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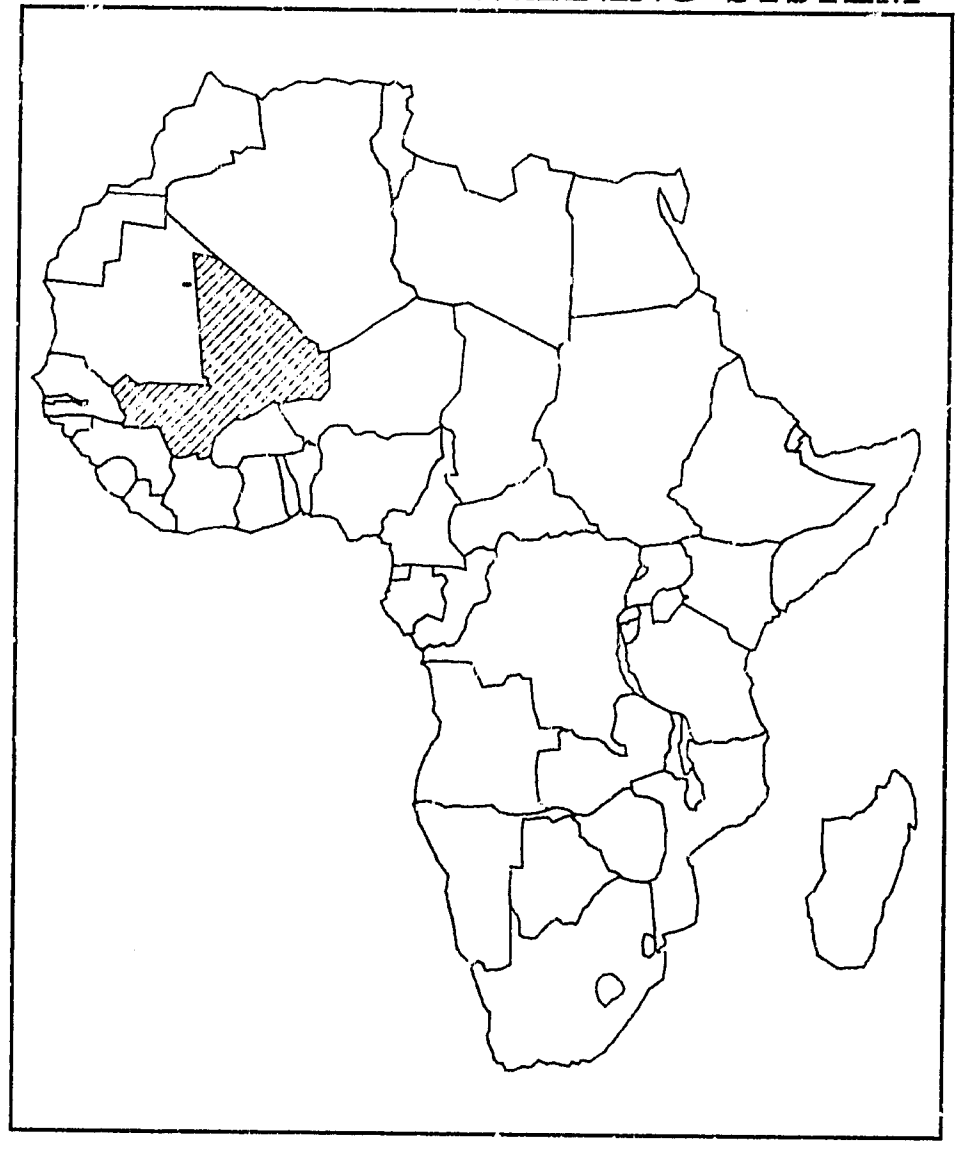
FEWS Country Report

JUNE 1988

# MALI

## VULNERABILITY ASSESSMENT

FAMINE EARLY WARNING SYSTEM



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

# FAMINE EARLY WARNING SYSTEM

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

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# MALI

## Vulnerability Assessment

## June 1988

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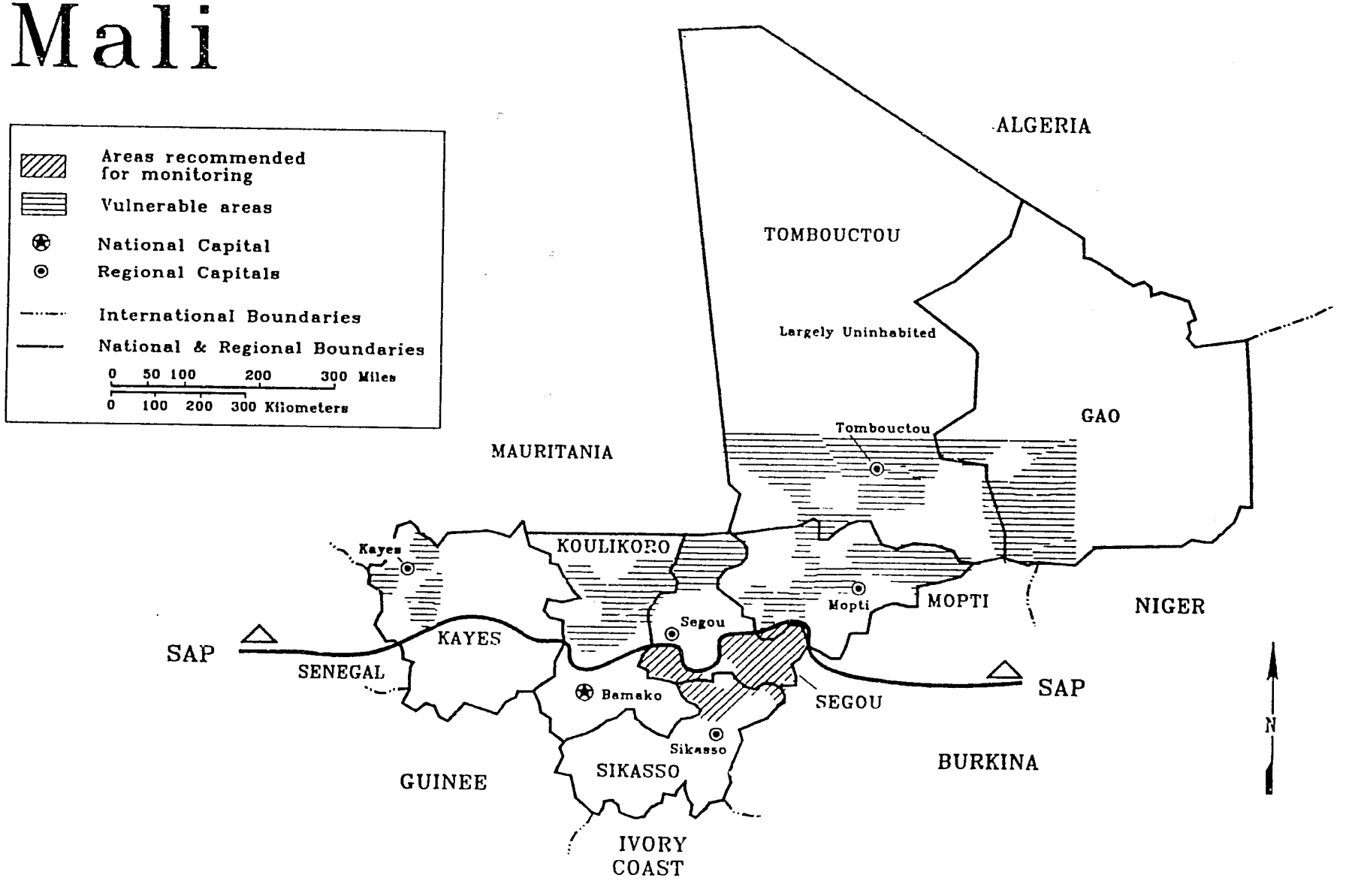
Map 1: Summary




Source: NASA NDVI Imagery
FEWS/PWA, June 1988

# Vulnerability Assessment

## SUMMARY

Some areas throughout northern Mali continue to be vulnerable because of low stocks and high prices. These are areas that historically have poor and undependable production. The Système d'Alerte Précoce (SAP) monitors most of the historically vulnerable areas of Mali (the northern half of Kayes, Koulikoro, and Segou Regions and all of Mopti, Tombouctou, and Gao Regions). It has identified specific arrondissements at risk distributed throughout this area (see Map 1). The following assessment also suggests that there are areas not within the zone of SAP's purview that have also experienced erratic and inadequate production and might require monitoring during the growing season. These areas include the southern half of Segou Region and northeastern Sikasso Region.

## CURRENT SITUATION

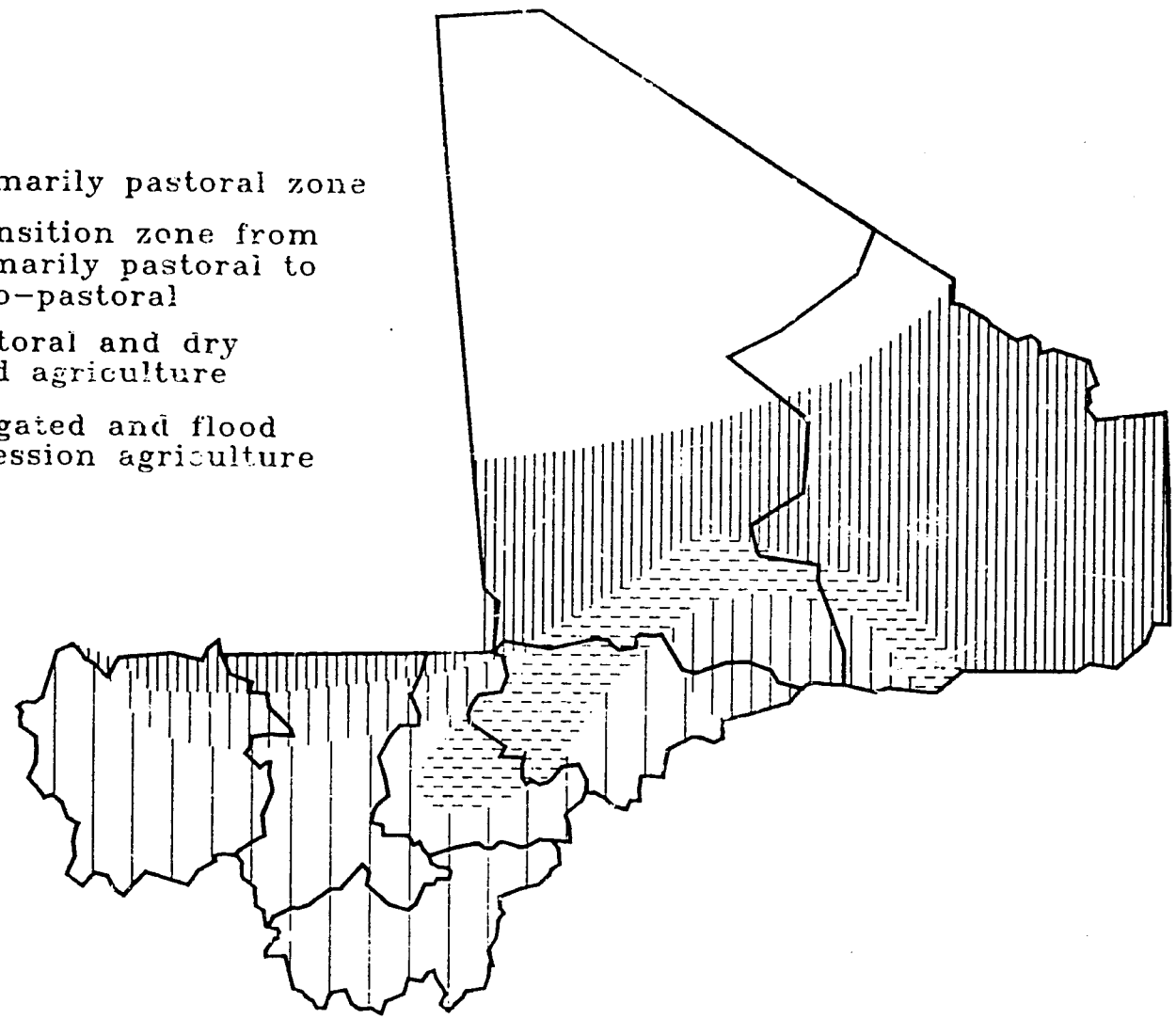
The United Kingdom Meteorological Service predicts that there is an 88% probability that the Sahel will receive less than 75% of its 30 year average rainfall. This forecast is based on an analysis of Atlantic Ocean sea-surface temperature anomalies during March and April of this year. USAID/ Washington has approved 5,000 metric tons (MT) of grain for Mali and has approved the USAID mission's request to modify its budget, allocating $500,000 so it can participate in the Emergency Locust/Grasshopper Assistance Program. Half of these funds will be used for Desert Locust control and the remainder for grasshopper control. The National Committee for Drought Relief (CNAUR) is distributing the first half of a planned total of 49,240 MT of grain. Koulikoro has received 466 MT, Segou 1,077 MT, Mopti 5,330 MT, Tombouctou 3,204 MT, and Gao 892 MT.

## PRE-SEASON ASSESSMENT OF VULNERABILITY TO FAMINE

Areas of high vulnerability in Mali are concentrated in the region already monitored by SAP (generally north of 14° N). Of special concern are northern Kayes, central Koulikoro, northern Segou, most of Mopti and much of Tombouctou and Gao Regions. These areas are characterized by poor to inadequate cereal stocks, high prices, limited other resources, and current food assistance. While pastoralism dominates in the northern tier of this area (see Map 2), grain is the primary component of the pastoralist diet. Thus, grain production, prices and stocks are important in judging vulnerability there.

The identification of these areas as vulnerable is no surprise. Historically, these same areas have had undependable and inadequate production. Similarly, satellite images suggest high variability of vegetation from year to year and generally low vegetative potential. Inferences on the historic

# The Relative Importance of Pastoralism




FEWS/PWA, June 1988

dependability and adequacy of pasturage, as well as agriculture, confirm the historic vulnerability of these areas.

The purpose of this report is to define the nature and relative degree of pre-rainy season vulnerability to famine in Mali. Specifically, this assessment will:

- indicate what food security-related data are available for Mali and the degree of confidence that can be put in them;

- examine structural vulnerabilities to famine in sub-national areas of Mali; and,

- describe:
  - current conditions of food security in these areas
  - the possible impact of differing agricultural season events

Measures of vulnerability to famine will be examined and mapped. Manifestations of food shortages will be similarly mapped and compared with the measures to see how well they conform. Finally, relative vulnerabilities will be noted by cercle and arrondissement, the administrative subdivisions. Definitions and assumptions about measuring vulnerability to famine, upon which this assessment is based, are found in the Appendix.

## Measures of Vulnerability

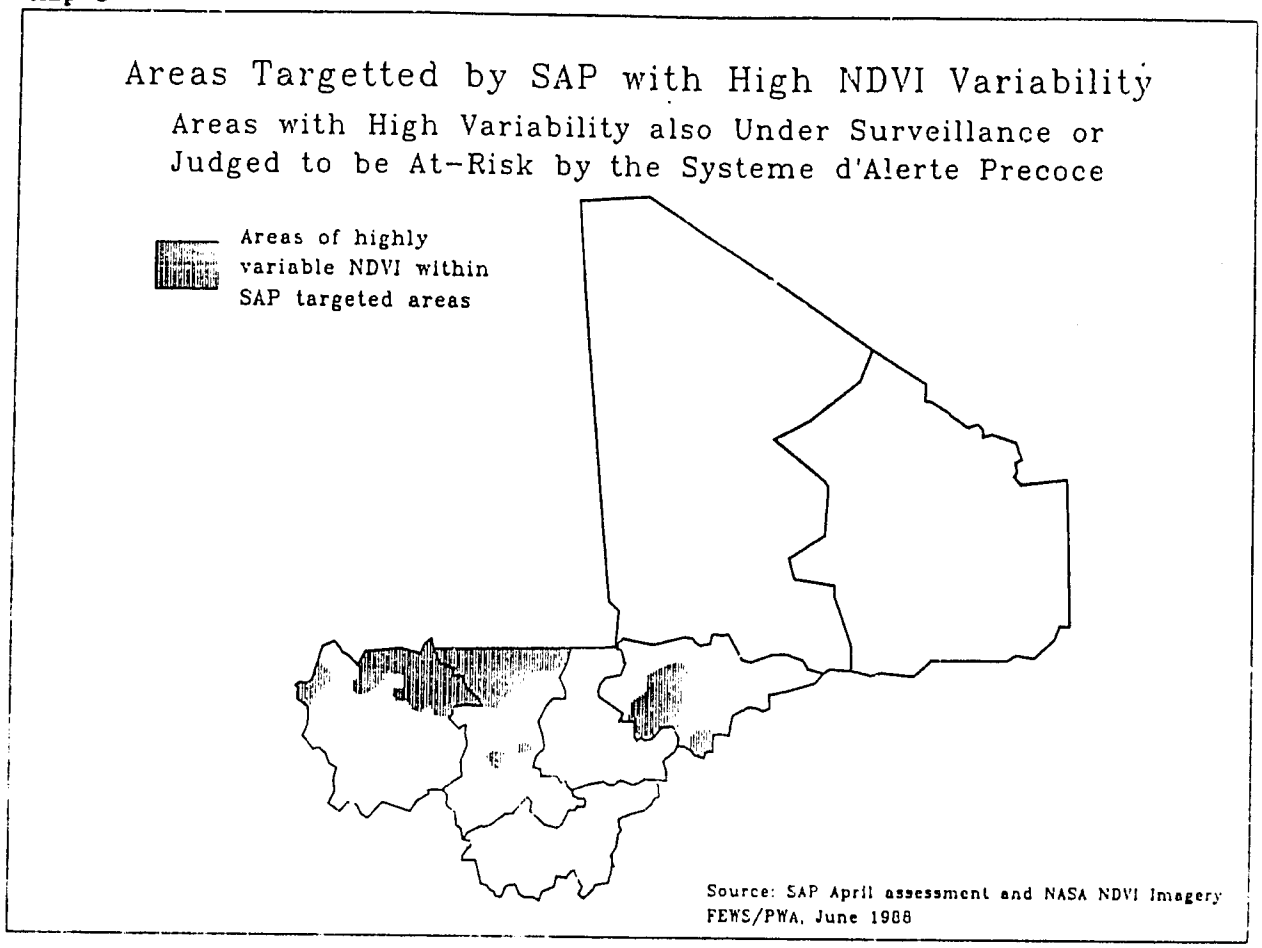
There are areas of relatively high agricultural variability, as inferred from satellite imagery of vegetation (Normalized Difference Vegetative Index or NDVI, see inside back cover), that lie within the Cercles designated by SAP as "at risk" (see Maps 3 and 4). However, a similar overlay analysis (with a wider scope) suggests that areas south of SAP's area of purview also have experienced high vegetative variability and low average NDVI. As shown in Map 5, these areas include a southern crescent around the Niger River Delta in Segou Region and northeastern Sikasso Region.

Using regional production data for 1975 through 1987, the administrative regions of Mali fall naturally into three categories: low production variability with low per capita production, high variability with low per capita production, and high variability with high per capita production. As shown in Map 6, only Segou and Sikasso Regions (not shaded) have had relatively high per capita production. Obviously, any underlying variability within Segou and Sikasso would be obscured by regional level production data. Data on regional production variability are broad and generalized and do not allow any assessment of production at the cercle or arrondissement level.

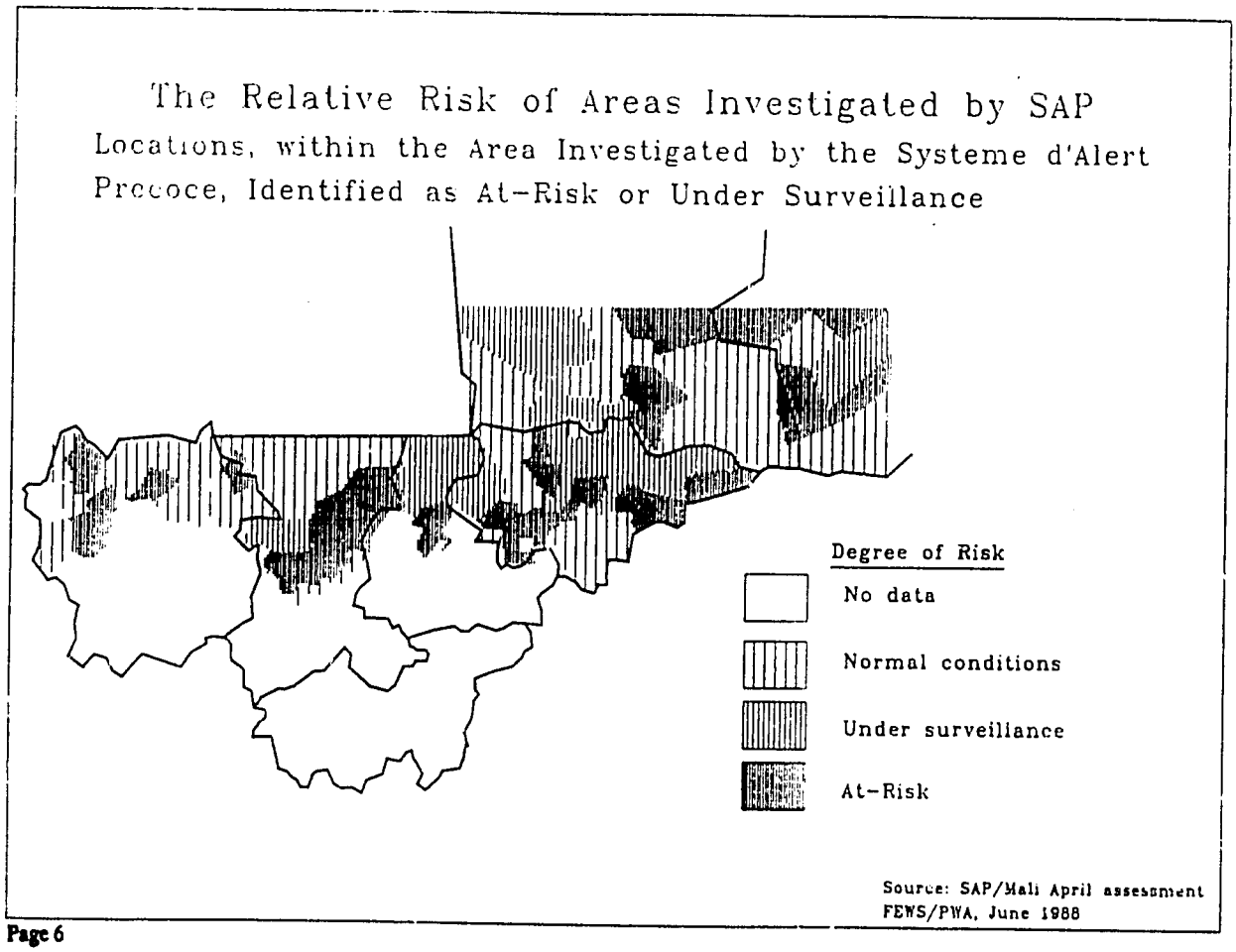
A preliminary assessment of historical agricultural vulnerability is presented in Map 7, which merges satellite imagery (NDVI) and production data. Some northern areas within Regions of high productivity have been subject to high NDVI variability and are situated in areas at the low end of the NDVI gradient. The implication is that these subareas do not provide much to regional production. As mentioned above, some of these areas fall within Segou Region. Segou has the highest per capita production of grain in Mali. Within Segou, these areas probably experience relatively low per capita production.

The historic dependability and adequacy of the local food production process (how production has varied from year to year and the amount of its usual contribution to the population's food needs) can inform and support findings of vulnerability from indicators of the current situation. An assessment of

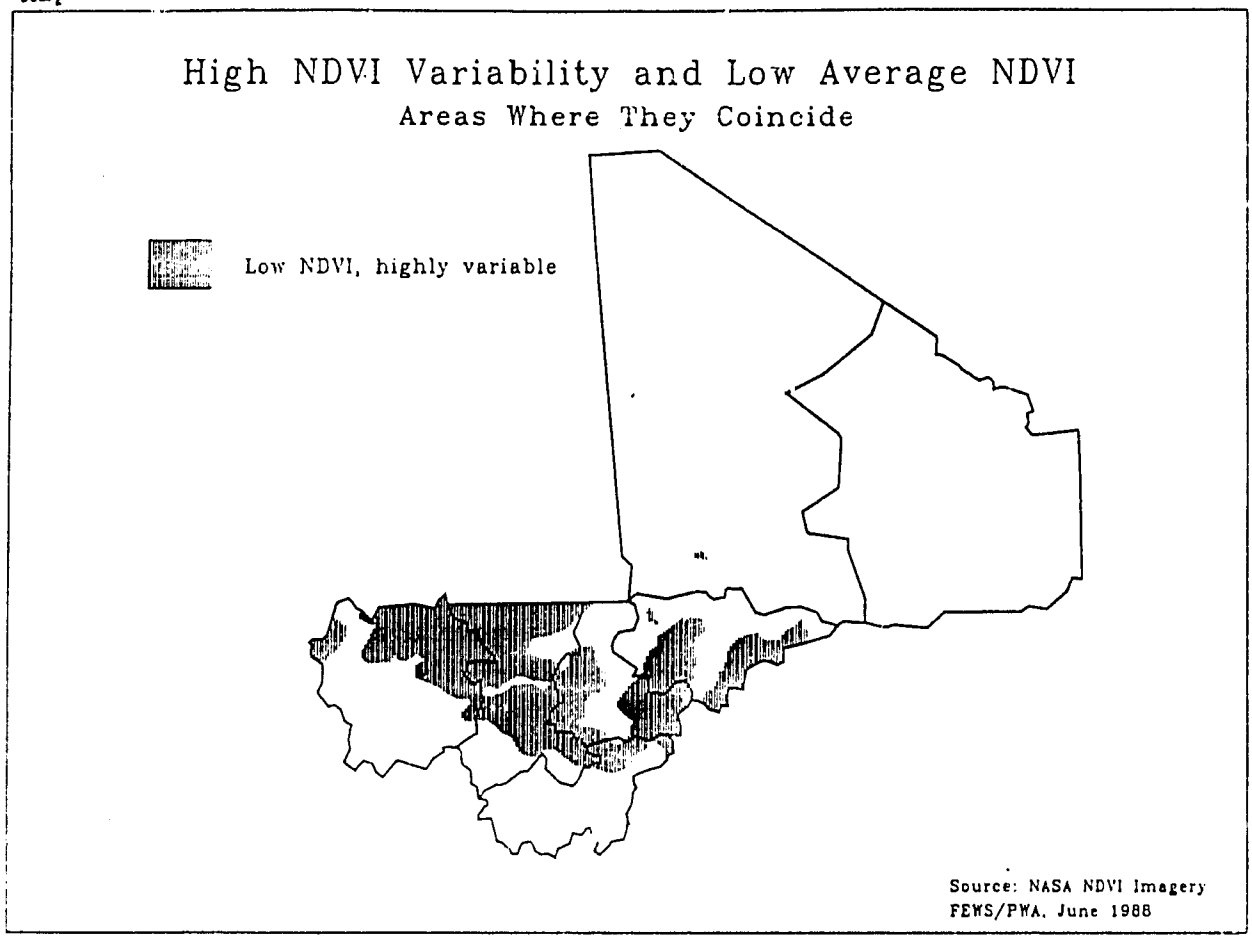
Map 3


Areas Targetted by SAP with High NDVI Variability
Areas with High Variability also Under Surveillance or Judged to be At-Risk by the Systeme d'Alerte Precoce
Areas of highly variable NDVI within SAP targeted areas
Source: SAP April assessment and NASA NDVI Imagery
FEWS/PWA, June 1988

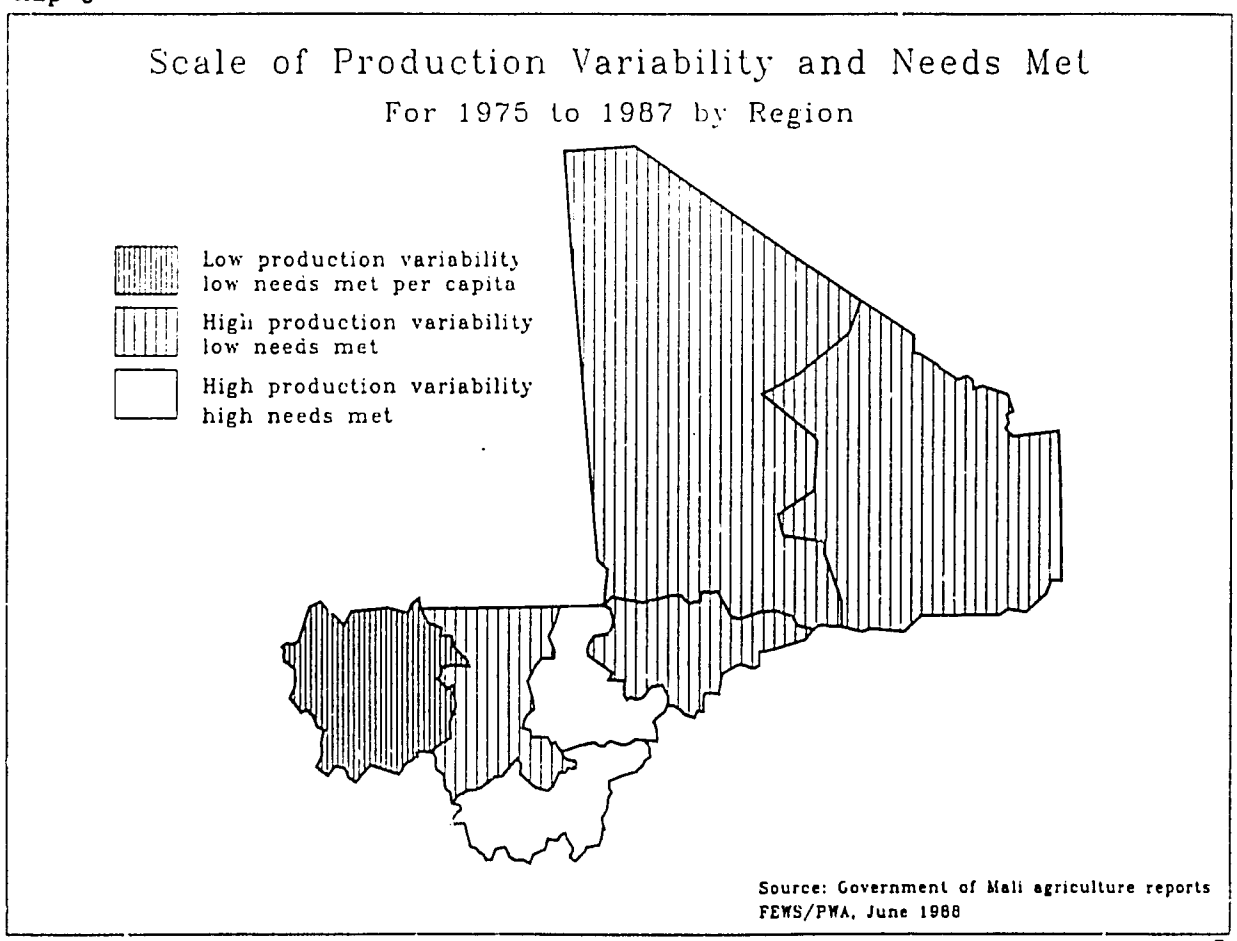
Map 4


The Relative Risk of Areas Investigated by SAP
Locations, within the Area Investigated by the Systeme d'Alert Precoce, Identified as At-Risk or Under Surveillance
Degree of Risk
No data
Normal conditions
Under surveillance
At-Risk
Source: SAP/Mali April assessment
FEWS/PWA, June 1988

Map 5

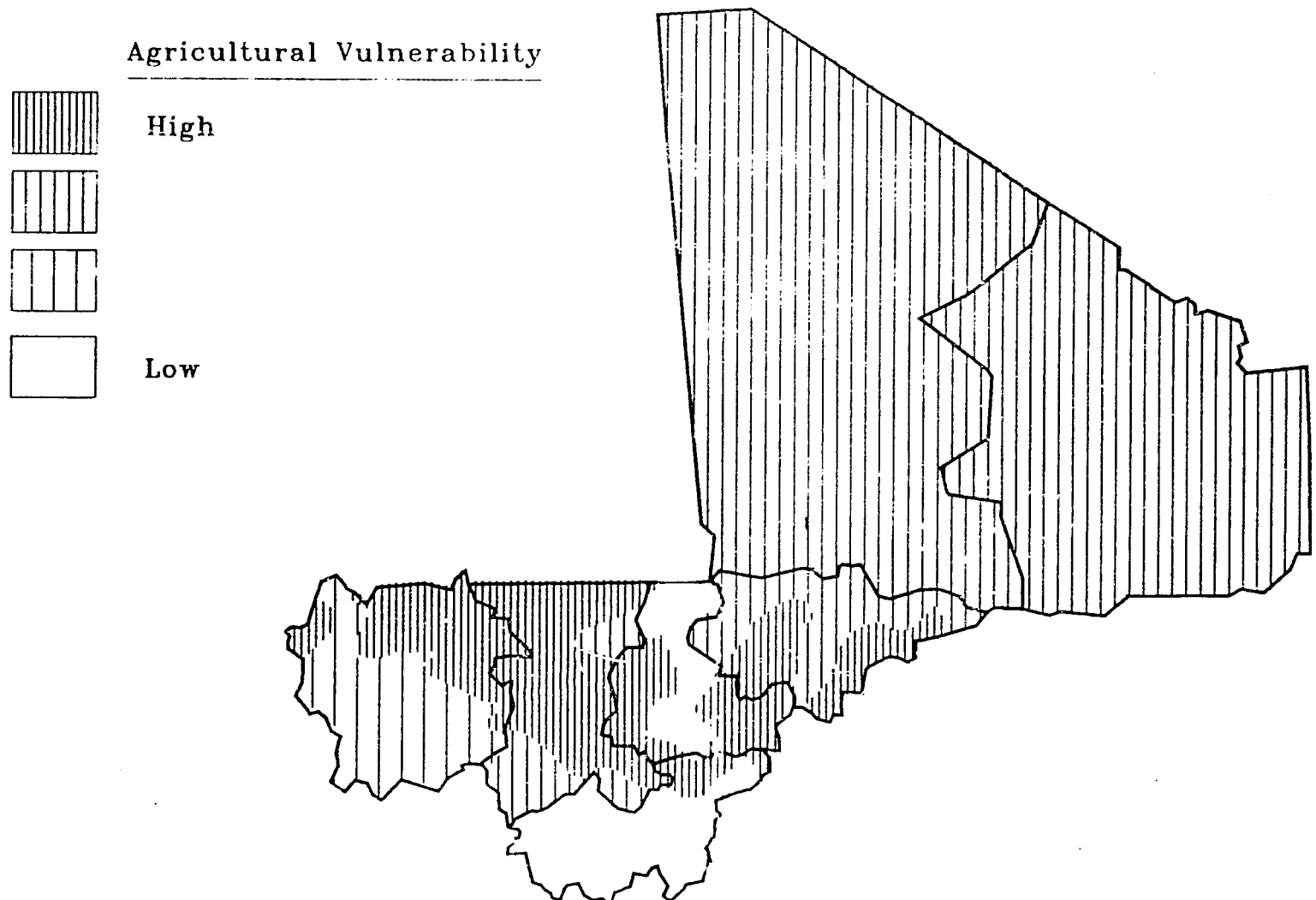

High NDVI Variability and Low Average NDVI
Areas Where They Coincide
Low NDVI, highly variable
Source: NASA NDVI Imagery
FEWS/PWA, June 1988

Map 6


Scale of Production Variability and Needs Met
For 1975 to 1987 by Region
Low production variability
low needs met per capita
High production variability
low needs met
High production variability
high needs met
Source: Government of Mali agriculture reports
FEWS/PWA, June 1988

# Relative Agricultural Vulnerability

## Convergence of Production and Satellite Data to Assess Relative Dependability and Adequacy of Agricultural Systems




Source: NASA NDVI Imagery, Ministry of Agriculture
FEWS/PWA, June 1988

food sources other than production contributes to an understanding of current food supply prospects, although data on such sources are scarce. In addition to production, there are two other general ways food can be obtained: (1) drawing from existing food stocks and (2) purchasing food (using remittances or the proceeds of wage labor or cottage industry). If these two other methods do not normally cover production deficits, vulnerability to famine will be high.

There are significant differences among the available estimates of regional agricultural production (1975 to 1987). Grain production data in Mali are estimated by both the National Agriculture Bureau (DNA) and the National Bureau of Statistics and Computer Sciences (DNSI), both of which use different methodologies. Their estimates can differ by 20% or more, as they did in 1987. The final, government of Mali (GOM) estimate for 1987 production was arrived at through negotiations between the two agencies.

Grain production is, nevertheless, naturally and necessarily a key element of this vulnerability assessment. At least 53% of the average Malian diet is supplied by millet and sorghum, 11% by rice, 5% by corn, and just under 2% by wheat. The rest of the Malian diet is comprised of milk, milk products, meat, beans, root crops, vegetables and wild foods. Production statistics for these non-grain food items are either not available or not reliable. While their impact on vulnerability to famine must be significant, it cannot, at this point, be measured. This gap in our knowledge of the food acquisition process is of particular consequence in times of food stress, when there is an increase in the consumption of wild and gathered foods.

**Variability of Agricultural Production**

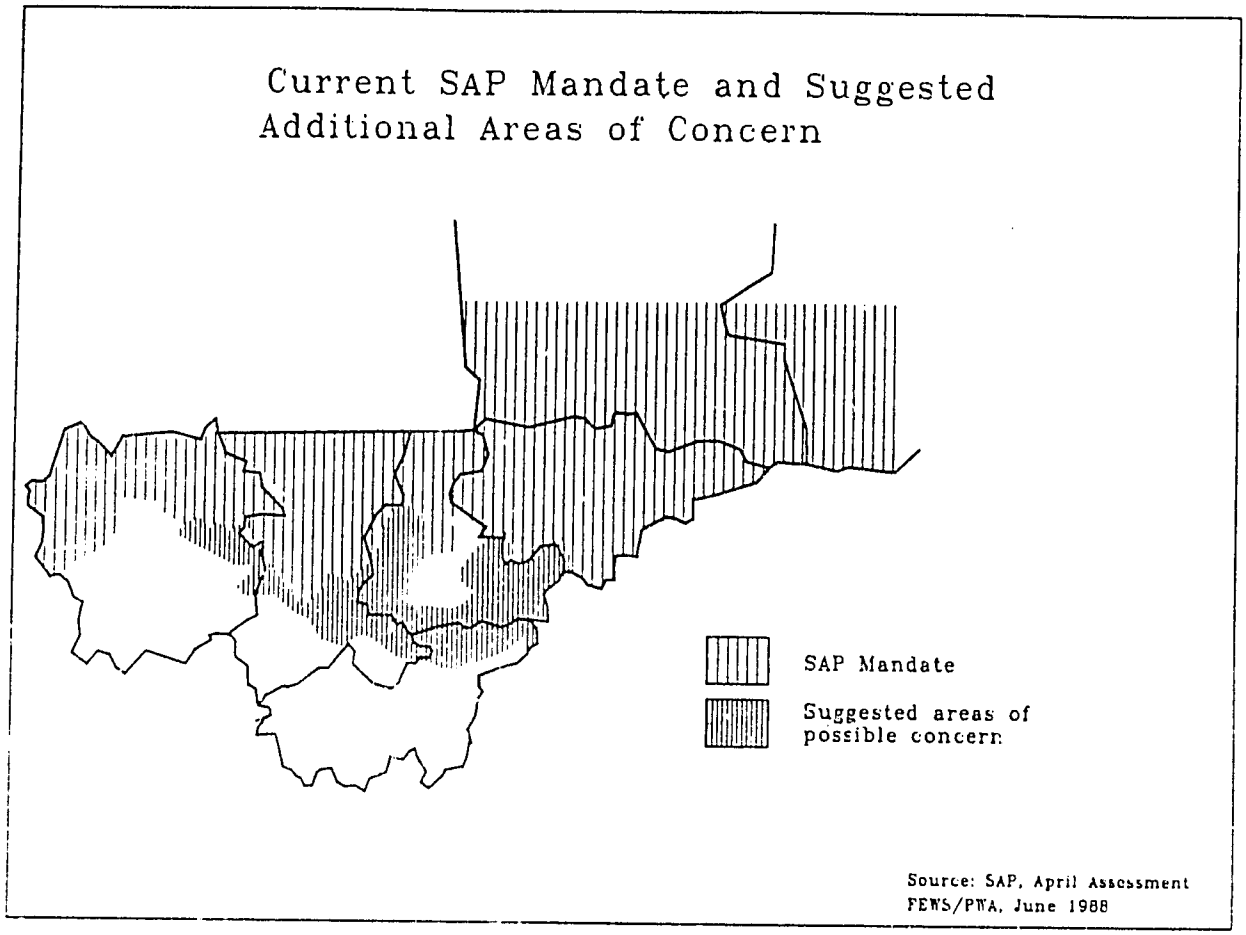
Production data from 1975 to 1987 show that there has been wide variability in production in all regions, with the exception of Kayes. An analysis of vegetation indices (NDVI) derived from satellite imagery suggests that large areas of Mali showed high variability in vegetation from year to year. On the basis of these NDVI indicators, SAP might monitor specified areas currently outside its mandate (see Map 8).

Inter-annual variability of agricultural production is characteristic of transitional climatic areas like the Sahel. Rain forests and deserts usually receive predictable amounts of rain and usually present the same, predictable opportunities for agriculture each year. In the Sahel, however, the northern limit of rainfall may advance in some years, and never arrive in others. A farmer's fortunes rise and fall upon the northward progression of the rainy season.

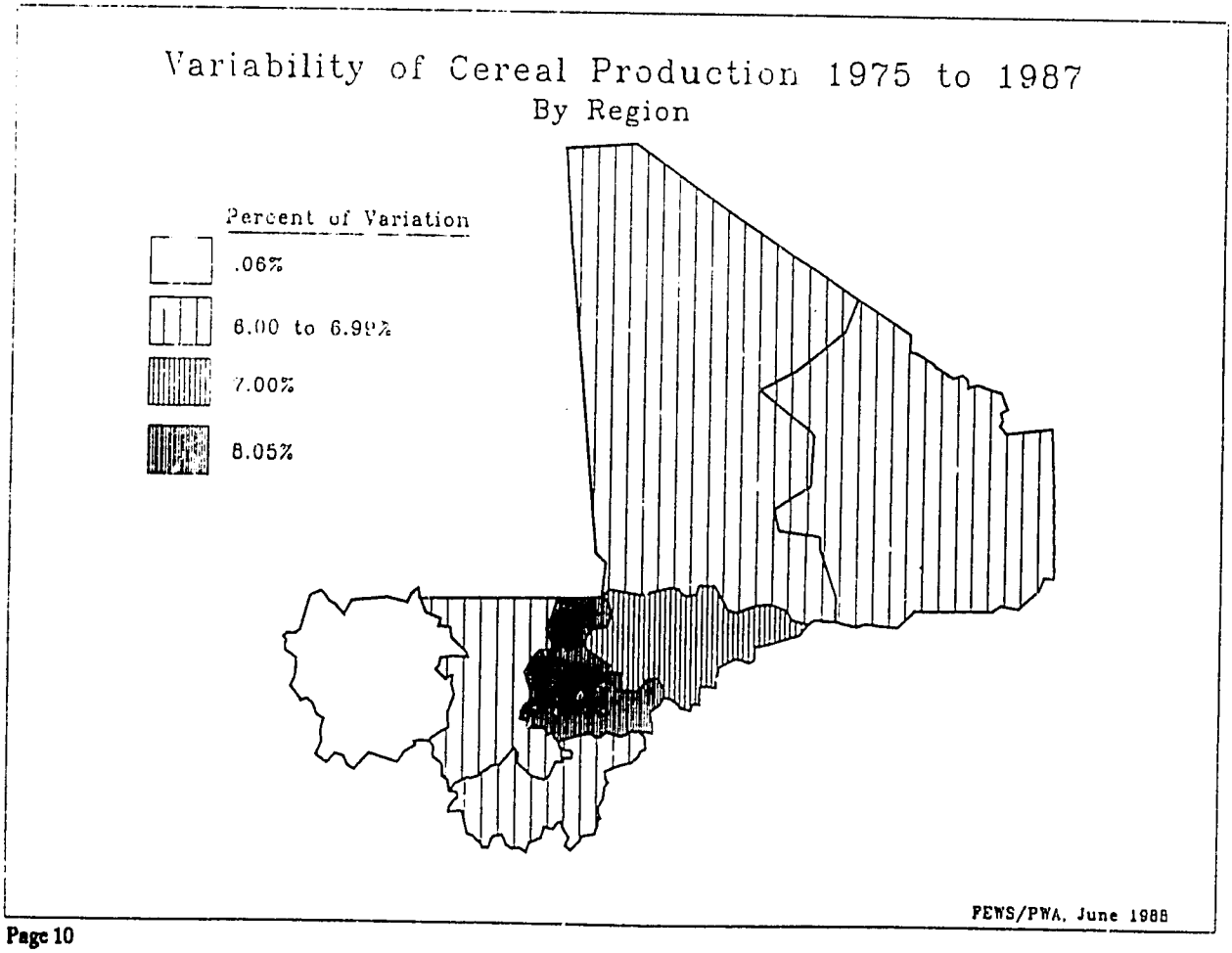
Map 9 displays the location and range of agricultural variability (maximum minus minimum production divided by the average) in each of Mali's seven regions between 1975 and 1987. Kayes Region had relatively stable (albeit low) production, while Segou (the most productive) had the most variable. Between 1975 and 1987, production ranged from a high of 368,000 MT in Sikasso Region to a low of 125,000 MT in Kayes Region (ignoring the generally pastoral Tombouctou and Gao Regions). Agricultural production in Mali generally increases as you move south. As a result, agricultural variability might differ considerably within regions, especially those oriented north-south.

Map 10 shows the extent to which the vegetation index (NDVI) and, presumably, economically important grasses and crops have varied historically in the different parts of the country. As shown in Map 10, NDVI varied greatly from year to year (1982-1987 during the period July 1 - October 31). NDVI is a measure of photosynthetic activity, not crop production. Nevertheless, the conditions favorable for vegetation will also favor crop growth. Therefore it is possible to infer from the NDVI

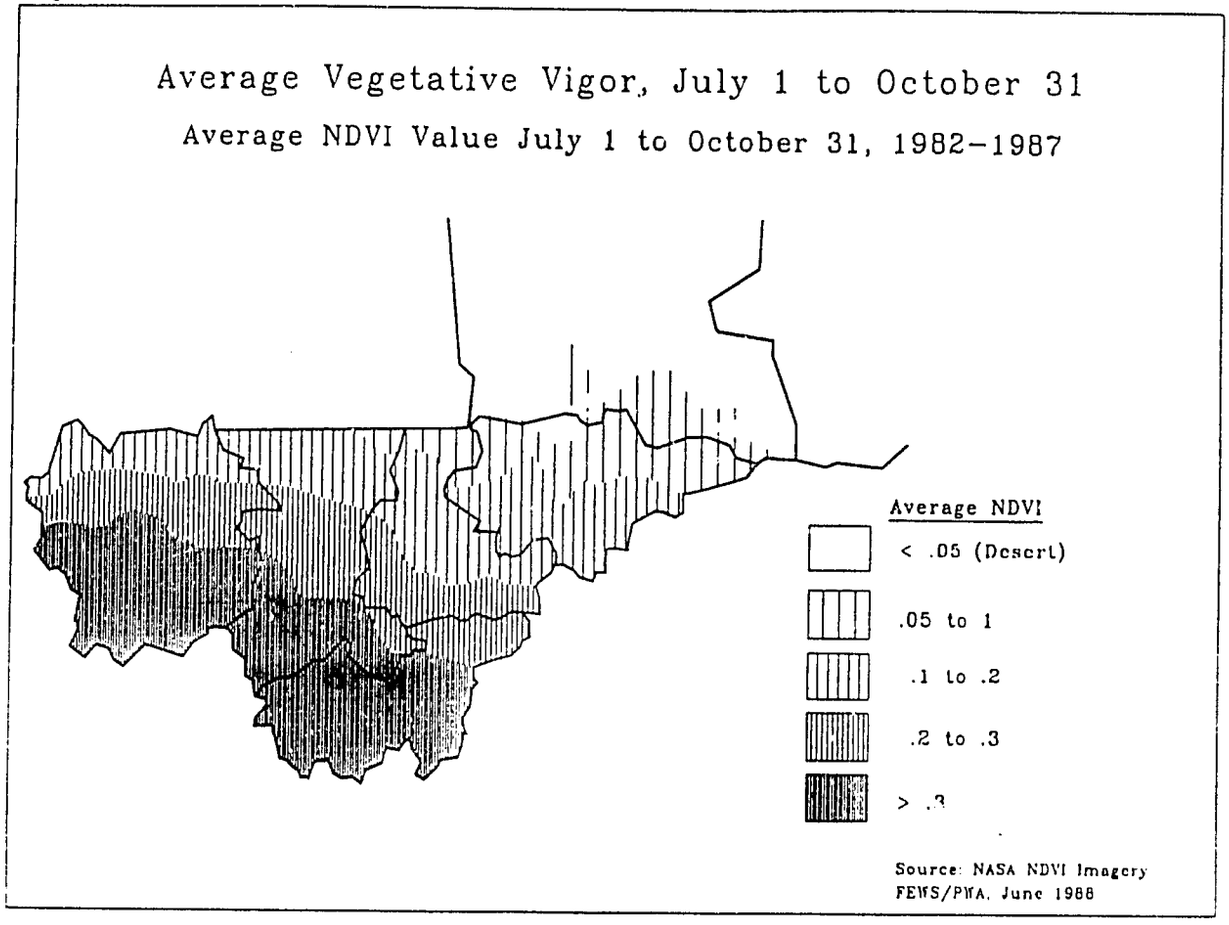
Map 8


Current SAP Mandate and Suggested
Additional Areas of Concern
SAP Mandate
Suggested areas of
possible concern
Source: SAP, April Assessment
FEWS/PWA, June 1988

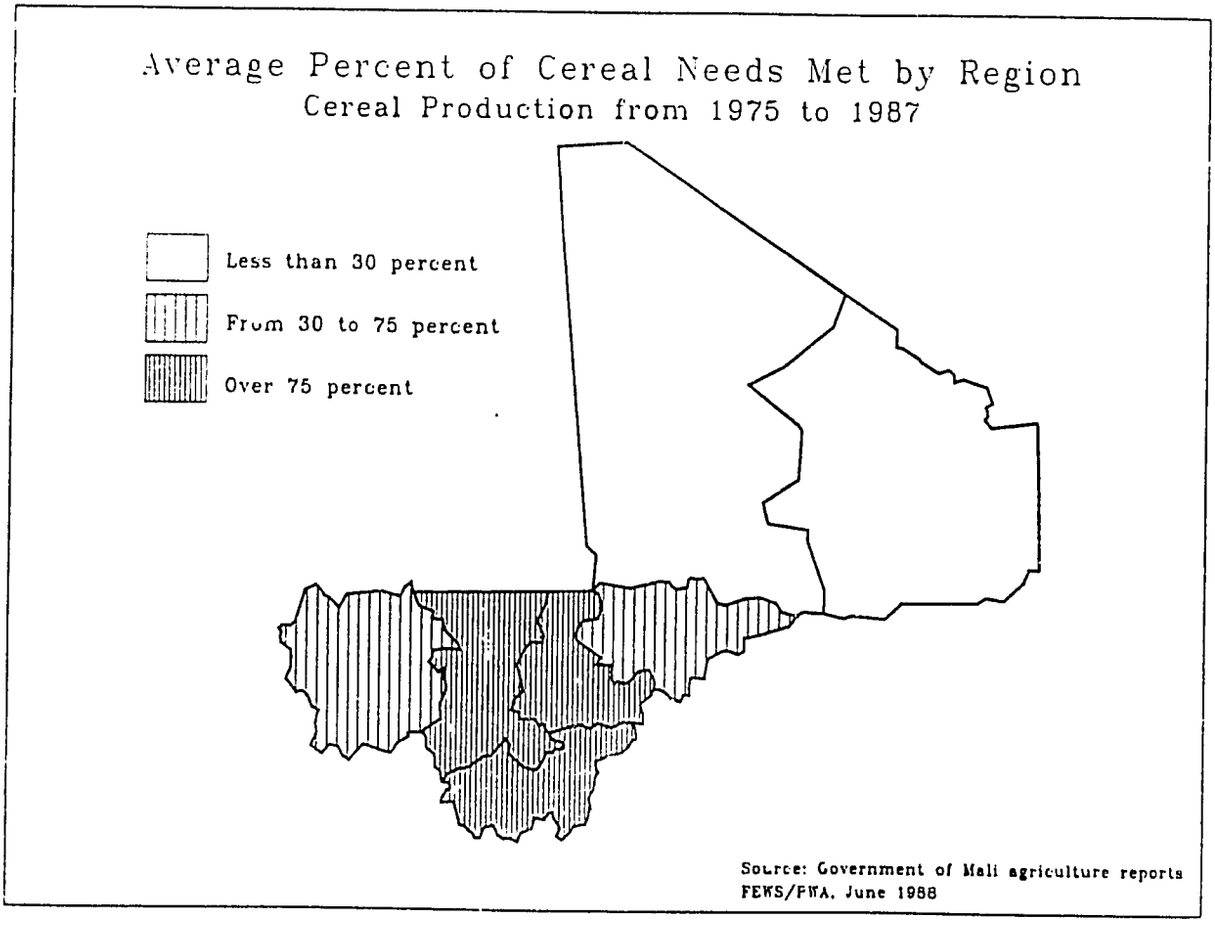
Map 9


Variability of Cereal Production 1975 to 1987
By Region
Percent of Variation
.06%
6.00 to 6.99%
7.00%
8.05%
FEWS/PWA, June 1988

Map 10


Average Vegetative Vigor, July 1 to October 31
Average NDVI Value July 1 to October 31, 1982–1987
Average NDVI
< .05 (Desert)
.05 to 1
.1 to .2
.2 to .3
> .3
Source: NASA NDVI Imagery
FEWS/PWA, June 1988

Map 11


Average Percent of Cereal Needs Met by Region
Cereal Production from 1975 to 1987
Less than 30 percent
From 30 to 75 percent
Over 75 percent
Source: Government of Mali agriculture reports
FEWS/PWA, June 1988

how vigorously crops might respond. Areas that have had high variability of NDVI (Map 5) extend across Mali and are especially apparent in northeastern Kayes and most of Koulikoro Region. This high variability extends in an arc across northern Sikasso and up into the interior delta of the Niger River and southeastern Mopti Region. Balle Arrondissement (Nara Cercle) in Koulikoro Region is the area of highest NDVI variability within Mali. It is at the northern limit of millet production and is in the transitional zone between pastoralism and agriculture.

**Adequacy of Agricultural Production**

From 1975 until the present, only three regions of Mali consistently approached self sufficiency in cereal production: Koulikoro, Sikasso, and Segou (see Map 11). Analysis at the regional level, however, masks local variations in cereal sufficiency. Within each region there is a gradient of agricultural potential that increases toward the south. Average vegetative conditions, as illustrated by the average NDVI for the period July 1 to October 31, approximate this gradient within regions (see Map 10). The historic NDVI data can suggest how well agricultural production has been able to meet local food needs, which can also inform and support findings of vulnerability based on current indicators.

Defining minimal food needs has always been a problem in the Sahel. Only a limited amount of research has been done to determine the basic needs of peoples in various parts of the Sahel. "Best estimates" of either nutritional or historic (usually cereal) consumption requirements are currently used to determine where food shortages might exist, and what level of assistance is required. Within any Sahelian country, and Mali is no exception, there exist several different estimates of cereal requirements.

This assessment uses an estimate similar to that used by USAID/Bamako for annual per capita cereal consumption requirements. Cereals, primarily millet and sorghum, are estimated to constitute 53% of the average diet in Mali. USAID/Bamako estimates consumption of these grains at 15.6 kilograms per person per month or 188 kilograms of milled millet and sorghum per year. In determining gross required per capita production, about 20% must be added to the milled consumption to account for seed, feed, post-harvest, and milling losses. The gross per capita production requirement would be approximately 225 kilograms. (The U.S. Department of Agriculture and Mali's National Committee on Drought Relief use 167 kilograms per person as the annual cereal requirement.)

Map 11 shows how well cereal needs were met in each region over the period from 1975 to 1987. Sikasso, Koulikoro, and Segou are the only regions that approached self sufficiency or produced a grain surplus. What this assessment does not show are the significant local differences in adequacy of production. These variations can be caused by accidents of soil type, topology, or other factors. On a broader scale across the country, harvests tend to vary in the same direction as the isohyets (higher production and rainfall levels in the south, lower in the north or east) -- noting exceptions in areas of flood recessional or irrigated agriculture. The larger administrative regions, particularly those that extend north and south over diverse climatological zones (as do Kayes, Koulikoro, Segou and Mopti Regions) are therefore poorly described by regional-level analysis.

As shown in Map 10, all the administrative regions of Mali are cut by lines representing different levels of average vegetative conditions (NDVI). The average NDVI approximates the vegetative potential of an area. Areas with an average NDVI of less than .05 are primarily pastoral. While regional data indicate that there has been a low level of production and a high level of production variability in Kayes Region (see Map 6), this is probably not true for the entire region. The map of average NDVI indicates that the southern area of Kayes probably produces more than the northern areas of the region. In this sense, agricultural production declines with the isohyets, which, in Mali, decrease as you

move north. This intra-regional variation underscores the limitations of using production data aggregated to the regional level.

**Food Stocks Currently Available**

While information on on-farm and commercial food stocks is not available, surrogate measures can be used to identify areas left with little or no stocks. Locations of public food stocks are known, but, in the quantities reported, they will do little to lower the vulnerability of areas at risk. The GOM's estimates of the 1987 shortfall in production have recently been increased. Emergency food is presently being distributed in the areas most affected. Assuming no stocks prior to 1987 remain, food stocks from the 1987 harvest are probably already depleted in some areas of Gao, Toumbouctou and Kayes, and possibly also in areas of Koulikoro and Mopti Regions. The data do not allow regional disaggregation. This analysis shows, however, that if 1987 harvests were consumed at the rate of 15 kg per person per month, stocks would run out before the 1988 harvest in all regions, except Segou.

The level of current food stocks is a critical measure for analysis of pre-rainy season vulnerability. In most of the Sahel, food reserves are usually lowest during the pre-harvest period. A perfect vulnerability assessment would be able to measure household stocks, commercial stocks held by traders, and public stocks available for distribution. An accurate judgement might then be made about the actual and potential role food stocks play in current vulnerability to famine.

In Mali, as elsewhere in the Sahel, reality is less kind. Little reliable information is available for household stock levels in any year or any area. The same is true for commercial stocks. Public stocks, which are likely to be the least of the three, can usually be estimated. In the absence of these data, one must seek surrogate measures that can establish possible ranges of stock quantities, and thus gain a broad understanding of the current situation.

A surrogate measure for household cereal stocks compares net 1987 production with minimal 1988 net cereal needs (188 kg per capita). This comparison shows how well minimal food needs would have been met if 1987 production had gone totally to stocks and no other stocks existed from prior production or purchase. This analysis indicates the maximum quantity of grain in stock for use during 1988.

Based on this measure, harvests would meet only between 18 and 25% of food needs (less than 4 months) in the primary pastoral regions of Tombouctou and Gao and between 55 and 73% of needs in Kayes and Mopti Regions. Tombouctou and Gao are far to the north and are economically dependent on pastoralism, so this measure should be used with caution. The figures for the percent of needs met for the year 1987 are generally comparable to the historical average from 1975 to 1987. Again, this analysis must be approached cautiously since it relies upon regional data. Indeed, if this analysis is correct and the rate of consumption is held constant, no grain stocks from local production currently exist in Tombouctou, Gao, and Kayes Regions. Exhaustion of stocks from 1987 production would occur soon in Koulikoro and Mopti Regions. In these areas, either consumption has already been reduced below the minimally acceptable rates, or other food acquisition mechanisms have been employed (where available).

Emergency food assistance is currently being distributed in designated areas in the northern tier of Mali. Quantity is limited and this assistance should do little to change vulnerability. Commercial stocks, of course, are only available for purchase. Their mere presence, were one able to accurately measure the amount held in each area, would therefore not necessarily translate into increased consumption or reduced vulnerability. One would also have to assume adequate purchasing power. Whether sufficient purchasing power exists this year in many deficit production areas is very much an unresolved issue at this point.

### Availability of Other Resources

There are no data available that will provide an accurate picture of the other resources available to Malians to cover food needs during periods of stress. Nevertheless, it is clear that non-farm economic activities play an important role in food acquisition. Government employees, many urban residents, military, police, and a small group of private sector employees, all largely purchase or trade for much of their food supplies. Many, if not most, rural farmers also rely upon migrant remittances, gifts, wild foods, and non-farm economic activities to supplement that part of their diet they cannot supply through their own production. Non-farm economic activities include both traditional crafts and more contemporary activities, such as operating small shops. Women play an important role in these activities, providing services, selling homemade or processed goods, or gathering wild foods. During the worst of times, people might use several of these strategies to provide for themselves and their households.

Non-farm economic activity is the element of the food acquisition process about which the least is known. Existing data are largely the result of a limited number of surveys, and are therefore difficult to extrapolate to other areas. Such survey data do suggest that even rural agriculturalists may receive an important percentage of their total income from non-farm economic activity. Intra and inter-African migration for wage labor is a widespread and economically important practice of many men in Mali. Labor migration to France is especially important in the Kayes and Koulikoro Regions. It is not yet possible to quantify the impact of labor migration on the vulnerability of any areas in this analysis. The lack of data on such an important aspect of the food acquisition process is a severe limitation on any vulnerability assessment. Any conclusions of this assessment must be qualified by the lack of data available on this topic.

## Manifestations of Vulnerability

High millet prices throughout northern Mali, as well as recommended emergency food distributions in the arrondissements judged to be at risk by SAP, make it clear that many areas of Mali are presently under stress (see Maps 12 and 13). These and other manifestations of food shortages generally support the view of conditions already identified by SAP.

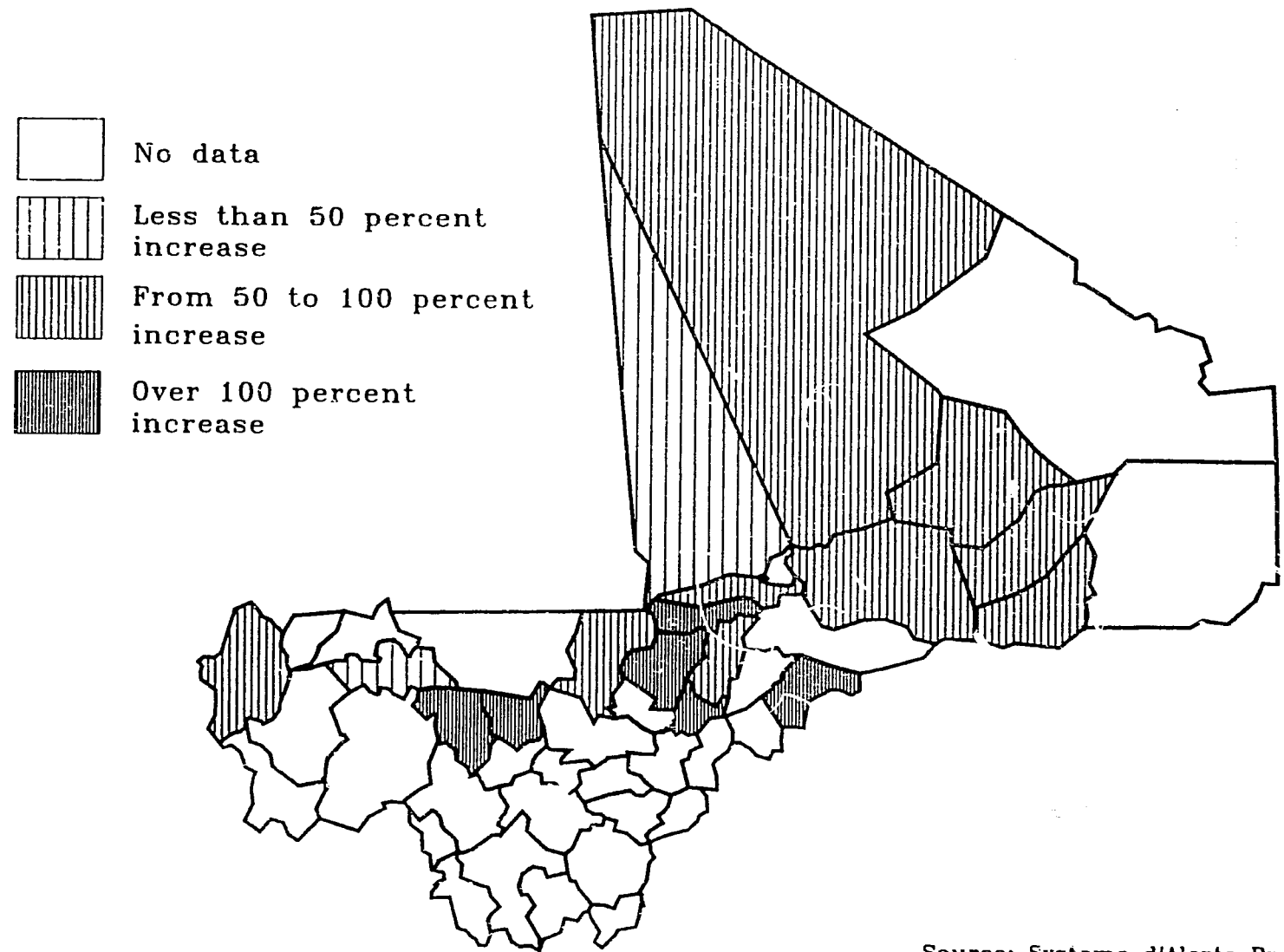
The consequences of food shortages should be manifest in various physical, social, and economic indicators. These indicators differ from the three indicators of vulnerability defined above, in that they do not measure the shortage of food, but rather some of the consequences of it. In this sense, they may help to confirm or deny degrees of vulnerability. The difficulty in using these indicators for confirmation of food shortages is that they usually reflect much more complex conditions than simply the scarcity of food. For this reason, they are particularly difficult to interpret for indications of the degree of current food stress. Particularly well-known indicators of this type include malnutrition levels and food price anomalies.

### Malnutrition

Few nutritional studies have been performed in Mali, and none that would permit an overview of a Region. SAP recently conducted a nutritional survey in the north among nomadic groups in Menaka and Asongo Cercles (Gao Region). SAP measured all children between 65 centimeters and 115 centimeters in each camp surveyed. This study found childhood malnutrition rates of between 2.8 and 4.7%. This range is considered acceptable within Mali, and is close to what would be expected according to international standards. The survey did reveal that there was little consumption of milk and meat. It also found that in 2.5% of the households, no one had eaten during the previous day

# Price Increase in Millet from April 1987 to 1988

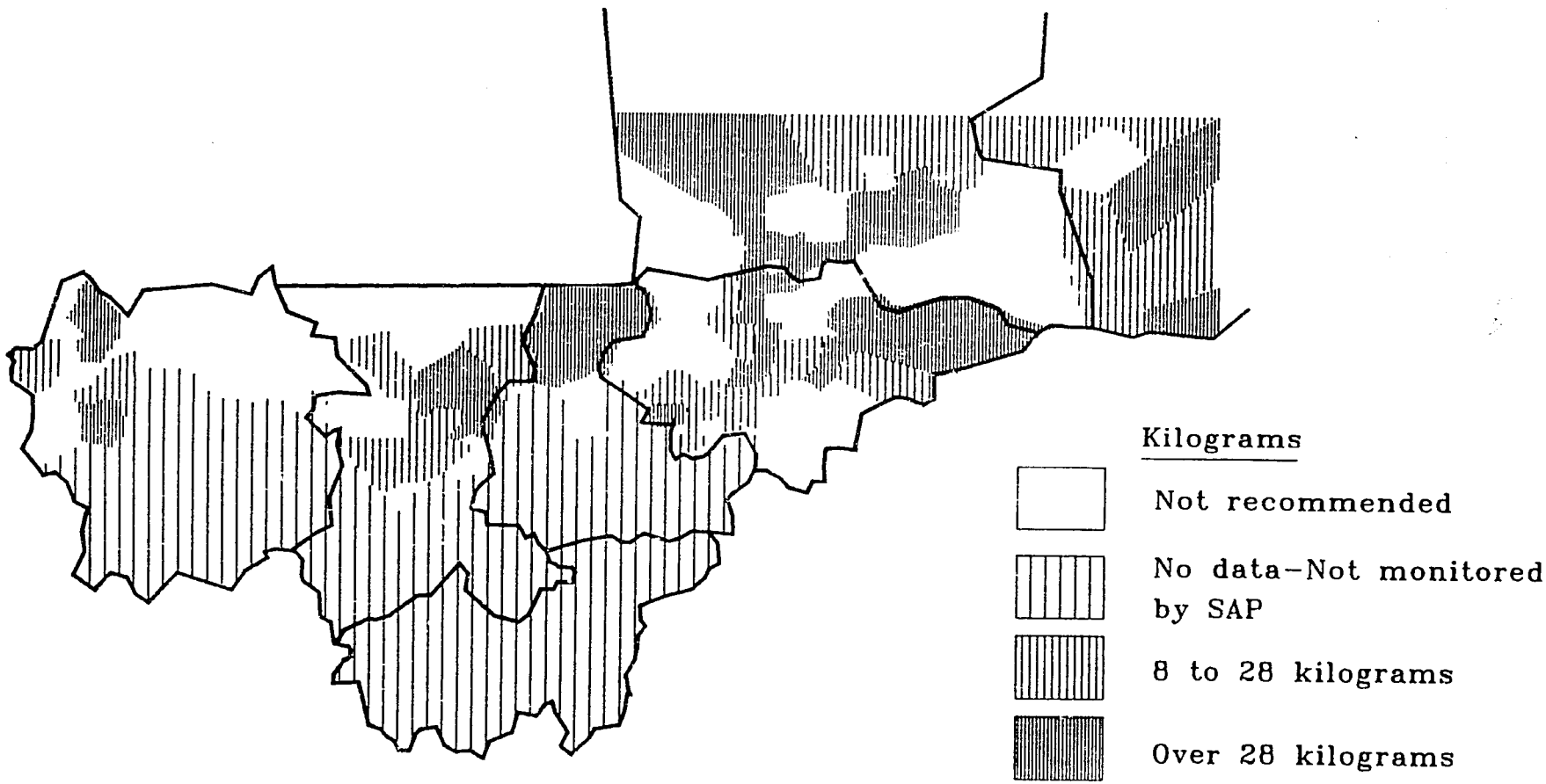
## Percent of Increase by Cercles Covered by SAP




Source: Systeme d'Alerte Precoce Report
FEWS/PWA, June 1988

# SAP Recommendations for Food Assistance

## Per Capita Food Aid Recommendations by the Systeme d'Alerte Precoce




Source: NASA NDVI Imagery
FEWS/PWA, June 1988

### Millet Prices

While millet price declines have recently been recorded for Tombouctou and Gourma Cercles, almost a third of the cercles for which there are data have experienced a greater than 100% increase in the price of millet over last year (see Map 12). Only Nioro and Yelimane Cercles, Kayes Region, show less than a 50% increase in millet prices. The general trend of millet prices has been a constant rise from April 1987 until August 1987, a slight dip in prices from January to February of 1988, and a constant rise since May.

### People At Risk

The Government of Mali's Système d'Alerte Précoce (SAP) tries to identify the number and location of people that require emergency food assistance. SAP concentrates its efforts in the northern areas of Mali (see Map 1) where it identifies areas at risk or of potential risk. SAP monitors these at the cercle and arrondissement level, using data on agricultural production, migration, livestock production, market prices, health and nutrition indicators (when available), and food stock reserves. SAP recommends areas of intervention to the National Committee for Drought Relief. Map 13 shows those areas currently recommended for food assistance. The population in these areas totals 1,352,000; those actually requiring and receiving food assistance are a small subset of the total population.

### Unusual Migrations

Unusual migrations from eastern and central Mali raise increased fears of food shortages. SAP has targeted nomad settlements in the area around the city of Mopti for food aid (see Map 14). It is not clear to what extent this migration is an adaptive response to food and pasture stress or is a desperate search for food. Post-rainy season reports indicate that migrants are returning to their areas of origin.

## Relative Vulnerability to Famine in Mali

The indicators of food shortage and its manifestations have been integrated to produce a picture of overall vulnerability in Mali. Historical data on agricultural dependability and adequacy contribute to an understanding of vulnerability derived from current stocks and other information. These findings confirm SAP's assessment of areas at risk (see Map 1). Other areas, to the south of SAP's mandate, might be monitored also, as conditions there appear to match those of areas known to be at risk.

### Areas of High, Continuing Vulnerability

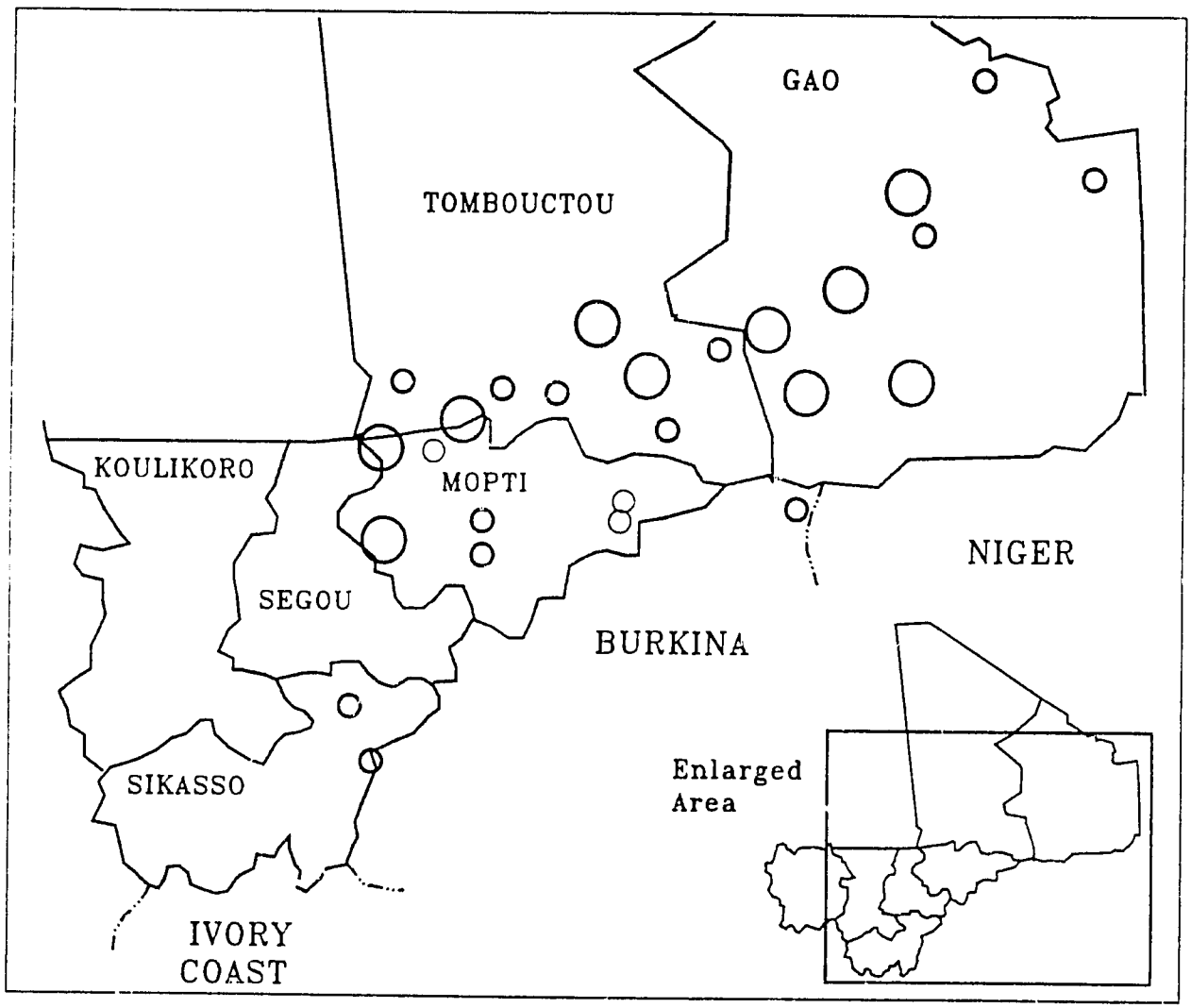
#### Koulikoro Region

Kolokani Cercle

- Didieni Arrondissement - On-farm stocks are currently low and this area has been designated as at risk by SAP. This is expected, as this arrondissement is an area of historically high vegetative variability and low average NDVI. This area continues to be at risk, even though Koulikoro is a region of relatively adequate production.

Map 14

# Abnormal Out-Migration Observed in February to March 1988




Circles represent points of origin and relative size of migration

FEWS/PWA, April 1988

**Segou Region**

Niono Cercle

Nampala Arrondissement - Low stocks and high grain prices confirm SAP's designation of this arrondissement as at risk. Nampala is in an area of historically high vegetative vulnerability and high regional production. Even though Segou is the region of Mali with the highest level of per capita cereal production, Nampala is located in the northern part of the region. It experiences lower productivity than is reflected in regional level data.

Sokolo Arrondissement - Low or nonexistent stocks and high grain prices confirm SAP's designation of this arrondissement as at risk. Sokolo is located in an area of historically high vegetative variability and high regional production. Even though Segou is the region of Mali that has the highest level of per capita cereal production, Sokolo is also located in the northern part of the region. It experiences lower productivity than is reflected in regional level data.

**Mopti Region**

Tenenkou Cercle

- Dioura Arrondissement - Dioura has low stocks of grain and is in an area where grain price are high. This arrondissement is located in an area of historically high vegetative variability and adequate regional production. Mopti Region has had generally inadequate levels of per capita cereal production and Dioura Arrondissement is located in its northern reaches (in an area of low average NDVI).

Mopti Cercle

- Mopti, Fatoma, and Konna Arrondissements - In these arrondissements SAP notes that agricultural production has declined, grain stocks are low, and market prices are high. These arrondissements are situated in an area of historically high vegetative variability, high variability of agricultural production, and consistently deficit agricultural production. Mopti Region of Mali has a generally inadequate level of per capita cereal production, and these arrondissements are located in its northern reaches.

Douentza Cercle

- Douentza, Boni, Bore, Hombori, and N'Gouma Arrondissements - SAP notes that after a poor harvest, on-farm stocks are low and grain prices are high. SAP has designated these arrondissements as at risk. These arrondissements are situated in an area of historically high vegetative variability, high variability of agricultural production and consistently deficit agricultural production. Mopti Region has a generally inadequate level of per capita cereal production and these arrondissements are located in its northern reaches.

Bandiagara Cercle

- Kanigogouna, Ningari, and Sangha Arrondissements - As a result of a poor harvest, on-farm stocks are low and grain market prices high. SAP has designated this area as at risk. These arrondissements are situated in an area of historically high vegetative variability, high variability of agricultural production and consistently deficit agricultural production.

**Tombouctou Region**

Goundam Cercle

- Bintagoungou, Farach, Gargando, and Telemsi Arrondissements - These arrondissements have been designated by SAP as at risk because of poor pasturage and because of abnormal migrations out of the area. These arrondissements are located in an area of historically low productivity and low NDVI variability. Livestock production plays an important role in the economic life of these areas.

Niafunke Cercle

- Niafunke, Banikane, Sarafere, and Soumpi Arrondissements - SAP has designated these arrondissements as at risk as a consequence of a high level of migration, poor pasturage, low cereal stock, and high grain prices. These arrondissements are all located in an area of historically low productivity and low NDVI variability.

**Gao Region**

Gao Cercle

- Gao and Djebock Arrondissements - These arrondissements have been designated as at risk by SAP as a consequence of poor pasture, low cereal stock, high and unusual migration and high grain prices. These arrondissements are located in an areas of historically low productivity and low NDVI variability. In this area, livestock production plays an important role in economic activities.

**Additional Areas not Presently Monitored by SAP**

The following areas not currently included in the SAP mandate might be monitored based on the analyses of satellite imagery and production presented in the preceding sections of this report.

**Segou Region**

Macina Cercle

Baraoueli Cercle

San Cercle

Tominan Cercle

**Sikasso Region**

Koutiala Cercle

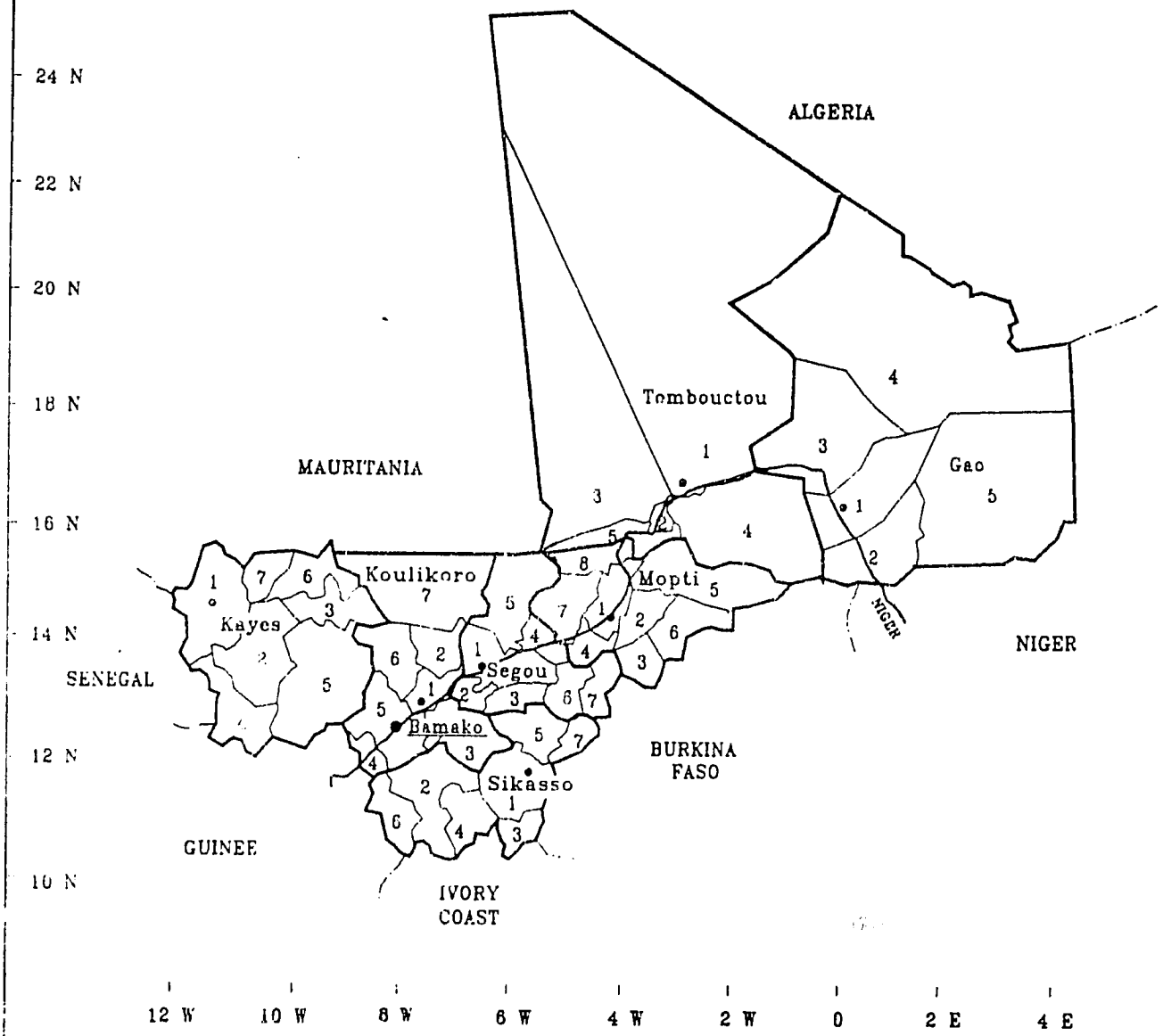
Yorosso Cercle

# APPENDICES

**APPENDIX 1**

# Administrative Units

## Regions and Cercles




REGIONS and CERCLES

KAYES
1. Kayes
2. Bafoulabe
3. Diema
4. Kenieba
5. Kita
6. Nioro
7. Yelimane

KOULIKORO
1. Koulikoro
2. Banamba
3. Dioila
4. Kangaba
5. Kati
6. Kolokani
7. Nara

SIKASSO
1. Sikasso
2. Bougouni
3. Kadiolo
4. Kolondieba
5. Koutiala
6. Yanfolila
7. Yorosso

SEGOU
1. Segou
2. Baraoueli
3. Bla
4. Macina
5. Niono
6. San
7. Tominian

MOPTI
1. Mopti
2. Bandiagara
3. Bankass
4. Djenne
5. Douentza
6. Koro
7. Tenenkou
8. Youvarou

TOMBOUCTOU
1. Tombouctou
2. Dire
3. Goundam
4. Gourma-Rharous
5. Niafunke

GAO
1. Gao
2. Ansongo
3. Bourem
4. Kidal
5. Menaka

Other Int'l Boundaries

Region Boundary

Cercle Boundary

● National Capital

• Regional Capital

200 km

FEWS/PWA, June 1988

## APPENDIX 2

## Model Used for Vulnerability to Famine

Over the centuries there have been many definitions of famine, reflecting the complexity of the process. The concept of measuring a population's vulnerability to famine is somewhat newer, and still without a generally-accepted methodology. Early warning systems, particularly those dealing with Africa, have begun to search for a set, or sets, of indicators of pre-famine conditions. FEWS assessments of vulnerability to famine form part of a continuing effort by USAID to identify incipient famine conditions, and to define important features of that process (the number of people involved, their location, and the nature of the problem). The mandate of the Famine Early Warning System is to provide an operational analysis of immediate use to decision-makers. The methodology used in this type of environment will continue to evolve.

**Definitions of Famine and Vulnerability**

- Famine is a sustained period during which large numbers of people consume less food than they require, giving rise to harmful physical and social effects.

- Vulnerability to famine is the degree to which the available food, from any source, does not meet a population's minimal requirements over a period of time. Highly vulnerable populations (those "at risk" of famine) currently are, or soon will be, unable to meet their minimal requirements for a sustained period of time. This will result in substantial harm to individuals and their society. Other, less vulnerable populations either currently appear to be meeting their minimal requirements, or are likely to fall below minimal levels for a limited period of time (i.e. they may experience a food shortage, which may also have harmful physical and social consequences). In the Sahel, virtually all rural populations are "vulnerable" to some degree.

**General and Site-Specific Vulnerability Assessment**

At the most basic level, access to food follows the same pattern everywhere. Food is made available by (a) producing one's own food and (b) acquiring food through other means: wage labor, gifts, trade, liquidation of assets, etc. An assessment of any population's current vulnerability to famine requires a measurement of the current condition and performance of these two basic processes. It also requires a context (the structural characteristics of vulnerability) against which to measure the range of successes or failures of each process over time.

Nevertheless, in each place, the relative degree of dependence upon the individual processes, and the performance of each, is specific to the local environmental, social, and economic opportunities. In each place, the operation and performance of the food acquisition processes become site-dependent, and can only be measured accurately in the context of their many interactions. For example, migrant Malians (who send remittances to family members remaining at home) have enormous impact on Mali's ability to purchase a part of its food supply, and, as well, upon its potential agricultural work force. This is particularly true in Kayes and the Koulikoro Regions of Mali where there is an important labor migration toward France. Within Mali's borders, the relative opportunities and adaptations vary greatly by area (witness the oasis inhabitants of Tombouctou and Gao Regions) and ethnic background, and must be taken into account while examining indicators of the food supply system.

An assessment of vulnerability to famine must also be sensitive to the season in which it is made. Around 53% of Mali's food needs are met by its own grain production. As in many other semi-arid zones, Mali's agricultural production is concentrated in one small part of the year. The food supply,

therefore, will often fluctuate seasonally around the harvest. An assessment undertaken one month before the harvest may give a very different picture from one performed one month after the harvest.

**Methodology of Niger Vulnerability Assessment**

The FEWS assessment of pre-agricultural season vulnerability to famine in Mali will attempt to identify both the structural characteristics and current conditions of vulnerability in Mali by answering four questions.

- Based on the past, what is the likelihood that a "normal" food production process will occur, and what is the quantity of food it may produce?
- Based on the past, what other opportunities are normally available for acquiring food?
- What are the levels of current food stocks (from local production or elsewhere)?
- What other food acquisition resources are currently available?

The first two questions help to establish the inherent, structural characteristics of site-specific food production capabilities and food acquisition opportunities. They provide a context against which to measure the responses to the two questions that follow. The responses to the second pair of questions allow one to judge the current vulnerability to famine. Current vulnerability frequently, but not always, stems from the same insufficiencies and irregularities that are characteristic of the structural weaknesses of the area.

In focusing on the areas thus identified as currently vulnerable, relative vulnerability will assessed through a ranking of the available indicators. The weights assigned to indicators are necessarily subjectively determined.

Finally, the areas identified as currently vulnerable will be compared to areas already reported to evidence signs of stress on the food supply, e.g., liquidation of assets, abnormal migrations. Where these areas intersect, this assessment may add to the depth of information available on the vulnerable areas. The non-overlapping areas represent districts about which further information is needed.

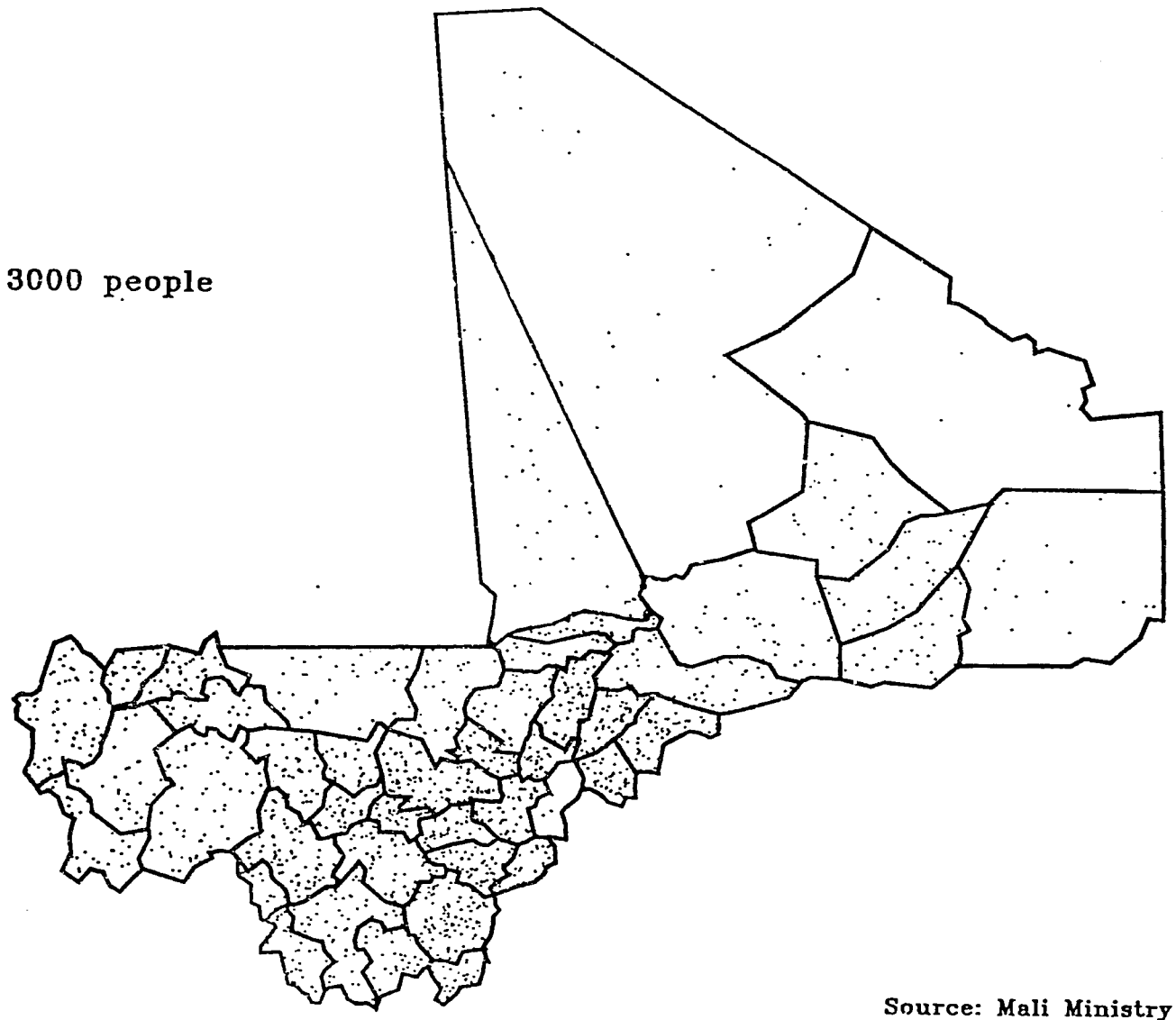
Restrictions of Data

Most of the data available for Mali are collected at the regional level, which is the geographic level of this analysis. This is particularly true for cereal production data. Because of the large surface areas covered by most regions of Mali (see Map of Administrative Regions, Appendix 1), these data do not account for regional differences, especially in regions which are on a north-south axis. Northern areas of most regions are more than likely affected by differing levels of rainfall, which in turn will affect rainfed cereal production. These facts limit how well the analysis can reflect local variation.

# Relative Density of Rural Population

## By Cercle

1 Dot = 3000 people



Position of dots randomly assigned within cercles.

Source: Mali Ministry of Planning
FEWS/PWA, June 1988

## APPENDIX 4

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## 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.

**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). The images are derived from Global Area Coverage (GAC) approximately 4 km resolution images 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.

## FEWS Publication Schedule

### Country Reports

FEWS Country Reports will be published monthly during the growing season and bimonthly during the rest of the year. A preliminary harvest assessment issue will be published toward the end of the growing season for each country.

GC - General Coverage GS - Growing Season Monitoring PHA - Preliminary Harvest Assessment

| | Jul | Aug | Sep | Oct |
|---|---|---|---|---|
| Mauritania | GS | GS | GS | PHA |
| Mali | GS | GS | GS | PHA |
| Burkina | GS | GS | GS | PHA |
| Niger | GS | GS | GS | PHA |
| Chad | GS | GS | GS | PHA |
| Ethiopia | GS | GS | GS | PHA |
| Sudan | GS | GS | GS | PHA |
| Mozambique | | GC | | GC |

### Bulletins

FEWS Bulletins are published every ten days during the Sahelian and East African growing season. Twelve Bulletins [*] are published annually starting with the 20th of June.

| FEWS Bulletins | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|
| Sahel & East Africa | ** | *** | *** | *** | * | | |