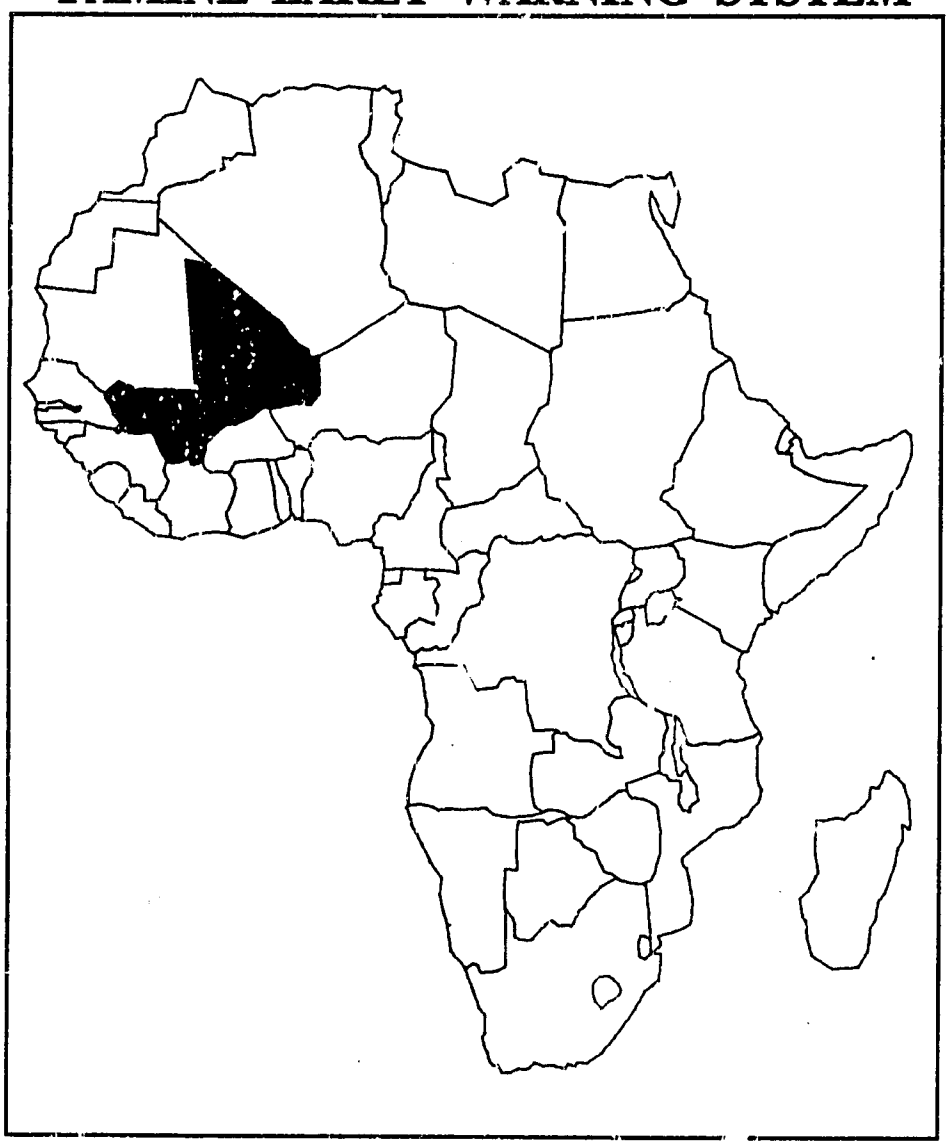
MALI

VULNERABILITY ASSESSMENT

FAMINE EARLY WARNING SYSTEM



Produced by the Office of Technical Resources - Africa Bureau - USAID

FAMINE EARLY WARNING SYSTEM

The Famine Early Warning System (FEWS) is an Agency-wide effort coordinated by the Africa Bureau of the U.S. Agency for International Development (AID). Its mission is to assemble, analyze and report on the complex conditions which may lead to famine in any one of the following drought-prone countries in Africa:

- **Burkina**
- **Chad**
- **Ethiopia**
- **Mali**
- **Mauritania**
- **Niger**
- **Sudan**

FEWS reflects the Africa Bureau's commitment to providing reliable and timely information to decision-makers within the Agency, and among the broader donor community, so that they can take appropriate actions to avert a famine.

The FEWS system obtains information directly from FEWS Field Representatives assigned to six USAID Missions. In addition, FEWS relies on information it obtains from a wide variety of sources including: USAID Missions, host governments, private voluntary organizations, international donor and relief agencies, and the remote sensing and academic communities.

This is the final report prepared under FEWS Phase I. The vulnerability assessment was completed for USAID's Africa Bureau by **Price, Williams & Associates, Inc.**

Under Phase I, the work of the FEWS Field Representatives was coordinated by **Tulane University's School of Public Health and Tropical Medicine.**

NOTE: This publication is a working document and should not be construed as an official pronouncement of the U. S. Agency for International Development.

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Vulnerability Assessment

June 1989

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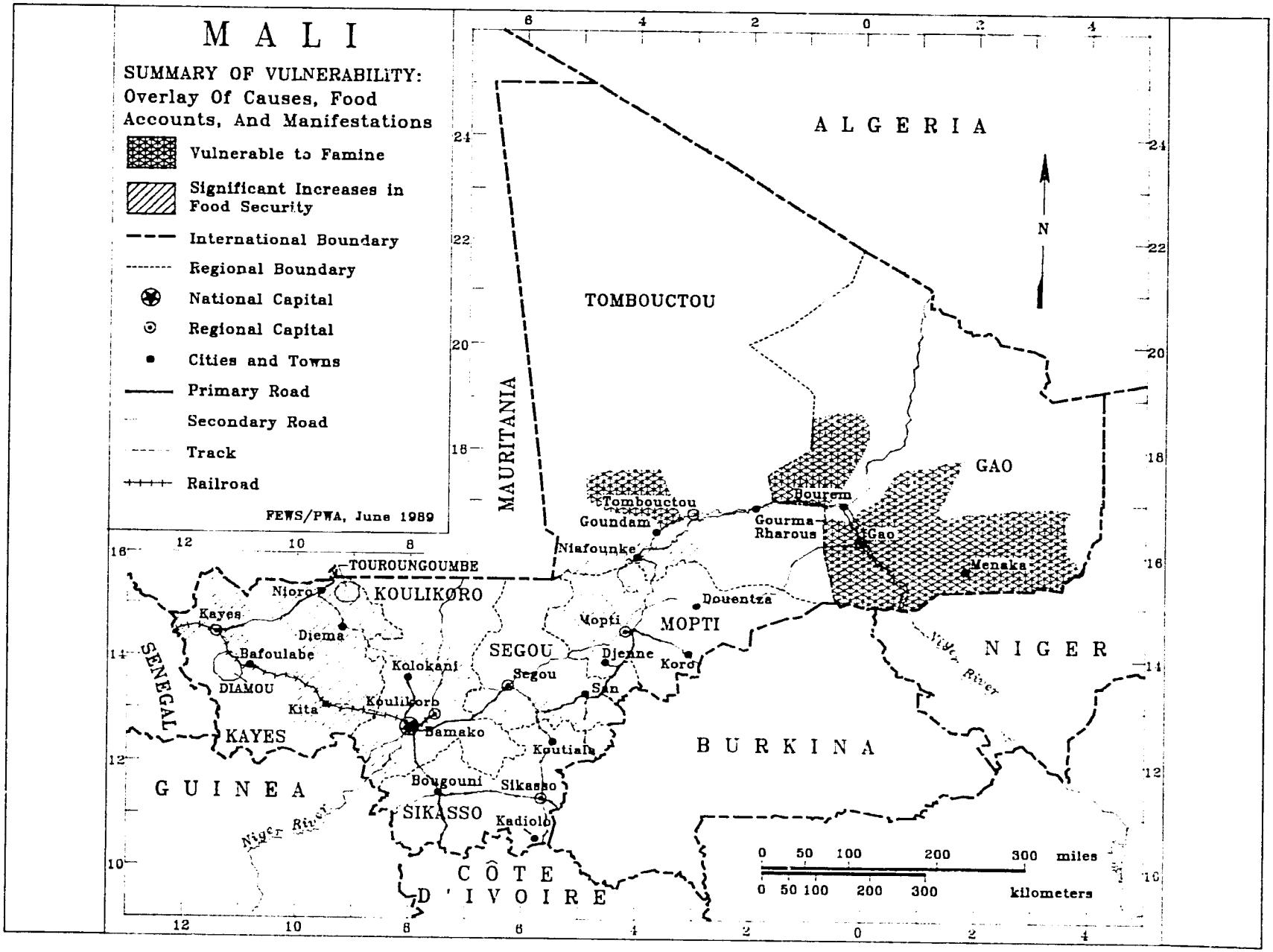
Executive Summary

Mali will not experience any major food emergencies this year. Any areas that experience food shortages will be quite small. The Government of Mali (GOM) should be able to handle such situations with its own resources. The 1988 harvest for Mali was exceptional, with a record gross cereal production of 2,700,000 metric tons. Despite the outstanding harvest, there are nine cercles in Mali that may potentially experience some degree of food shortage between now and the coming harvest (Gao, Ansongo, Bourem and Ménaka cercles in Gao Region, and Goundam Cercle in Tombouctou Region). The populations of these possibly vulnerable cercles totals about 97,800. In addition, there are displaced populations in Segou and Niono that are estimated to number around 5,000 people.

DRY FORECAST FOR 1989 RAINFALL IN THE SAHEL

The Synoptic Climatology Branch (SCB) of the U.K. Meteorological Office forecasts a 60% chance that the Sahel will receive less than 75% of normal rainfall. The SCB therefore expects rainfall to be less than 1988 (an average year compared to the long-term mean) but more than the "very dry years of 1986 and 1987".

As part of the SCB's research into the effects of sea surface temperatures on Sahelian rainfall, it has made experimental rainfall forecasts each year since 1986. The SCB employs four forecast methods, all based upon sea surface temperature anomaly patterns in April. Three statistical methods predict that 1989 will be dry to very dry. A dynamic general circulation model method predicts more rain in the Sahel than either of the statistical methods. At this early stage of research, the SCB has more confidence in the dry forecast. The SCB warns that the forecasts are experimental and must be used with caution. The forecasts are based on the assumption that sea surface temperature anomalies will not change in an unusual way between spring and summer. This assumption broke down for the 1988 forecast, leading the SCB to continue monitoring sea surface temperatures after April this year.


MALI
SUMMARY OF VULNERABILITY:
Overlay Of Causes, Food Accounts, And Manifestations
Vulnerable to Famine
Significant Increases in Food Security
International Boundary
Regional Boundary
National Capital
Regional Capital
Cities and Towns
Primary Road
Secondary Road
Track
Railroad
FEWS/PWA, June 1989
ALGERIA
TOMBOUCTOU
GAO
MAURITANIA
Tombouctou
Goundam
Bourem
Gourma Rharous
Gao
Menaka
Niafounke
TOUROUNGOUMBE
Nioro
KOULIKORO
Kayes
Diema
Bafoulabe
Kolokani
SEGOU
Segou
Mopti
Douentza
MOPTI
Djenne
Koro
San
NIGER
Niger River
SENEGAL
DIAMOU
Kita
Koulikoro
Bamako
KAYES
Koutiala
BURKINA
GUINEA
Bougouni
Sikasso
SIKASSO
Kadiolo
Niger River
CÔTE D'IVOIRE
N
0 50 100 200 300 miles
0 50 100 200 300 kilometers

I. Vulnerable/At-Risk Populations

Methodology: Vulnerability Assessment

The FEWS vulnerability assessment uses agro-meteorological and socio-economic indicators to define a population's probable level of vulnerability to famine. Four stages of vulnerability are identified: vulnerable, at-risk, nutritional emergency, and famine. Because available indicator data are frequently of relatively poor quality, or without extensive baselines for reference, FEWS relies upon a "convergence of evidence", a comparison of several indicators, to interpret the meaning of any single indicator. Each section that follows (Causes, Food Accounting, Manifestations) uses indicator data in different ways to locate actual and potential food stress (see Appendix 1 for details). Each surface of food stress thus created is mathematically weighted for significance to vulnerability, subjective judgements are applied, and then the surfaces of food stress are combined into a summary of vulnerability. Maps for each surface and the summary are provided within this assessment.

There are nine areas in Mali that may become vulnerable to food emergencies between now and the end of the 1989 harvest. They are (see Map 1): Gargando and Raz-El-Ma arrondissements in Tombouctou Region; and N'Tillit, Talataye, Almoustarat, Bamba, Temera, Inékar, and Tidarmene arrondissements in Gao Region. The population of these arrondissements[1] is estimated by the *Système d'Alerte Précoce* (SAP) to be 97,800. Elsewhere, this year's good rains and exceptional harvest have significantly reduced the number of areas falling into the vulnerable category. For instance, areas that were recently quite vulnerable in northern Kayes, northern Koulikoro, and northern Ségou and Mopti are doing much better this year and do not show signs of stress.

- Gargando and Raz-el-Ma arrondissements are judged to be vulnerable because of low household stocks, significant damage by rodents to rice crops, and the fact that these arrondissements are generally cereal production deficit areas.

- In N'Tillit, there has been an outbreak of Pasteurellosis among small-stock herds, and the area almost always has a cereal production-to-consumption shortfall.

- Markets in Talataye Arrondissement are showing a worrisome rise in the price of both cereals and livestock prices, according to SAP. Households have increased their consumption of foraged foods, such as wild *fonio* and *Boscia sengalensis*, to compensate for high prices and low food stocks. It is not entirely clear whether the famine-coping strategies reported by SAP in Talataye Arrondissement are in response to an impending crisis or are economic strategies developed to cope with the usual cereal production deficits of this area.

- The arrondissements of Almoustarat, Bamba, and Temera in Bourém Cercle are reporting a 58 percent increase in the number of visits to Infant Nutrition Centers (CREN), and an increase in the consumption of gathered wild grains and foods, including wild *fonio*, *cram cram*, and lily pads. There are also reports of increased migrations by local populations in search of food and work as agricultural laborers to help compensate for normal cereal production shortfalls. Again, it is not entirely clear whether these famine coping strategies are in response to perceived food shortages or are economic strategies developed to cope with the usual cereal production shortfalls of the area.

- There are reports of increased migration of households from Ménaka Central Arrondissement south towards Andéramboukane and Niger. These increased migrations could be

[1] In Mali, the administrative unit hierarchy is regions, followed by cercles, and then arrondissements.

in response to a decline in the accessibility of food in the area. In addition, Inékar and Tidarméne arrondissements are reporting a mediocre garden harvest and increases in cereal prices in markets along with a drop in cereal quality.

In addition to the nine arrondissements described above, SAP has named two other arrondissements as being at-risk: Diamou and Touroungoumbé in Kayes Region. SAP recommends emergency food deliveries to all 11 arrondissements starting in June and July of 1989, the population of which totals about 123,600. NDVI (Normalized Difference Vegetation Index, see inside back cover) levels for 1988 were significantly above normal in Tourongoumbé, however, and well within the average range for Diamou Arrondissement, while 1988 rainfall was between 80 and 120 percent of the 30-year norm in both areas. The rainfall and NDVI imply that conditions were quite good for range development and crop production in these areas. With such evidence and no other indication that there were extensive pest damage, floods, or other factors reducing either rangelands or cereal production, it is difficult to judge these two arrondissements as vulnerable to famine.

In general, in the areas designated as potentially at-risk, the food security situation is not extremely serious. In order to be prepared for any shortfalls, however, it will be essential that the Government of Mali (GOM) and the Mali Office of Agricultural Production (OPAM) preposition stocks in areas that have been identified as possibly having problems. This must be completed before the onset of the rains. If an emergency should occur, the first manifestation will most likely be a rapid increase of cereal prices in the markets that would put grains out of reach for some of the population. SAP maintains that if its recommendations of food distributions are followed, there will be very little chance of an emergency occurring.

II. Causes of Reduced/Increased Access to Food

Methodology: Causes of Reduced or Increased Access to Food

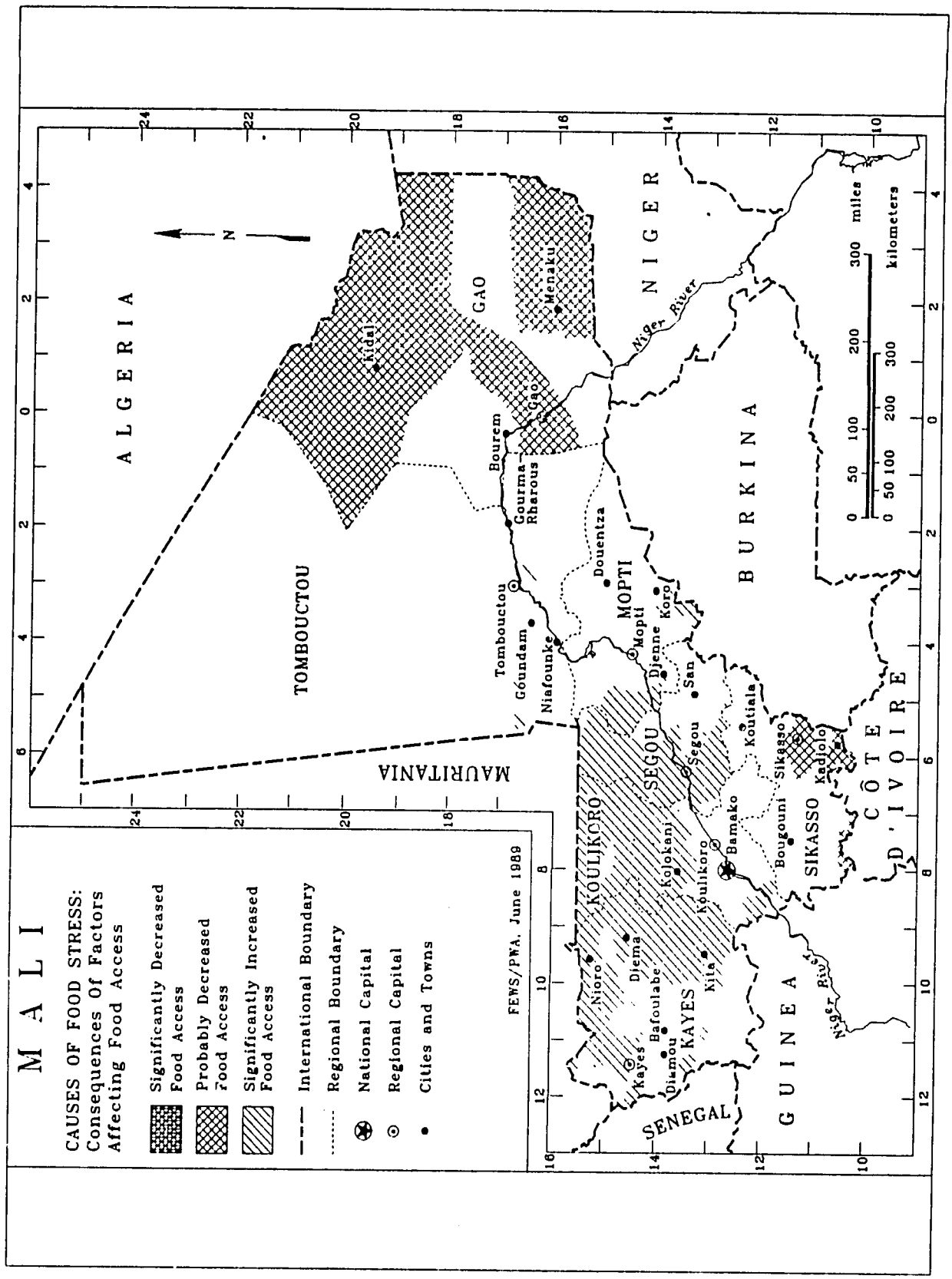
Food is acquired through production, exchange, or transfer (gifts). Many factors, including rainfall, pests, floods, and warfare, can affect these acquisition mechanisms. This section provides a qualitative assessment of these factors and their likely impact on food access.

The areas showing some probability of decreased access to food are primarily found in eastern and northeastern Mali (see Map 2). Their status is a consequence of several factors: a) the low level of **emergency food stocks** located in these areas, b) below average **rainfall** and average or below average **growing conditions**, and c) the cumulative effects of **chronic food stress**.

Only in Mopti Region were OPAM emergency stocks large enough to significantly improve the population's access to food. Other food transfers and exchanges included in the analysis of causes were too small to have any appreciable affect on any location's food security. SAP recommendations for food distributions were not considered in this analysis, however, since it is not certain that the recommendations will be followed by the GOM.

A second set of indicators used to assess vulnerability were rainfall data and the difference between the maximum NDVI levels for 1988 and the average of maximum NDVI levels for each year from 1982 through 1987. Together, these indicators provide evidence of generally good growing conditions. In Mali, the 1988 NDVI levels are significantly higher than the six year norm, with the exception of northern and northeastern Mali. The boundary between low 1988 rainfall and average rainfall falls further south, along a line cutting from southeastern corner of the Mauritania-Mali border through the town of

Map 2


MALI
CAUSES OF FOOD STRESS:
Consequences Of Factors
Affecting Food Access
Significantly Decreased Food Access
Probably Decreased Food Access
Significantly Increased Food Access
International Boundary
Regional Boundary
National Capital
Regional Capital
Cities and Towns
FEWS/PWA, June 1989
ALGERIA
MAURITANIA
NIGER
BURKINA
GUINEA
SENEGAL
CÔTE D'IVOIRE
TOMBOUCTOU
GAO
MOPTI
SEGOU
KOULIKORO
KAYES
SIKASSO
Kidal
Menaka
Gao
Bourem
Gourma Rharous
Tombouctou
Goundam
Niafounke
Douentza
Mopti
Djenne
Koro
San
Segou
Koutiala
Sikasso
Kadiolo
Bamako
Bougouni
Kolokani
Koulikoro
Nioro
Djema
Bafoulabe
Kayes
Diamou
Kita
Niger River
0 50 100 200 300 miles
0 50 100 200 300 kilometers
N

Mopti. This implies that northern and northeastern Mali had mediocre growing conditions during 1988 and that it is also possible that the area just to the south had mediocre growing conditions.

It is generally held that vulnerability is not necessarily the result of a single bad harvest, but rather that vulnerability increases over time with a series of poor or mediocre harvests following each other in close succession. The use of a measure that accounts for stocks over time is important because it attempts to take into account granary reserves that, in an ideal situation, would be available to households during years of poor harvest. In an effort to gauge the cumulative effect of food stress, a measure was developed which compares the position of cumulative stocks by cercle for the last three years (1986/1988) to the cumulative stocks of the previous, overlapping three years (1985/1987). Using this measure, the cumulative stock position for Mali as a whole is generally better in 1989 than it was in 1988. In other words, the trend of production-to-population is up over the last three years. However it must be kept in mind that this measure uses as its base cercle production, which is interpolated data. The conclusions must therefore be taken with caution.

III. Food Accounting

Methodology: Food Accounting

A quantitative account of all estimable food resources (production and aid) available for consumption until harvest is calculated using cercle-level data. Seed, feed, post-harvest losses, exports, and consumption-to-date are subtracted from this account. The months of food remaining are then calculated by dividing the food resources by the consumption rate (population times monthly consumption rate). Inadequate food access is assumed if stocks fall short of needs until harvest.

Large areas of Mali are identified as having inadequate access to food (see Map 3). They fall into two categories: cercles where production is indeed lower than what is required by their populations, and cercles where the food requirements of urban centers such as Bamako and Mopti overwhelm the contribution to food stocks from local production.[1] In total, however, national cereal production levels for 1988 are sufficient to meet Mali's food needs.

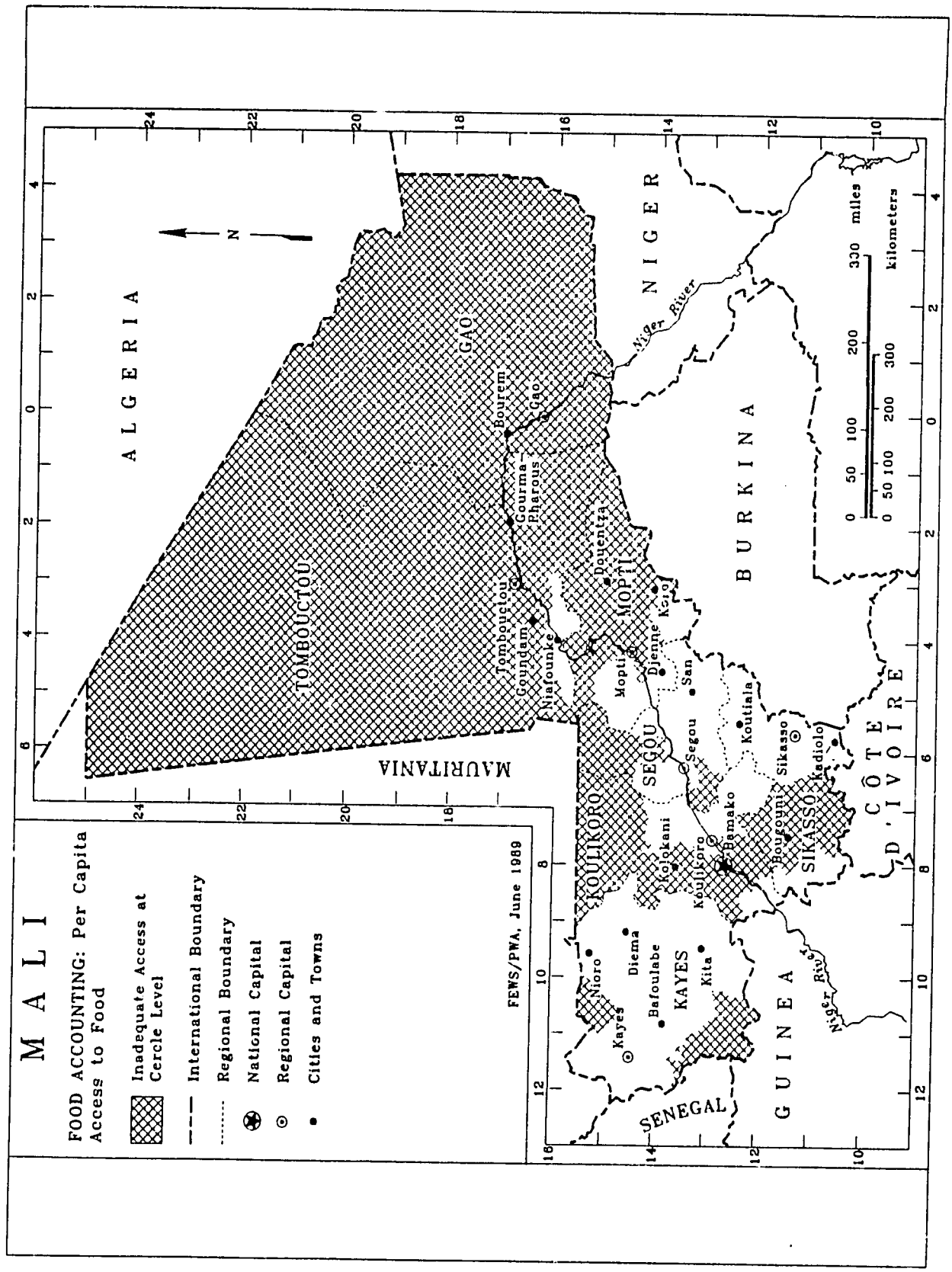
In previous years, only regional level production data has been available for Mali. Because of the enormous size of regions in Mali, however, production data at this level is of little use in assessing the impact of production on local populations. Recently, cercle level cereal production data has become available for 1985 to 1987. This level of data provides a much better picture of production variation across the country (there are over 40 cercles in Mali, which aggregate into only seven regions). In an effort to bring 1988 cereal production data to the same administrative level, the regional estimates were reapportioned on the basis of the average cereal production produced in each cercle during the period from 1985 to 1987. Because only three years of cercle level data is available for this calculation, however, the interpolated production figures must be viewed with caution. The use of these estimated production figures may account for some of the anomalies seen in Map 3.

All cereals were included in calculating the food accounts, although parastatal or "modern sector" rice production was reduced by one third to cover the cost of inputs which are assessed to tenants. Private commercial stocks were not included in the Food Accounting because of a lack of data on the sale or movement of commercial stocks in Mali. Transfers (food aid) programmed by non-governmental agencies were included, however.

Mali is not planning to request external food assistance, although emergency food distributions will be made to settlements of displaced popula-

[1]The fact that the data at the cercle level is interpolated from regional data inserts some anomalies into the picture. This is particularly true for Bougouni and Kolondiéba cercles, which from 1975 to 1987 had generally been able to meet their needs.

Map 3


MALI
FOOD ACCOUNTING: Per Capita Access to Food
Inadequate Access at Cercle Level
International Boundary
Regional Boundary
National Capital
Regional Capital
Cities and Towns
FEWS/PWA, June 1989
ALGERIA
MAURITANIA
NIGER
BURKINA
GUINEA
SENEGAL
D'IVOIRE
CÔTE
TOMBOUCTOU
GAO
MOPTI
SEGOU
KOULIKORO
SIKASSO
KAYES
Niger River
Bourem
Gao
Gourma-Pharous
Tombouctou
Goundam
Niafounke
Douentza
Mopti
Djenne
Kona
San
Segou
Koutiala
Sikasso
Kadiolo
Bougouni
Bamako
Koulikoro
Kolokani
Nioro
Diema
Bafoulabe
Kayes
Kita
Niger River
N
0 50 100 200 300 kilometers
0 50 100 200 300 miles

tions in Ségou and Niono cercles of Ségou Region. There are plans to conduct a survey of the displaced population in the Ségou Region to have a more accurate socio-economic profile of that population and to obtain data on the reasons for and length of their dislocation.

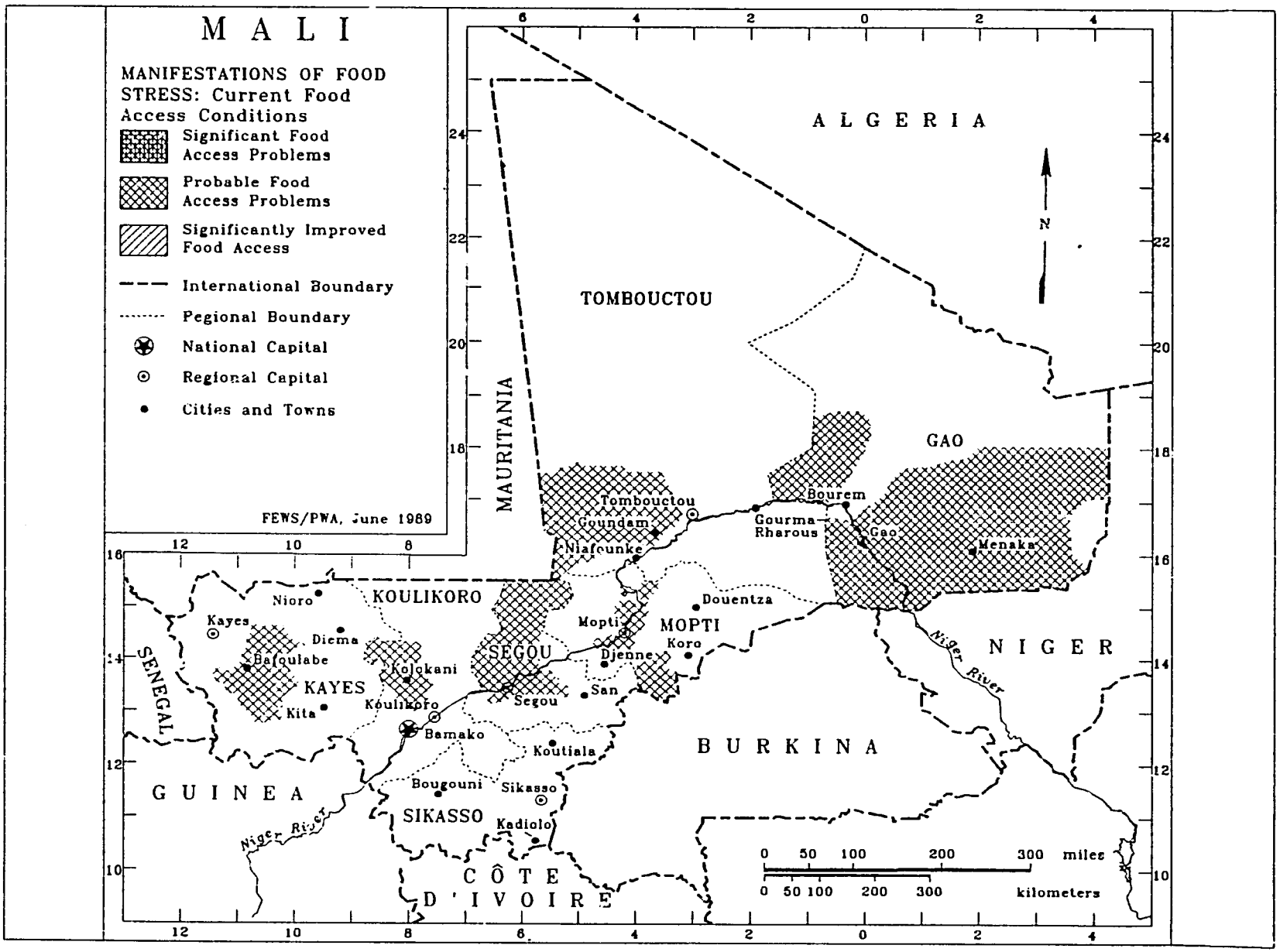
IV. Manifestations of Reduced Access to Food

Methodology: Manifestations of Reduced or Increased Access to Food

Populations may manifest their current vulnerabilities to famine by their physical and socio-economic reactions to food access conditions. Based upon observed behaviors and conditions compared to a reference baseline, a subjective judgement is made of their degree of vulnerability.

The assessment of the manifestations of food stress in Mali is based on cercle level cereal **market prices** and the **SAP list of vulnerable areas**. The analysis of cereal price data compares the change in cereal prices from December 1986 to April 1987 with price changes in the same markets from December 1988 to April 1989.

The manifestations of reduced access to food found this year (see Map 4) can be divided into two zones. South of the axis cutting through Bafoulabe and Djenne, fairly high cereal prices areas imply that the area may probably experience food access problems before the next harvest. North of that zone, the combination of high prices and findings by SAP that the areas are at-risk provides a slightly stronger indication of potential food access problems during the 1989 lean season.


MALI
MANIFESTATIONS OF FOOD STRESS: Current Food Access Conditions
Significant Food Access Problems
Probable Food Access Problems
Significantly Improved Food Access
International Boundary
Regional Boundary
National Capital
Regional Capital
Cities and Towns
FEWS/PWA, June 1989
ALGERIA
TOMBOUCTOU
GAO
MAURITANIA
SENEGAL
GUINEA
KOULIKORO
KAYES
SEGOU
MOPTI
SIKASSO
BURKINA
NIGER
CÔTE D'IVOIRE
Tombouctou
Goundam
Niafounke
Bourem
Gourma Rharous
Gao
Menaka
Douentza
Mopti
Koro
Djenne
Nioro
Kayes
Diema
Bafoulabe
Kolokani
Kita
Koulikoro
Bamako
Segou
San
Koutiala
Bougouni
Sikasso
Kadiolo
Niger River
0 50 100 200 300 miles
0 50 100 200 300 kilometers

APPENDIX 1

Mechanics of the Vulnerability Assessment

All available indicator data of major significance to the food security of Mali was gathered and analyzed for significance. The geographic boundaries for each were mapped as accurately as possible. Using a computer-based Geographic Information System (ArcInfo), the indicator maps were scored according to a three position scale of food stress to indicate whether they showed 1) an obvious cause of food stress, 2) no obvious food stress or significant increase in food access, or 3) a significant increase in food access (only applicable in areas without stress).

All indicators relating to "Causes" of food stress were overlaid to produce a summary surface of food stress as seen by these indicators (Map 2). A similar process was used for all indicators relating to "Manifestations" of food stress (Map 4). For the food accounting analysis, areas were mapped and scored as having adequate or inadequate access depending upon whether all food resources identified met assumed food needs (Map 3).

In a final step, the "Causes", "Manifestations", and "Food Accounting" summary maps were themselves overlaid for a grand summary of "Food Access" (Map 1). Analysts were free to use subjective criteria in applying food stress scores at each stage based upon their best judgments.

APPENDIX 2

Indicators Used in the Mali Vulnerability Assessment

NDVI - Growing Conditions: The 1988 NDVI maximum was compared to the normal (1982-1987) yearly maximum. All areas significantly higher or lower (+/- 0.05 NDVI) than normal were identified. Areas of sparse vegetation (less than 0.1 NDVI) were excluded from this analysis. Sources: NOAA/NASA GAC NDVI.

Rainfall: 1988 cumulative rainfall was compared to the 30 year normal historic cumulative rainfall. All areas receiving more than 120 percent or less than 80 percent of normal were identified. Areas where 1988 cumulative rainfall was less than 200 mm were excluded from this analysis. Sources: Joint Agriculture Weather Facility, Government of Mali (GOM) Meteorological Service.

Cereal Price Behavior: The average of December 1988 to April 1989 cercle-level millet prices was compared to the average of December 1986 to April 1987 prices. Where the current average was greater, food access was judged to have declined; where less, food access was judged to have improved. Source: *Système d'Alerte Précoce.*

Food Production Trend: Cercle production figures for the last four years were compared for trends and for per capita production figures. Source: Ministry of Agriculture.

Food Stock Reserves: These were noted for their bearing on food security and were mapped. Source: GOM/OPAM.

Health and Nutrition Data: None reported.

Conflict/Civil Disruption: None reported.

Areas Reported as Requiring Food Aid: Food access was judged to be poor in areas reported requirement of food aid. Source: *Système d'Alerte Précoce.*

Food Accounting Notes: Net harvest includes sorghum, miliet, rice, and *fonio*, and is estimated at the cercle level. The food accounting includes distributions of emergency food aid for 1988 lean period and post-1988 harvest season, but assumes no carryover of stocks from 1987-88 and does not count imports or off-season production. Rate of consumption used is 181 kg per person per year. Population is based on 1987 census and brought forward to June 1989. Date of harvest assumed to be October 15. Amount of cereals consumed is based on the June 1989 population times seven and one-half months of consumption to give amount consumed from harvest until June 1. Sources: GOM/Ministry of Agriculture, USAID/Bamako, UNICEF, *Medecins Sans Frontiers.*

Key Terms

At Risk - FEWS Reports employ the term "at risk" to describe those populations or areas either currently or in the near future expected to be lacking sufficient food, or resources to acquire sufficient food, to avert a nutritional crisis (i.e., a progressive deterioration in their health or nutritional condition below the status quo), and who, as a result, require specific intervention to avoid a life-threatening situation.

Where possible, food needs estimates are included in the FEWS reports. It is important to understand, however, that no direct relation exists between numbers of persons at risk and the quantity of food assistance needed. This is because famines are the culmination of slow-onset disaster processes which can be complex in the extreme. The food needs of individual populations at risk depend upon when in the disaster process identification is made and the extent of its cumulative impact on the individuals concerned. Further, the amount of food assistance required, whether from internal or external sources, depends upon a host of considerations. Thus the food needs estimates presented periodically in FEWS reports *should not* be interpreted to mean food aid needs, e.g., as under PL480 or other donor programs.

ITCZ - The Intertropical Convergence Zone (ITCZ) is where the high pressure system originating in equatorial regions of the Atlantic (the St. Helena's High) collides with the Azores High descending from the north. The ITCZ tends to move northward during the spring and summer in response to normal global weather patterns. The position of the ITCZ normally defines the northern limits of possible precipitation in the Sahel; rainfall generally occurs 100 to 300 kilometers south of the ITCZ.

NDVI - Normalized Difference Vegetation Index (NDVI) images are created at the laboratory of the National Aeronautic and Space Administration (NASA) Global Inventory Modeling and Monitoring System (GIMMS). These images are derived from Global Area Coverage (GAC) imagery (of approximately 4 km resolution) received from the Advanced Very High Resolution Radiometer (AVHRR) sensors on board the National Oceanic and Atmospheric Administration (NOAA) Polar Orbiting series of satellites. The polar orbiter satellites remotely sense the entire Earth and its atmosphere once each day and once each night, collecting data in 5 spectral bands. Bands 1 and 2 sense reflected red and infra-red wavelengths respectively, and the remaining 3 bands sense emitted radiation in 3 different spectral bands. The NDVI images are created by calculating

$$(\text{infrared} - \text{red}) / (\text{infrared} + \text{red})$$

for each pixel from the daytime satellite passes. Since chlorophyll reflects more in the infrared band than in the red band, higher NDVI values indicate the presence of more chlorophyll and, by inference, more live vegetation. A composite of daily NDVI images is created for each 10-day period, using the highest NDVI value for each pixel during that period. This technique minimizes the effects of clouds and other forms of atmospheric interference that tend to reduce NDVI values. NDVI is often referred to as a measure of "greenness" or "vegetative vigor." The NDVI images are used to monitor the response of vegetation to weather conditions.