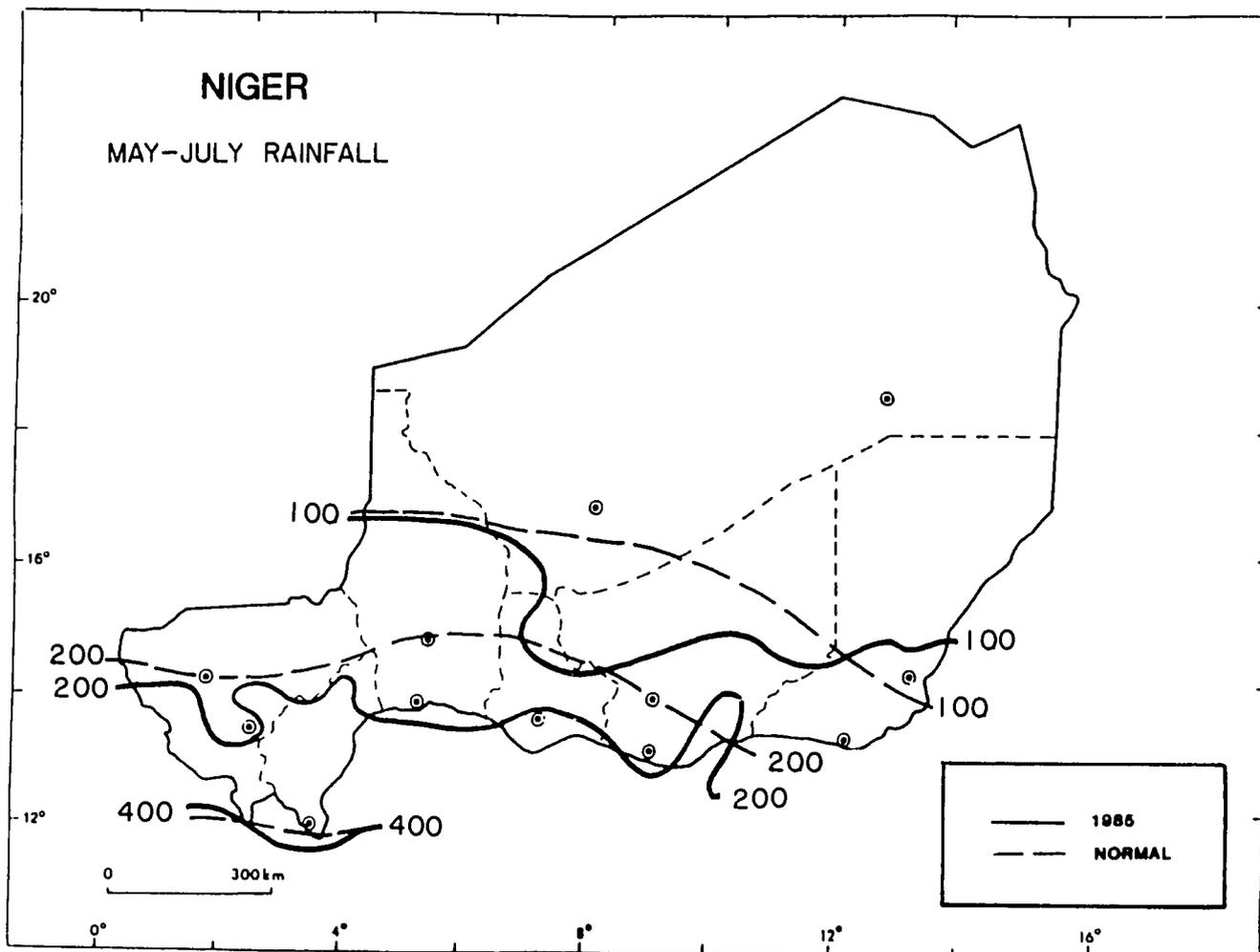


Figure 4

Approved Page 17/20

# MONTHLY RAINFALL TABLE

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles  
(Rnk, on Scale of 0 to 100)

Country: Niger Year: 1985

Station	May (5)			June (6)			July (7)		
	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk
Agadez	0	0	31	11	92	67			
Tillabery	0	0	31	21	42	21	90	71	31
Tandjari	0	0	31	33	98	23	69	59	17
Ni-Guizum	5	71	69	32	320	92	65	107	67
Wamey Wandjari	0	0	31	59	91	53	132	79	33
Sikou Moukoko	1	3	6	12	18	3	99	70	31
Mahadi	5	21	17	71	108	61	132	86	44
Sinder Wandjari	36	157	81	20	43	28	132	99	56
Maganza	?	25	22	58	95	53	117	66	25
Makina-Soube	0	0	31	34	103	61	105	99	47
Daye	59	82	42	85	67	32	216	113	64

**Notes:**

- " " = No data for calculations.
- "???" = Percent of normal not calculated because average rainfall is zero.
- "\*\*\*" = Percentiles not calculated because less than 15 years of historical data exist on file.

**Table 1**

# CUMULATIVE RAINFALL TABLE

Expressed in Millimeters (mm), Percent of Normal (%) and Percentiles  
(Rnk, on Scale of 0 to 100)

Country: Niger Year: 1985

Station	May (5)			May - Jun (5-6)			May - Jul (5-7)		
	mm	%	Rnk	mm	%	Rnk	mm	%	Rnk
Agadez	0	0	3	11	55	44			
Fillibari	0	0	3	21	20	7	111	57	14
Tahoua	0	0	3	23	44	17	102	53	5
N. Guigou	5	71	69	37	218	91	102	131	69
Miamey Airdport	0	0	3	69	61	22	201	71	26
Binni R. Kandi	1	3	6	13	13	3	112	46	6
Kanadi	3	21	17	76	94	50	208	85	42
Linder Airdport	36	157	91	56	91	56	138	93	47
Magaria	7	25	22	65	73	42	182	68	19
Kaindoudou	0	0	3	34	79	47	139	93	53
Sega	59	82	42	144	73	31	360	92	44

**Notes:**

" " = No data for calculations.

"???" = Percent of normal not calculated because average rainfall is zero.

"\*\*\*\*" = Percentiles not calculated because less than 15 years of historical data exist on file.

**Table 2**