Chad

1999/2000

Current Vulnerability Assessment

March 2000

Famine Early Warning System Project

U.S. Agency for International Development

Table of Contents

List of Abbreviations

ACF - Action Contre la Faim
APICA - Association pour la Promotion des Initiatives Communautaires Africaines
BELACD - Bureau d'Etudes et de Liaison des Actions Caritatives et de Developpement
CASAGC - Comite d'Action pour la Sécurité Alimentaire et la Gestion des rises
CILSS – Comité Interétat de Lutte contre la Sécheresse au Sahel
DERA - Direction de l'Elevage et des Ressources Animales
DOP - Direction de l'Organisation Pastorale
DREM - Direction des Ressources en Eau et de la Meteorologie
DSA - Division de la Statistique Agricole
GOC - Government Of Chad
MOA - Ministry Of Agriculture
NFSS - National Food Security Stocks
ONC - Office National Cerealier
ONDR - Office du Developpement Rural
SAP - Systeme d'Alerte Precoce
SISAAR - Système d'Information pour la Sécurité Alimentaire et l'Alerte Rapide
SODELAC - Societe de Developpement du Lac

Executive Summary

This current vulnerability assessment (CVA) considers the ability of populations to meet their food needs between November 1999 and October 2000 (the 1999/2000 consumption year).

The 1999 rainy season (May-October) was characterized by poor rainfall distribution at the beginning, but improved rainfall starting in early July. Heavy rains recorded during July and August resulted in extensive flood damage in parts of the Sudanian zone and reduced yields of dune millet in parts of the Sahelian zone. Also, in the north of the Sahelian zone relatively dry conditions in September and October favored crop pest proliferation and pests caused damage to crops, lowering yields. Outside the flood- and pest-affected areas yields were high. The overall result was better than average production (+9 percent) but lower production than last year (-17 percent), which was a record year. This year, pasture and water are plentiful over the whole country south of the Saharan zone. River levels are high, favoring fish production.

Final production assessments estimated 1999/2000 gross national cereal production at approximately 1,237,000 MT. The part of this production that will be available for consumption was estimated at approximately 1,010,000 MT. Given estimated cereal consumption needs for the 1999/2000 consumption year of 1,177,000 MT, net stocks of about 50,000 MT, and projected net imports of over 76,000 MT, the national cereal deficit is estimated at 43,000 MT. Even in years of excellent production, like last year (1998/99), Chad registers an overall cereal deficit. This year's deficit is smaller than last year's deficit of 76,000 MT, largely because of substantial carry-over stocks from the 1998/99 harvest. It is a fraction of the 240,000 MT deficit in 1997/98. The small size of the deficit will help to keep cereal prices low in 2000 in most areas.

The 1999/2000 CVA indicates that all pastoralists and most farmers in the Sahelian zone will be food secure during the 2000 hungry period (May to August) (figure 1). However, because of the poor rainfed millet production in western Kanem and eastern Lac Perfectures, farmers in Mao, Nokou, Rig-Rig and N'Gouri subprefectures are considered highly food insecure (see *FEWS Categories of Food Insecurity* box). Considering the average level of cereal production in the Sudanian zone

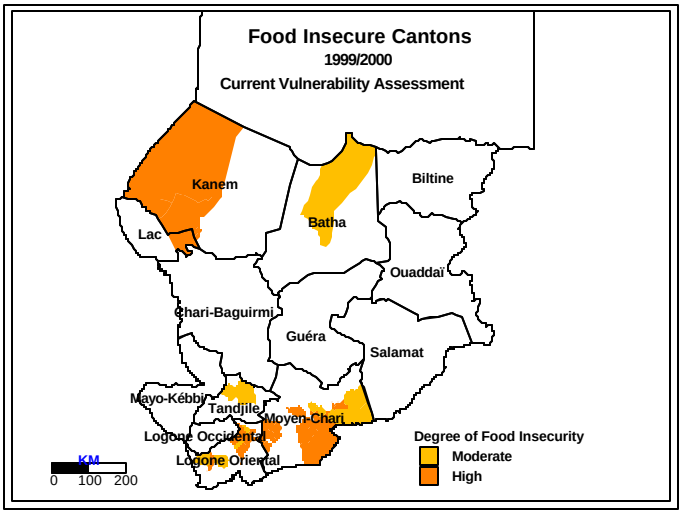


Figure 1
Source: FEWS

farmers outside of flood-affected areas will be food secure during the coming hungry period. However, because of the heavy food and cash crop losses in flood-affected areas, Sudanian zone farmers in parts of Logone Oriental, Mayo-Kébbi, Moyen-Chari, and Tandjilé Prefectures are either moderately or highly food insecure. Populations in some of these areas are already experiencing difficulty meeting their food needs.

Food access conditions for the highly food insecure may be rendered even more difficult by the fact that food availability in rural areas of the Sudanian zone may be limited, in spite of the relatively good food harvest. This is because farmers sold a large part of their food at harvest time to traders who transported the food out of the rural areas to urban centers where purchasing power is stronger.

Two intervention options are being discussed by the Government-donor coordinating committee (CASAGC) to assist populations living in highly food-insecure areas. The preliminary discussions seem to indicate that WFP is likely to set up a program of free food distribution in the Sudanian zone and ONC will organize a subsidized sale in the Sahelian zone. A definite plan will be adopted after the series of field trips to highly food-insecure areas planned for early April.

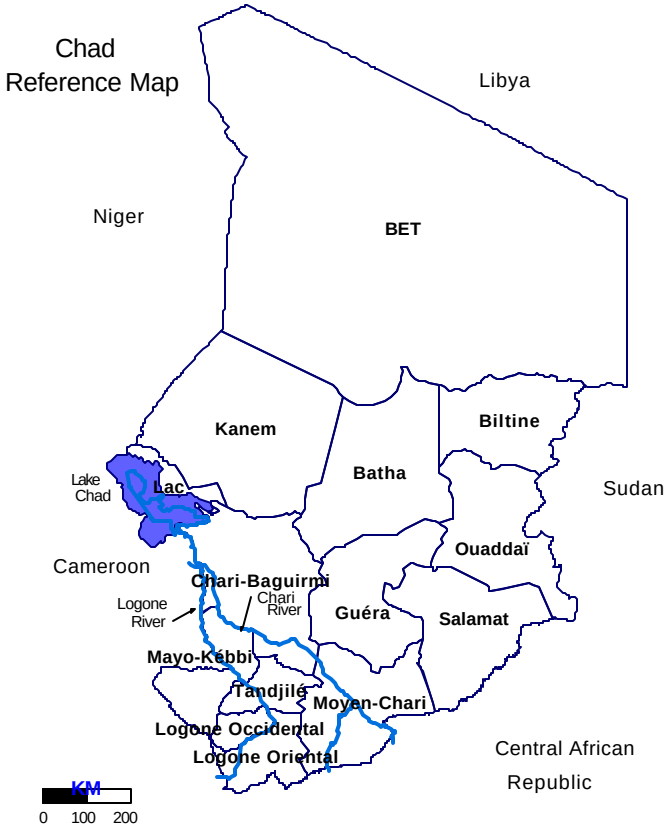

Chad
Reference Map
Libya
Niger
BET
Kanem
Biltine
Batha
Lake
Chad
Lac
Sudan
Ouaddaï
Cameroon
Chari-Baguirmi
Logone
River
Chari
River
Guéra
Salamat
Mayo-Kébbi
Tandjilé
Moyen-Chari
Logone Occidental
Logone Oriental
Central African
Republic
KM
0 100 200

Figure 2

I. Introduction

This Current Vulnerability Assessment (CVA) focuses on current or transitory food insecurity (see Key Terms box) for rural and urban populations in Chad.

For the current consumption period (November 1999 to October 2000), it:

- evaluates whether there will be enough food available at the national level to meet the consumption needs of the entire population;
- identifies cantons where the 'average' household is likely to be food insecure;
- describes the extent to which households in these cantons are food insecure;
- evaluates the impact of potential shocks to food security in the current consumption period;
- provides a basis for determining where concerted monitoring and possible interventions (including emergency food aid) may be needed; and
- summarizes the actions that are being taken or need to be taken to respond to any food emergencies.

Key Terms

Food Security is a condition in which a population has physical, social and economic access to sufficient safe and nutritious food over a given period to meet dietary needs and preferences for an active life. A food-secure population can meet its consumption needs during the given consumption period by using strategies that do not compromise future food security.

> **Food Availability** is a measure of the food that is, and will be, physically available in the relevant vicinity of a population during the given consumption period through a combination of domestic production, stocks, trade and transfers.
>
> **Food Access** is a measure of the population's ability to acquire available food during the given consumption period through a combination of its own production and stocks, market transactions or transfers.
>
> **Food Utilization** is a measure of whether a population will be able to derive sufficient nutrition during the given consumption period from available and accessible food to meet dietary needs.

Food Insecurity is the inverse of food security: a condition in which a population does not have access to sufficient safe and nutritious food over a given period to meet dietary needs and preferences for an active life. Possible causes are insufficient food availability, insufficient food access and inadequate food utilization.

> **Current (or transitory) food insecurity** occurs when a population suffers a temporary decline in consumption. Current food insecurity can result from instability in food production, food prices, household incomes, or health conditions.
>
> **Chronic (or long-term) food insecurity** occurs when a population has continuously inadequate consumption. Chronic food insecurity arises from conditions of poor food production, limited incomes, and poor health.
>
> (Adapted from World Bank, 1986)

II. National Food Security

A. Domestic Food Availability

There are two main components of domestic food availability: food production and initial or opening food stocks.

1. Production

The 1999 rainy season (May-October) was characterized by poor spatial and temporal distribution of rains until the end of June, resulting in some sowing and planting delays. These delays were not significant in the Sahelian zone, where short-cycle crops are grown; however, in the Sudanian zone, where long-cycle crops are grown, the poor early-season rains caused sowing/planting delays that delayed the entire calendar of cropping activities. Between early July and the end of August, heavy to extremely heavy rains fell over most agricultural parts of the country. The rains were mostly beneficial to rainfed crops and provided good conditions for recessional crop production, but they also resulted in some crop losses.

In western Kanem and eastern Lac Prefectures of the Sahelian zone, the excess moisture from the heavy rains hindered the development of dune millet, which normally needs very little rain and lots of sunshine. Since dune millet is the main cereal crop in these areas, high yield losses greatly reduced local production in western Kanem (Mao, Nokou, Rig-Rig subprefectures) and eastern Lac (N'Gouri subprefecture). In other parts of the Sahelian zone, the cereal harvest might have been as good as last year's, but relatively dry conditions in September and October fostered late-season pest attacks that caused high crop losses, especially in the northern parts of the zone. Outside of the areas of the Sahelian zone affected by pests and excess moisture, cereal yields were high and wild cereal production (*krep*) was excellent.

In the Sudanian zone, the heavy rains led to floods of unprecedented magnitude in many areas, and many farmers along rivers lost their crops to flooding, especially in Logone Oriental and Moyen-Chari Prefectures. However, outside of flood-affected areas of the Sudanian zone, food-crop production benefited from the abundant rainfall.

The final estimate of 1999/2000 cereal production released by the Agricultural Statistics Office (DSA) shows above-average national production (9 percent above the 1994/1995-1998/1999 average), but lower production (by 17 percent) than that of last year, which was a record year (table 1). Harvest-period (October to December) cereal prices seem to corroborate the overall good production picture.

Table 1. Comparison of 1999/2000 Gross Production with 1998/99 and Average (1994/95-1998/99) Gross Production (Final Estimates)

Consumption Year	*Berbéré*	Fonio	Maize	Millet	Rice	Sorghum	Wheat	Total
1999/2000 (MT)	174,781	2,270	94,151	367,964	138,282	455,904	3,585	1,236,937
1998/99 (MT)	133,216	2,270	179,999	357,321	120,666	554,670	4,749	1,352,891
Average (MT)	107,769	956	115,114	282,153	100042	450,389	3,315	1,059,737
Difference in % 1999/2000 vs 1998/99	31	0	-48	3	15	-18	-25	-9
Difference in % 1999/2000 vs average	62	137	-18	30	38	1	8	17

Source: DSA (Division de la Statistique Agricole), DPPASA, MOA

2. Initial Stocks

Estimated initial stocks include farmer stocks, commercial stocks, the National Food Security Stocks (NFSS) managed by a government parastatal (ONC), and WFP stocks for its school feeding programs. Total stocks were estimated at 126,076 MT as of the end of October 1999 (see Table 2 for details). Initial stocks are well above the levels estimated in 1998/99 (8,500 MT), which followed a very poor production year in 1997/98.

Farmer stocks have never been assessed in a satisfactory manner; however, low cereal prices observed during this past hungry period were a good indication of high farmer stocks.

B. Domestic Utilization

Food requirements for the year include food use and closing or carry-over stocks.

1. Food Use

a. Population

The National Statistics Office (NSO) estimates the country's population at 7,403,592 at the end of April 2000 (the mid-way point in the consumption year). The population estimate is derived from the 1993 census using a 2.36 percent national growth rate per annum.

b. Consumption period and requirements

The consumption period covered in the food balance sheet is common to all CILSS countries and extends from November 1, 1999 to October 31, 2000.

The national cereal consumption requirement is calculated using an annual per capita consumption norm of 159 kg. Thus, the total human consumption requirement amounts to 1,177,171 MT.

The cereal consumption requirement of 159 kg/year is based on the results of a recent study[1]. Cereals consumed include traditional cereals (sorghum, maize, millet and fonio), rice and wheat. For the purposes of the cereal balance sheet, the norms for rice and wheat, the two imported commodities, are determined using the estimated availability minus target carry-over stocks. Once this is determined, the total consumption for the other cereals is determined by subtracting the rice and wheat total from 159 kg/year per capita. For instance, this year the norms are 8.89 kg/year for rice, 9.18kg/year for wheat, and 140.93 kg/year for the rest of cereals.

2. Final Stocks

Closing or final stock levels are estimated based on historic levels. For the 1999/2000 consumption year, they were estimated at 76,225 MT (table 2).

C. Trade

Cross border flow of traditional cereals is very limited for a variety of reasons:

- A difference in dietary habits with the Central African Republic[2] and much of Cameroon, where people eat more tubers and root crops (yams, cassava, etc.)
- Any potential flows from Nigeria must flow through Cameroon, therefore crossing two borders. This increases the amount of informal taxes at border crossing and limits profitability of such trade.
- The production areas on either side of the Niger-Chad border are structurally deficit, providing little incentive for cereals to flow. In addition, the transport infrastructure linking Niger and Chad is poor, reducing further any possibility of significant cereal trade.
- While Sudan shares a long border with Chad and its population has similar dietary habits to those in Chad, its weak currency and high inflation hamper trade between the two countries.

[1] Charmes, J, 1997: Etude sur la Consommation et le Secteur Informel au Tchad (ECOSIT) pp. 38. DSEED (Direction de la Statistique des Etudes Economiques et Demographiques), Ministère des Finances, de l'Economie, du Plan et de l'Amenagement du Territoire, N'Djaména.

[2] Under extreme price differential conditions, cereal and other foodstuff trade may reach significant proportions. For instance in 1998 foodstuff prices were so high in Chad that an important amount of maize and cassava originating from places as far as Bangui crossed the border into Chad from CAR.

1. Projected Exports

Chad's exports are comprised of livestock (mainly cattle) and agricultural products other than cereals, such as cotton, groundnuts, and to a lesser extent garlic and onions. Cereals are rarely exported, even during years of good production.

2. Projected Commercial Imports

Most cereal imports are limited to rice and wheat, which are captured in official trade statistics. The Agricultural Statistics Division has projected commercial cereal imports at 12,000 MT of rice and 52,000 MT of wheat grain. This is a little less than the 1998/99 imports.

3. Projected Food Aid Imports

Given the good national production, no donor is planning to import food aid for the 1999/2000 period except WFP, which has plans to import 4,909 MT of soy-fortified corn flour, which is equivalent to 7,223 MT in grain, and another 5,005 MT of maize. The total amounts to 12,228 MT of program food aid imports. Available National Security Stocks are sufficient to initiate likely relief interventions and additional food aid stocks can be purchased on the local market.

D. National Food Balance

Cereal availability from current production and opening stocks amounts to approximately 1,134,000 MT. Consumption needs are estimated at 1,253,396 MT, resulting in a gross deficit of 119,690 MT (table 2). When anticipated net imports are added to availability, the net deficit is approximately 43,000 MT. Even in years of excellent production, like 1998/99, Chad registers an overall cereal deficit. This year's deficit is smaller than last year's deficit of 76,000 MT and a mere fraction of the 1997/98 deficit of 240,000 MT. The overall impact of the small deficit will be keep cereal prices relatively low prices during the hungry period (May-August), probably comparable with last year's very low prices.

Table 2. Post-Harvest Cereal Balance for 1999/2000

	Rice	Wheat	Traditional Cereals[1]	Total
Population through 4/30/2000				7,403,592
I. Domestic Availability	76,520	4,864	1,054,604	1,133,706
Production				
Gross	138,282	3,585	1,095,070	1,236,937
Net[2]	76,055	3,047	930,810	1,009,912
Initial stocks as of 11/1/98	465	1,817	123,794	126,076
Farmer	0	0	22,000	22,000
Other	465	1,817	101,794	104,076
II. Needs	66,318	69,965	1,117,113	1,253,396
Human consumption	65,818	67,965	1,043,388	1,177,171
Final stocks	500	2,000	73,725	76,225
Farmer	0	0	20,000	20,000
Other	500	2,000	53,725	56,225
III. Gross Surplus (+)or Deficit (-)	10,202	-65,101	-62,510	-119,690
IV. Imports/Exports	12,000	52,000	12,228	76,228
Projected commercial imports	12,000	52,000	0	64,000
Projected food aid imports	0	0	12,228	12,228
Projected exports	0	0	0	0
V. Net Surplus (+) or Deficit (-)	22,202	-13,101	-50,282	-43,462
VI. Per Capita Cereal Availability[3] (kg)	12	7	134	153

Sources: Ministry of Agriculture, FAO/CILSS

Note 1: Traditional cereals include fonio, maize, millet, and sorghum (including *berbéré* or recessional sorghum).

Note 2: The conversion factors between gross and net quantities are: 0.55 for rice and 0.85 for all other cereal crops. The rice conversion factor includes dehulling.

Note 3: Per capita cereal availability is (domestic availability – final stocks + net imports) / population.

E. Caveats and Uncertainties

1. Caveats

In the overall analysis of food security, it is important to understand the limitations of the cereal balance sheet. Because the assumptions and the methodologies for collecting the data that go into the cereal balance sheet remain the same from year to year, it is a useful tool for detecting anomalies. But, it does not give an accurate idea of the match between availability and needs in absolute terms. A large deficit does not necessarily signal a pending crisis. The size of the deficit (or surplus, should that be the case) needs to be compared with previous deficits (or surpluses) to interpret the impact on access to food, and hence, food security at the household level.

2. Uncertainties

The harvest estimates upon which this CVA are based include estimated recessional production but the recessional harvest will not be complete until March or April 2000, therefore, any large changes in estimated recessional production could change the conclusions in this CVA. In addition, as noted above, the final production estimates do not adequately reflect the late-season pest damage in the Sahelian zone.

III. Household Food Security

A. Objective of the Analysis

The objective of the analysis of food security at the household level is to:

- identify cantons where the 'average' household is likely to be food insecure;
- describe the extent to which households in these cantons are food insecure (see FEWS Food Security Categories box);
- evaluate the impact of potential shocks to food security in the current consumption period; and
- provide a basis for determining where concerted monitoring and possible interventions, including emergency food aid, may be needed.

FEWS Categories of Food Insecurity

In Current Vulnerability Assessments, FEWS classifies areas or specific socio-economic groups within areas as food secure or food insecure. In food-secure areas, an average household can maintain normal seasonal consumption patterns during the given consumption period using income derived from strategies that do not compromise future food security. In food-insecure areas, this is not the case.

To assist decision-makers in prioritizing emergency food allocations within and between countries, FEWS classifies food-insecure populations using the following operational definitions:

- Moderately food-insecure populations can meet their consumption needs during the given consumption period only by intensifying their normal coping strategies. These households are vulnerable to any subsequent shock, either in the given or subsequent consumption period.
- Highly food-insecure populations will not be able to meet their consumption needs during the given consumption period. They will be forced to reduce consumption and dispose of their productive assets, thereby undermining their future food security.
- Extremely food-insecure populations are now, or will soon be, unable to meet their consumption needs. They have already exhausted their strategies for acquiring food and are currently destitute.

Although the CVA assigns a food security status to each socio-economic group at the administrative level that constitutes the unit of analysis, it cannot quantify the number of food-insecure people. Rather, the CVA applies a food security classification to an "average" member of the area or group, the entire population of which can be counted. The larger the area and the more heterogeneous the group, the more likely it is that food security levels will vary among households within the group. Detailed food needs assessments are required to identify the precise numbers of affected people and appropriate interventions.

B. Conceptual Approach

FEWS defines food security as the condition in which a population has physical, social and economic access to sufficient safe and nutritious food over a given period to meet dietary needs and preferences for an active life (see Key Terms box). Embodied in this definition is the important concept that food security is more than simple food self-sufficiency. As the work of Nobel Prize winner Amartya Sen on entitlements underscores, even if adequate food supplies are available, a household's access to that food depends on its income-earning strategies, assets and coping behaviors. Thus a population's food security goes beyond aggregate food availability to include an assessment of how much food people can access directly through their own production or indirectly through market and other transactions. A population's food security also depends on its ability to properly utilize food. Individual health and nutritional conditions, as well as food care practices, determine whether available, accessible food can provide nutritional value to the individuals consuming it. Using quantitative and qualitative information, FEWS pulls together information on each of these three pillars of food security – availability, access and utilization – to determine whether households will be able to meet their consumption requirements in a given period.

C. Methodology

1. The Parameters for the Analysis

a. Time period

This CVA considers the ability of populations to meet their food needs between November 1999 and October 2000 (the 1999/2000 consumption year). It analyzes the outcome of the 1999/2000 growing season, which extends from April of 1999 to March of 2000: April marks the start of field preparations for the main-season rainfed crops, December the end of the rainfed harvest, and March the end of the recessional sorghum harvest.

b. Level of analysis

Although the conceptual framework is based on the household, the CVA groups households into representative populations to facilitate the analysis and improve targeting of relief interventions. These populations are defined in terms of their location (administrative unit) and way of accessing food (food economy or livelihood system). This analysis takes the canton, that is the 4th order, administrative unit, as the unit for analysis. This is done for two reasons:

- The canton is the smallest administrative unit for which agroclimatic conditions are sufficiently homogeneous for conclusions to be valid for the whole unit;
- Emergency responses to food insecurity and mitigation efforts focus on administrative units rather than households.

In focusing on the canton, CVA conclusions apply to an 'average' household in the canton but do not necessarily hold for the poorest and richest households within a canton. There are 347 cantons nationwide and the average population of a canton is 21,000.

c. Socio-economic groups
This CVA considers current food access of farmers, pastoralists and urban dwellers (see Appendix B for a description of the subgroups within each of these broad groups).

2. General Approach to Assessing Household Food Access at the Canton Level

a. Rural farming and pastoralist populations
All rural farming and pastoralist households derive some of their food access directly through food and livestock production or though fishing and wild food gathering. They also obtain some indirectly through market food purchases or gifts. Market purchases are paid for through crop and livestock sales and other income-generating activities.

The annual ebb and flow of crop and pasture production are key factors that affect whether rural households will be able to meet their food needs. If crop and/or pasture conditions are poor in the current year, the extent that populations can cope with the situation largely depends on whether

- they have alternative sources of income;
- they have had good or bad crop/livestock production over the past couple of years;
- the level of market food availability and prices.

Thus to monitor current year household food access at the canton level, it is important to understand the relative importance of the various income sources for each socioeconomic group, to assess current performance of each source, to analyze likely hungry period price movements, and to assess coping ability if total income is below average.

While the most logical level of analysis is the canton level, there are no income/production data on any of the key components of household income at that level. Crop production data are only available at the prefecture level (second order administrative unit). Crop price data is available at a limited number of markets. There are no recent livestock census data (the last census was in 1976) and livestock price data are not regularly collected. There is no regular collection of fish production or price data at any level.

Thus, to provide a good qualitative assessment of the current performance of the key production components of rural household income, FEWS Chad assesses current year crop, livestock, fish, and wild food production through analysis of a series of indicators derived from satellite imagery (both NDVI and Meteosat –

See Appendix D for a detailed methodology description), station rainfall data, and river level data (especially for recessional crop production and fish production). Pest and flood damage information is used to further refine the assessment. Corrections to account for socio-economic factors on production are also made. For example, analysis of hungry period food prices for the just completed growing period is performed to give an indication of whether market access difficulties could have limited food intake during the period of the year when farmers need to expend the most energy. If hungry period market prices were unusually high, farmers may not have been able to purchase sufficient food to meet their energy requirements and this could have limited area planted and weeding, leading to reduced production in the current season.

Analysis of hungry period food prices for the just completed growing period also gives an indication of household stock levels and coping ability. If prices remained low during the hungry period, this indicates that farm households have relied predominantly on household stocks to meet their food needs rather than market purchases. While this does not necessarily mean that households will have carry over stocks from the previous harvest at the end of the hungry period, it does indicate that they have had to draw less on savings and coping activities to meet food needs in the past year. This can imply that they are in a good position to cope with at least small current-year income declines.

Analysis of harvest-period food and cash crop prices provides information about revenue streams from current production. Changes in revenue streams from cash crops often determine whether farmers will have to sell more cereals than usual. Also, since many farmers sell much of their ‘surplus’ food production right after harvest, low harvest-period prices mean that the average farmer sells more of his/her food harvest to obtain cash to cover non-food needs, which in turn limits household food availability and access during the next hungry period. Lack of livestock and fish price data prevents comprehensive analysis of these important revenue sources; however, available anecdotal information on these revenue sources is used where possible. For example, information about animal diseases and animal conditions is used to infer the direction and magnitude of changes in pastoralist or agropastoralist income from animal offtake.

Analysis of national food availability and subnational food production provides information about likely food flows and price movements during the upcoming hungry period and the impact on market purchasing power.

FEWS Chad relies on the previous year’s CVAs to assess coping ability. If populations were food secure in the previous year, they are more likely to be able to cope with a negative shock to this year’s income. If they were already food insecure coming into this year, their coping ability has already been taxed.

b. Urban populations

Urban populations purchase the majority of their food on the market. They earn income through petty commerce, occasional wage labor and artisanal activities. A small minority are employed as soldiers, civil servants, and private-sector employees. There is a very little information on these major revenue streams. Under these circumstances, FEWS/Chad relies largely on an analysis of current and projected prices to assess current year food access and food security status of urban populations.

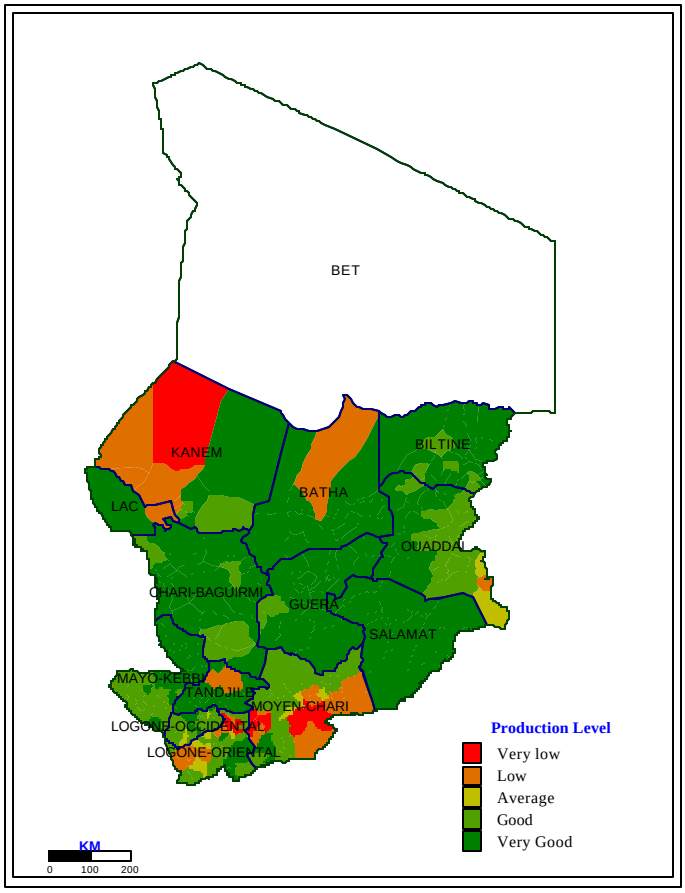
D. Overview of Factors Affecting Current Food Access at the Canton Level

1. Direct Access to Food

a. Direct access from production

The 1998 and the 1999 rainy seasons were very comparable in terms of rainfall distribution and quantity; however, flood damage was heavier in 1999. Analysis of satellite imagery, bolstered by analysis of other biophysical and socio-economic indicators, shows (figure 3) that over most of the Sahelian and Sudano-Sahelian zones food and pasture production varies from good to very good except in western Kanem Prefecture, and in parts of Lac, Batha and Ouaddaï Prefectures, where production varies from low to very low. In the Sudanian zone, there are areas of large production shortfalls over large parts of southeastern and a small part of western Moyen-Chari Prefecture, in the north and southwest

Figure 3: Crop, Wild Food and Pasture Production in 1999/2000



Source: FEWS

of Logone Oriental Prefecture, and in north-central Tandjilé Prefecture. In these areas, mostly affected by flooding, production varies from low to very low.

These findings from the analysis of satellite data and other information at the canton-level seem to mostly correspond with official production estimates at the prefecture level in the Sahelian and Sudano-Sahelian zones. Both may be overestimating production in the northern part of the Sahelian zone because neither takes adequate account of the late-season pest damage. However, for the Sudanian zone, the estimated Prefecture-level production balances (production compared to consumption needs) depict very poor production in Logone Oriental and Tandjilé (table 3), which does not conform with analysis of biophysical and socioeconomic information or with field observations. Reliance on convergence of evidence has led FEWS to question the apparently overly pessimistic production estimates in the Sudanian zone. The CVA assumes average cereal production in all but the flood-affected areas of the Sudanian zone.

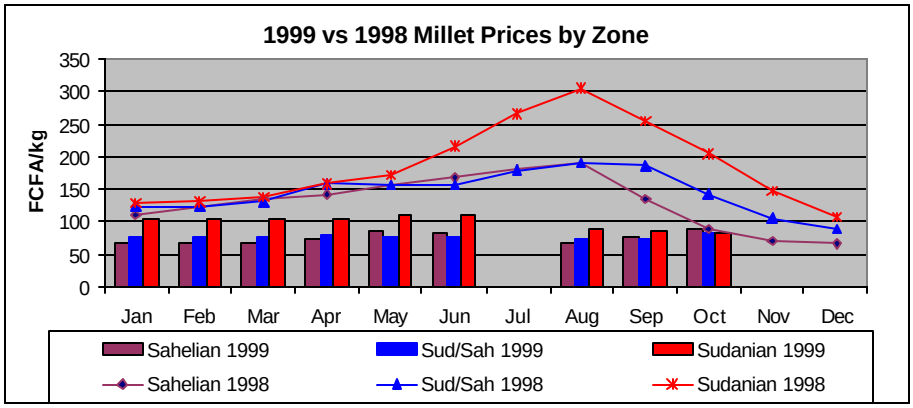
Table 3. Cereal Production by Prefecture

Zone	Prefecture	Avg Net Prod (kg/cap)	1999 Net Prod (kg/cap)	Dif Net Prod 1999 vs Avg (%)	Avg Cereal Balance (MT)	1998/99 Cereal Balance (MT)
Saharan	**BET**	0	0	0	-12,040	-13,217
Sahel	**Batha**	141	193	37	-5,557	11,463
Sahel	**Biltine**	75	119	59	-16,911	-8,823
Sahel	**Kanem**	28	26	-7	-39,522	-44,066
Sahel	**Lac**	170	200	18	2,946	12,024
Sahel	**Ouaddaï**	148	151	2	-6,709	-5,472
Sud/Sah	**Chari-Baguirmi**	100	96	-3	-79,700	-92,160
Sud/Sah	**Guéra**	118	141	20	-13,423	-6,327
Sud/Sah	**Salamat**	299	284	-5	27,950	27,462
Sudan	**Logone Occidental**	79	70	-12	-38,999	-47,801
Sudan	**Logone Oriental**	135	53	-61	-11,166	-55,103
Sudan	**Mayo-Kébbi**	169	147	-13	8,960	-11,305
Sudan	**Moyen-Chari**	131	110	-16	-22,281	-42,562
Sudan	**Tandjilé**	169	100	-41	4,911	-31,925

Source: DSA

b. Direct access from carry-over stocks

Stocks at the household level are never known with any level of accuracy. However, food prices during the 1999 hungry period remained well below average in the Sahelian, Sudano-Sahelian, and Sudanian zones, indicating that many households were able to rely largely on household stocks, rather than the market to meet food needs. This was a huge improvement over the situation in 1998, when hungry-period food prices reached unusually high of levels (figure 4), especially in the Sudanian zone.



Source: Market Information System (SIM)
Figure 4

2. Indirect Access to Food

a. Income from crop sales

As with production of food crops, outside of areas of excess moisture (Lac and Kanem Prefectures) and flooding (Logone Oriental, Moyen-Chari, and Tandjilé Prefectures) cash crop production was relatively good. In addition, heavy rains mid-season provided ideal conditions for market gardening around Lake Fitri, Lake Chad and along the Chari River, where market gardening is practiced.

In the Sudanian zone, ONDR estimates show groundnut production outside of flood-affected areas to be higher this year compared to the 1998/99 production. While quantitative estimates of cotton production are not yet available, qualitative estimates show that production in non-flood-affected areas should be about average. In flood-affected areas, however, farmers lost cotton, groundnut and food crops. For example, according to ONDR in the sector of Léré, one of the hardest flood-hit areas, groundnut production fell by about 60 percent compared to last year, with much higher losses in the cantons and villages directly affected by flooding. Sahr and Moïssala sectors were also hard-hit, with estimated groundnut production 13 percent below last year. Cotton also sustained heavy damage in flood-affected areas. Furthermore, the fall of cotton price at the international level resulted in a 12 percent decrease in producer cotton prices. The decrease in cash crop income will limit households' ability to purchase food in flood-affected areas.

b. Income from livestock offtake and direct access to milk
A combination of good pastures and water supplies for livestock, no major animal diseases, and good market prices for animals indicates that most pastoralists and agropastoralists will have easy access to milk from their herds and should expect adequate income from livestock offtake to finance food and non-food needs this season.

Some agropastoralists in the Sahelian zone along the Chari and Logone Rivers lost significant numbers of small ruminants this year because of parasites, but households in these areas mostly keep and sell animals to cover expenses for special events (weddings, funerals, etc.) or to finance food purchases during times of food shortages. While income from livestock offtake will be reduced during next hungry period, agriculture production was good in the area and the lost livestock income should not pose food access problems.

c. Income from income generating activities
Income generating activities in the Sahelian and Sudano-Sahelian zones are expected to be normal throughout the season. These include handicraft, hay and charcoal sales, seasonal outmigration, and market gardening and fishing, where possible.

The main off-season activity for rural Sudanian zone populations is casual agricultural labor. Because of the localized nature of flooding in the Sudanian zone this year, many households in flood-affected areas were able to find work in near-by non-flooded areas helping with the harvest. Gardening prospects are good and households will also be able to consume and sell mangos during the mango season from February to late May.

In the recessional crop areas where pastoralists provide transport of the recessional harvest from fields to farmers' homes, the excellent recessional prospects promise good income earning opportunities for these pastoralists.

Urban populations' activities are also expected to remain normal throughout the season. Their ability to acquire food will depend on urban markets supplies and foodstuff prices.

d. Coping ability
Sahelian zone populations are typically exposed to frequent disruptions to crop and livestock production. Consequently, they have developed diversified sources of food access. In many areas, wild food collection plays an important role in helping needy households meet food needs. Seasonal migration in search of employment and sales of handicraft production provide important contributions to household income.

In contrast, Sudanian zone rural populations are typically exposed to food insecurity events at a lower frequency. They have very little ability to cope in the

event of disruptions to their main source of food access: crop production. They do not have a strong tradition of building and keeping food stocks in years of good harvests to help them weather bad years. They tend to sell part of their food harvest, not keeping enough reserves to assure family food security. Also a large amount of grain is used for beer brewing, which is not a problem in normal times but could be a serious one in times of food shortages.

The 1998/99 FEWS CVA classified all Sahelian zone populations as food secure for the 1999 hungry period. This was in agreement with the EU-funded SAP preliminary analysis of food security status. The excellent cereal harvest and pastoral conditions across the zone in 1998/99 allowed households to build cereal stocks and savings in the form of livestock. Thus, coming into the 2000 hungry period, these households have strong coping capacity.

On the contrary, in the Sudanian zone, the 1998/99 CVA identified 42 cantons as highly food insecure. Most of these cantons were in Logone Occidental (16 cantons) and Tandjilé (16 cantons) and in some parts of Logone Oriental (8 cantons), and Mayo-Kébbi (2 cantons). Subsequent field trips confirmed these findings. Thus, in these areas, households, many of whom had suffered 2 consecutive years of hardship, had lost their means of production (such as traction animals and ploughs), sold their liquid assets, or contracted debts. Consequently, many households were not able to take full advantage of the good agroclimatic conditions during the 1999/2000 growing season. For those who suffered flood-induced losses over the course of the season, this represents a third consecutive year of hardship and coping strategies have been largely exhausted.

e. Purchasing power – Likely hungry period market prices

Analysis of the national food balance shows that at the national level, Chad has a net cereal deficit of over 43,000 MT. This is less than last year's estimated deficit of about 76,000 MT and well below the 240,000 MT deficit of 1997/98. This level of national availability is likely to help keep overall prices relatively low, perhaps as low as the extremely low levels of 1999 (figure 4).

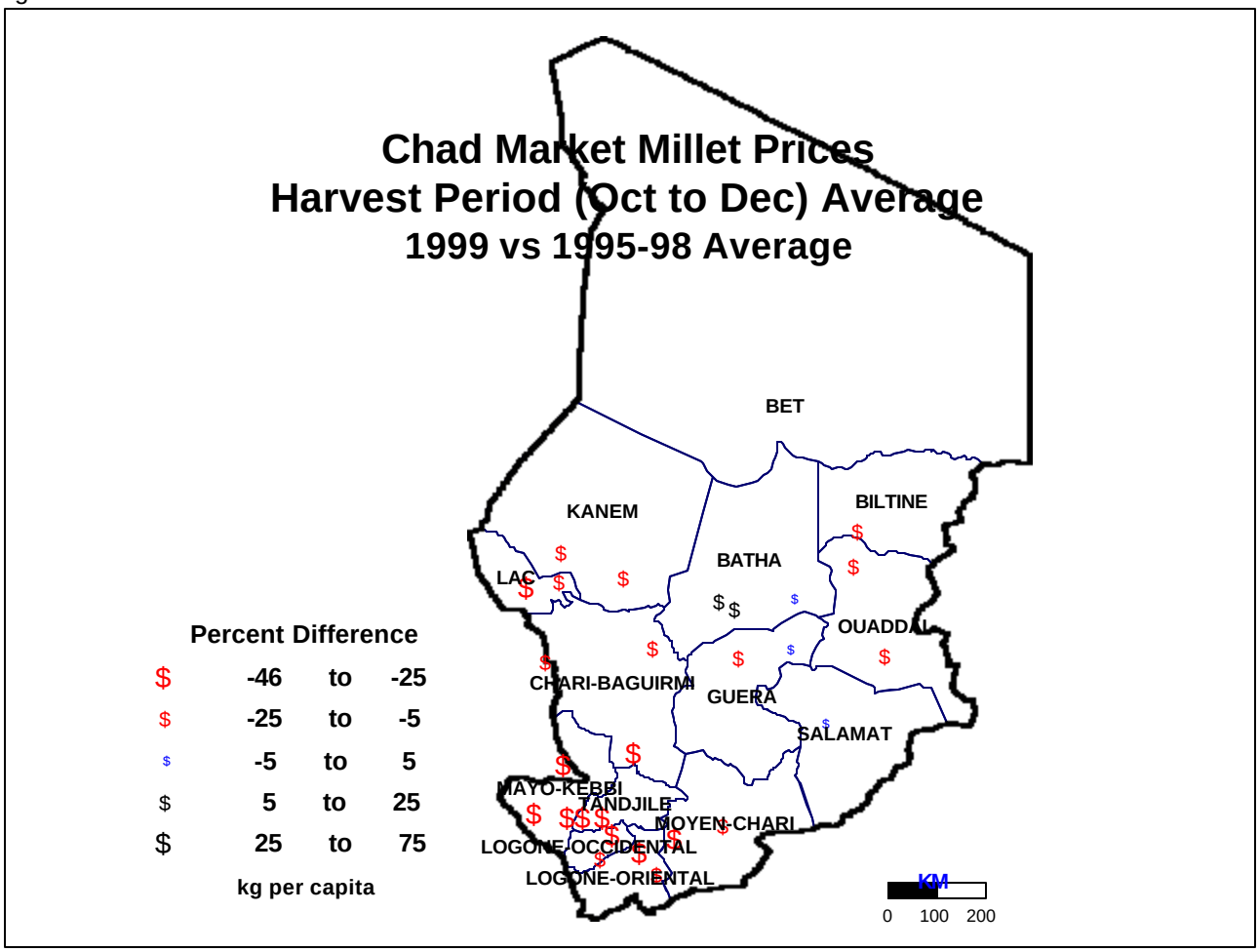
One consideration that may affect supply and price levels in rural areas of the Sudanian zone is that farmers sold a large part of their food at harvest time to traders who have transported the food out of the rural areas to urban centers where purchasing power is strong.

The reason for increased food sales this year is two fold:

- Cotton farmers saw their incomes from their most important income source, cotton, fall because SONALEC, the cotton parastatal, lowered the producer cotton price by 12 percent in response to falling world cotton prices. To meet cash needs, some farmers have sold more food crops at harvest than they normally would.

- Because harvest-period cereal prices have been so low (figure 5), farmers had to sell more of their harvest to generate sufficient revenue to meet non-food needs and to pay debts.

Figure 5



Source: Market Information System (SIM)

E. Current Food Security Status

1. Rural Populations

a. Dryland farmers

In the Sudanian zone, ONDR estimates and FEWS analysis of biophysical and socio-economic information indicate that overall cereal and cash crop production for the 1999/2000 season is at least average and higher than in 1998/99 except in areas affected by flooding. The majority of dryland farmers in this zone are therefore food secure. In areas of flood damage, however, farmers lost an important part of their cotton, groundnut and cereal crops, reducing their direct

and indirect access to food. For some of these households, this represents the third consecutive year of very poor food production and low cash crop revenue. In addition, food supply in rural areas may be limited and prices high because farmers across the Sudanian zone have had to sell more of the cereal harvest than usual to off-set lower cereal prices and lower cash-crop revenues. Thus, dryland farmers in parts of Logone Oriental, Mayo-Kébbi, Moyen-Chari, and Tandjilé Prefectures are either moderately or highly food insecure (table 4 and appendix C). Populations in some of these areas are already experiencing difficulty meeting their food needs.

In the southern part of the Sahel (southern Guéra, southern Ouaddaï, southern Chari-Baguirmi Prefectures) record levels of both food crop and wild food production and increased water resources for off-season production have left dryland farmers food secure for the coming hungry period.

In the northwestern part of the Sahel (Kanem and the continental part of Lac prefecture), dune millet, the main crop in the area, was stunted by excess moisture and insufficient sunshine. While these areas traditionally rely heavily on remittances and seasonal migration and will benefit from the good pasture and water resources, the magnitude of the crops losses are significant enough that the affected households are unlikely to be able to meet food needs without depleting productive assets and reducing consumption to levels that could cause malnutrition in vulnerable groups. Wild food production, which has been plentiful in other parts of the Sahelian zone, is not plentiful in the affected areas. For this reason, farmers in Mao, Nokou, Rig-Rig and N'Gouri subprefectures are considered highly food insecure.

In the northeastern part of the Sahel (Biltine Prefecture and northern Batha, Guéra and Ouaddaï Prefectures) crops have suffered from pest attacks. Mining caterpillars and birds heavily damaged sorghum and millet crops at their milky stage in September and October. Mid-season hopes for crop harvests as good as in 1998/99 were not borne out. Instead, the late-season pest attacks put production at about average levels at the province level but left important localized production shortfalls. However, crop production will be supplemented by good wild food supplies and abundant pasture and water supplies for livestock. Furthermore *berbéré* production in Salamat, the main cereal supplier to the prefectures laying north of it (Guéra, Batha, Ouaddaï and Biltine), has been excellent. Within these prefectures only canton Ouled was identified as moderately food insecure by our analysis.

b. Recessional farmers

The heavy to extremely heavy rains that fell over most agricultural parts of the country between early July and the end of August resulted in floods that provided good conditions for recessional crop production. Unlike in 1998, when people weakened by food shortages were not able to take good advantage of the good

rains and high flood levels, this year farmers have taken full advantage and harvest prospects are excellent. Thus recessional farmers are food-secure.

c. Fisher-farmers

This year river levels did not reach those of 1998, but they were still among the highest in the past 20 years. Consequently, fish production is expected to be above average. Despite the anticipated good fish production, fishing households in flood-affected areas of the Sudanian zone are expected to be moderately food insecure because they lost an important part of their crop and cash crops harvests to flooding.

d. Pastoralists

This year, pasture and water are plentiful over the whole country south of the Saharan zone, promising good animal production. Terms of trade (kg of cereal per animal) are expected to continue to rise, improving pastoralists' purchasing power. Food prices are not expected to be high during the hungry period in the Sahel, especially in areas where pastoralists spend the rainy season. With good purchasing power in areas where food availability is expected to be at least normal, pastoralists will be able to meet their food needs through market purchases and are considered food secure.

2. Urban Populations

a. Residents of major cities

Urban residents of major cities (N'Djaména, Moundou, Sarh, and Abéché) purchase most of their food, and their access to food is tightly linked to food prices. With above average levels of food production and significant carry-over stocks, merchants in large cities will have large stocks to meet urban demand. During the hungry period food prices are expected to be a little higher than in 1999 but not prohibitive and access should be easier for most urban residents. They are, therefore, considered food secure.

b. Residents of secondary cities

Residents of secondary cities have more diversified income than their counterparts in major cities. They are more likely to farm and own livestock, providing them with additional income to supplement their urban-income activities. With the good harvest outcome at the national level they are considered food secure.

F. Caveats and Uncertainties

In the Sudanian zone, food insecurity has been caused by floods this year. For most cantons, detailed flood damage information at the village level was available. In these cases, only the affected villages in these cantons are identified as highly food insecure, so the whole population of the canton is not enumerated in the population total for the canton. In other flood-affected

cantons, where detailed lists of villages were not available, 10 percent of the canton population is arbitrarily enumerated as highly food insecure. If and when detailed information becomes available the population figures will be adjusted.

Table 4. Food-Insecure Populations in 1999/2000

Prefecture	Subprefecture	Socio-economic group	Highly Food-Insecure	Moderately Food-Insecure
Moyen-Chari	Sarh Rural	Farmers	35,961	
	Maro	Farmers	4,309	
	Koumra	Farmers	15,400	
	Bedjondo	Farmers	48,417	
	Kyabé	Farmers	2,484	20,690
Logone Oriental	Bebedjia	Farmers	19,394	11,434
	Doba Rural	Farmers	19,925	7,541
	Bessao	Farmers	7,593	21,196
	Laramanaye	Farmers		17,543
Mayo-Kébbi	Léré	Farmers	3,130	
Tandjilé	Laï	Farmers		24,509
Lac	Ngouri	Farmers	10,089	
Kanem	Mao	Farmers	91,559	
	Nokou	Farmers	34,693	
	Rig-Rig	Farmers	10,000	
Batha	Djedaa	Farmers		4,589
Total			**302,954**	**107,502**

Source: FEWS/CHAD

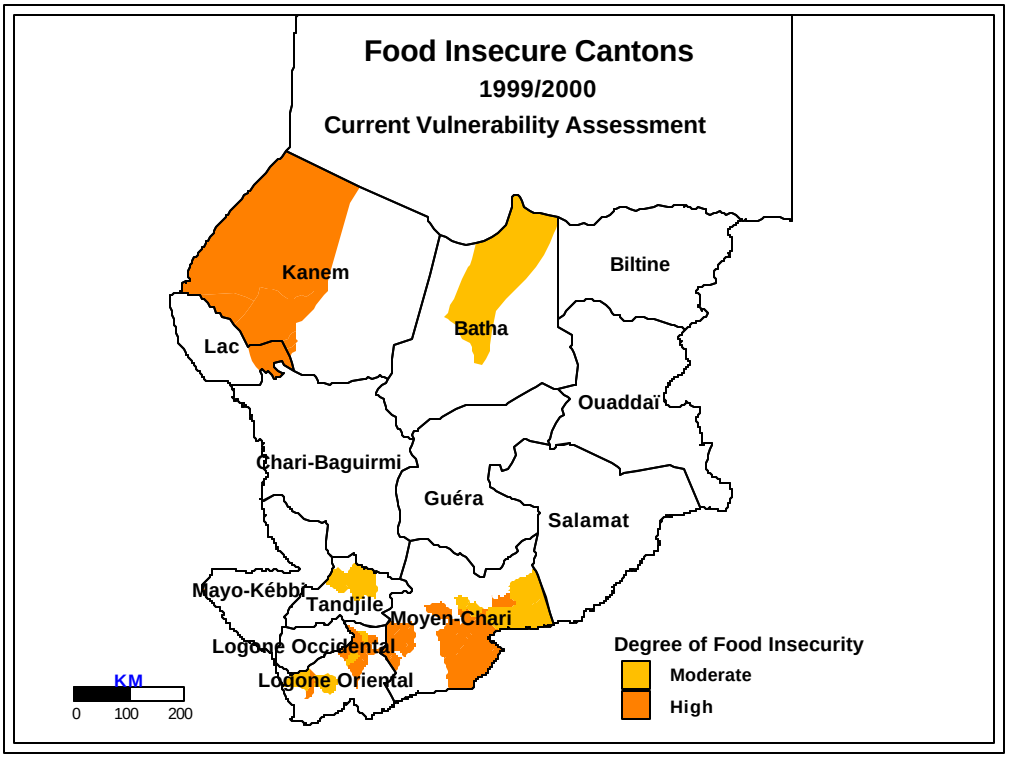


Figure 6
Source: FEWS

IV. Conclusions and Actions

A. Summary of Food Insecurity

The analysis indicates that about 146,300 Sahelian zone farmers are highly food insecure and another 4,600 moderately food insecure. About 156,600 Sudanian zone farmers in flood-affected areas are highly food insecure and another 102,900 are moderately food insecure.

B. Actions Required

1. Information Needs

SISAAR (Système d'Information pour la Sécurité Alimentaire et l'Alerte Rapide), the recently created early warning information unit of the Action Committee for Food Security and Crisis Management (CASAGC), identified 690,000 people as highly food insecure for the 1999/2000 consumption year. Their findings are in disagreement with the FEWS VA results in terms of both areas and numbers of people affected. Field trips are planned to collect information that will help refine the VA and lead to a consensus list of food-insecure areas and number of people affected.

During these trips potential implementing partners among local NGOs will also be sought.

2. Response Planning Process

Donors and the Government have met through CASAGC meetings to discuss potential response options for food-insecure populations. Two separate food aid options are considered.

WFP is planning an assistance program in the Sudanian zone that will target all the areas identified as highly food insecure by FEWS. Because most of these areas have been food insecure for 2 to 3 consecutive years, WFP is considering a free food distribution in the amount of 2,958 MT of cereal, 119 MT of cooking oil, and 420 MT of beans and peas. These quantities may be revised after the forthcoming field trips to verify the CVA results. WFP does not have any current plans to intervene in the Sahelian cantons that FEWS identified as highly food insecure.

ONC is planning to use the 3,600 MT of cereals in the national food security stock for subsidized sales in the Sahelian zone. France is likely to authorize ONC to use counter-part funds to buy an additional 4,000 MT of sorghum for additional subsidized sales should these be deemed necessary.

V. Appendices

A. Chad's Ex-post Cereal Balance for 1998/99
B. Definitions of Socio-economic Groups
C. Food-Insecure Cantons in 1999/2000
D. Satellite Imagery Analysis in Vulnerability Analysis

Appendix A. Chad's Ex-post Cereal Balance for 1998/99

	Rice	Wheat	Traditional Cereals[1]	Total
Population to 30-04-99				7,232,896
1. Availability	66,866	5,537	1,049,855	1,122,258
Gross Production	120,666	4,749	1,227,476	1,352,891
Net Production[2]	66,366	4,037	1,043,355	1,113,758
Initial stocks	500	1,500	6,500	8,500
a) Farmer stocks	0	0	0	0
b) Merchants	500	1,500	3,000	5,000
c) NFSS			1,100	1,100
d) WFP			2,400	2,400
2. Needs	72,504	73,423	1,130,179	1,276,106
Cons. (kg/year per person)	9.96	9.9	139.14	159
Consumption	72,039	71,606	1,006,385	1,150,030
Final Stocks	465	1,817	123,794	126,076
a) National FSS + WFP			5,151	5,151
b) Villagers' associations			92,500	92,500
c) Farmers			22,000	22,000
d) Other	465	1,817	4,143	6,425
3. Gross surplus (+)				
or deficit (-)	-5,638	-67,886	-80,324	-153,848
4. Import/Export	10,000	62,727	4,739	77,466
Commercial Import	10,000	50,000	0	60,000
Aid pledged	0	12,727	4,739	17,466
5. Net surplus (+) or				
Deficit (-)	4,362	-5,159	-75,585	-76,382
6. Per capita cereal				
Availability[3] (kg)	9.24	0.77	145.15	155.16

Source: Ministry of Agriculture

Note 1: Traditional cereals include fonio, maize, millet, and sorghum (including *berbéré* or recessional sorghum).

Note 2: The conversion factors between gross and net quantities are: 0.55 for rice and 0.85 for the rest of cereal crops. The conversion factor for rice included dehulling.

Note 2: Per capita cereal availability is (domestic availability – final stocks + net imports) / population.

Appendix B. Definitions of Socio-economic Groups

This CVA considers current food access of rural populations (farmers and pastoralists) and urban dwellers.

1. Rural Populations

The main subgroups within this category are farmers and pastoralists.

a. Farmers
This group represents about 73 percent of the total population and constitutes the bulk of the rural population. All farmers practice dryland agriculture, and most integrate small-scale livestock raising. There are important subgroups of farmers who, in addition to practicing dryland agriculture and raising livestock, supplement their incomes through recessional agriculture (sorghum, rice, maize, and wheat), large scale market gardening, or seasonal fishing.

Dryland farmers
In the Sudanian zone dryland farmers grow diversified food crops, including cereals, cassava, and yams. Most grow cash crops such as groundnuts and cotton. In the Sahelian zone, dryland farmers have much less diversified cropping systems. They mainly grow millet and sorghum. During the nine months of dry season, much of the work force leaves the villages to seek employment in towns or other rural areas where there are better employment opportunities in market gardening, off-season agriculture, and seasonal fishing. Those who remain in the villages normally engage in labor intensive and less lucrative activities such as cutting hay or firewood, producing charcoal, and collecting wild food. In southern Oum-Hadjer Subprefecture (Batha Prefecture) and in Mangalmé Subprefecture (Guéra Prefecture), people make and sell palm mats. In Abéché Rural Subprefecture in Ouaddaï, an important subgroup of dryland farmers relies heavily on income from onions and garlic produced during the dry season to purchase cereals. The onions and garlic produced in the wadis of Ouaddaï meet a large share of national demand and are also exported to CAR, Congo, and Gabon.

Recessional farmers
This subgroup includes farmers who practice a combination of rainfed and recessional agriculture. It includes people living in the flood plains of Salamat, the Mayo-Kébbi and Tandjilé water shed areas, the Lake Chad polder area, the Lake Fitri area of Batha, and at some extent the large bas-fond areas of Chari-Baguirmi. In Salamat and around Lake Fitri, *berbéré* (recessional sorghum) is the main recessional crop grown. In the polders of Lake Chad, maize and wheat comprise most of the recessional crops. In Mayo-Kébbi and Tandjilé, *berbéré* and recessional rice supplement rainfed production. In Chari-Baguirmi *berbéré* cultivated surfaces are highly correlated with rainfall amounts. In a drought year bas-fonds do not hold water and surfaces suitable for *berbéré* are reduced. In a

good rainy season like 1998 and 1999, surfaces cultivated to *berbéré* could be as large as those cultivated to rain-fed crops.

Recessional farmers are less vulnerable to drought than dryland farmers because they can integrate recessional and rainfed production. Recessional production depends on the river levels, which depend more on rainfall upstream than on local rainfall. Drought may prevail locally, but if rainfall is good upstream or somewhere within the river catchment basin, then the recessional agricultural production is not affected. In the rice-producing Prefectures of Mayo-Kébbi and Tandjilé, farmers can compensate for expected reductions in rice production by shifting to recessional sorghum. However, while recessional farmers are less vulnerable to drought they can be as much vulnerable to other causes of food insecurity. The case of the 1998 hungry period, when people weakened by food shortages were not able to take good advantage of the good rains and high flood levels, was a good illustration.

Fisher-Farmers

In addition to dryland and recessional farming, seasonal fishing is practiced by people living around the lakes Iro (Moyen-Chari Prefecture), Fitri (Batha Prefecture), Léré (Mayo-Kébbi Prefecture), Chad (Lac Prefecture), along the Chari and Logone Rivers, and around permanent ponds such as Assida, Amdouma, and Gara (Salamat Prefecture). The fishing population was estimated by DEPA (Direction des Eaux Pêches et Aquaculture) in June of 1994 to be approximately 300,000 people. No reliable records exist, but a study on the informal sector[3] suggested that annual fish production could be around 50,000 MT. The same study suggested a strong positive correlation between river levels and fish production.

b. Pastoralists

Pastoralists represent about 6 percent of the total population in Chad. Based on the type of livestock owned, pastoralists can be divided into camel herders, cattle herders, and small ruminant (goats and sheep) herders. All pastoralists lead a nomadic lifestyle and earn their living through sales of livestock and dairy products. Camel herders also derive a significant share of their income from providing transport services in isolated areas with limited road access. In Salamat during *berbéré* harvest, camels transport the harvest from the field to storage locations. Pastoralists rely on market purchases and payment in kind for transport services to meet their cereal consumption needs.

During the rainy season, when wet conditions in the south foster favorable conditions for insects and animal diseases, pastoralists move their households

[3] Charmes, J, 1997: Etude sur la Consommation et le Secteur Informel au Tchad (ECOSIT) pp. 38. DSEED (Direction de la Statistique des Etudes Economiques et Demographiques), Ministère des Finances, de l'Economie, du Plan et de l'Amenagement du Territoire, N'Djaména.

and herds north, where drier conditions provide a healthier environment for livestock. At the end of the rainy season, as surface water for livestock becomes scarce in the north, herders start their seasonal migration southward. The transhumance pattern of camel and goat/sheep herders extends from the northern Sahel to the Sahelo-Sudanian areas (Salamat Prefecture, Melfi Subprefecture in Guéra, Bousso Subprefecture in Chari-Baguirmi, and Bongor Subprefecture in Mayo-Kébbi). The transhumance pattern of cattle herders is much more extensive, stretching from northern Batha, Biltine, and Kanem to the southern frontier of Chad.

Given the vast extent of pastureland in Chad, pastoralists can usually find adequate pasture for their livestock. However, when a major drought occurs, water becomes a limiting factor. Camel and goat herders are less vulnerable to drought than cattle herders because goats and camels feed on perennial plants that can withstand drought better than the annual grasses cattle feed on. In addition, goats need less water and camels can survive without water for longer periods than cattle. As surface water becomes scarce, herders converge on what few water sources remain, and overcrowding leads to overgrazing and often the spread of animal diseases. As available pastures are depleted, animals lose weight; milk production falls and so does the value of livestock, reducing pastoralists' two most important sources of revenue. This in turn limits pastoralists' purchasing power and their access to food.

2. Urban Populations

Based on the 1993 census, 21 percent of the total population is urban. Within this group there are two subgroups[4]. The first subgroup consists of residents of the four major cities (N'Djaména, Moundou, Sarh, and Abéché) and represents 59 percent of the total urban population. The second subgroup consists of residents of secondary cities (such as Prefecture capitals).

a. Residents of major cities

These urban residents earn their living through a wide range of activities, most of which fall within the informal sector of the economy, such as commerce, handicrafts, and selling water. A minority are employed as soldiers, civil servants, and private-sector employees. Urban residents of major cities purchase most of their food, and their access to food is tightly linked to food prices.

[4] Bureau Interministeriel d'Etudes et de Programmation (B.I.E.P.) 1991: Evaluation Rapide de la Securité Alimentaire au Tchad, pp 57.

b. Residents of secondary cities

While residents of secondary cities also purchase most of their food, they have more diversified income sources than their counterparts in major cities. They are more likely to farm and own livestock, providing them with additional income to supplement their urban-income activities.

Appendix C. Food-Insecure Cantons in 1999/2000

Prefecture	Subprefecture	Canton	Highly Food Insecure	Moderately Food Insecure
Moyen-Chari	Sarh Rural	Balimba	12334	
		Banda	9956	
		Djoli	757	
		Moussafoyo	4475	
		Koumogo	8439	
	Maro	Maro	4309	
	Koumra	Matekaga	1016	
		Mouroum Goulaye	3178	
		Koumra Rural	9489	
		Bekamba	1717	
	Bedjondo	Bebopen	9332	
		Bedjondo	4926	
		Nderguigui	11740	
		Yomi	4793	
		Peni	17626	
	Kyabé	Kyabé	1191	
		Koskobo	1157	
		Kotongoro	134	
		Bohobe		2360
		Marabe		4303
		Ndjokou		6816
		Singako		7211
Logone Oriental	Bébédjia	Beboni	832	
		Bébédjia	3900	
		Bero	5313	
		Miandoum		11434
		Komé Ndolebé	2950	
		Mbikou	6399	
	Doba Rural	Mango	2994	
		Nankessé	1269	
		Doba	1632	
		Maibo Mbaye	14030	
		Nassian		7541
	Bessao	Pandzangue	7593	
		Gadjibian		21196
	Laramanaye	Andoum		12634
		Mbouroum		4909
Mayo-Kébbi	Léré	Bipare	3130	

Prefecture	Subprefecture	Canton	Highly Food Insecure	Moderately Food Insecure
Tandjilé	Laï	Soumraye		10219
		Deressia		14290
Lac	Ngouri	Ngouri	10089	
Kanem	Mao	Mondo	9610	
		Motoa	4296	
		Sulatanat	77653	
	Nokou	Nokou	10313	
		Ntiona	24380	
	Rig Rig	Rig Rig	10000	
Batha	Djedaa	Ouled Rachid		4589

Appendix D

Satellite Imagery Analysis in Vulnerability Analysis

Alkhalil Adoum, FFR, Chad

SUMMARY

FEWS uses normalized difference vegetative index (NDVI) and METEOSAT rainfall estimates (RFE) for pre-harvest assessment and vulnerability analysis. The following analysis technique was developed by the CFFR for Chad.

It starts with the extraction of spatial averages from the West Africa GAC (Global Area Coverage) for the past year images and normal images at the fourth administrative unit level for both NDVI and RFE using SPACEMAN from the first dekad (10-day period) of April to the third dekad of October. The growing season was then divided into three parts: a start, middle and an end. The agricultural area was divided into three agro-ecological zones: the Sudanian zone, the Sahelian zone, separated by a Sahelo-Sudanian zone. The three parts of the season, that are agro-ecological zone dependent, were then defined. Three indices are constructed separately for NDVI and RFE and then combined to obtain an index of each one of the three season parts. The latter three indices were at last combined into a global index used to characterize the whole season.

1 Presentation of the methodology

a. The theory

In order to understand why FEWS uses remote sensing products we need to briefly state what the ultimate goal of FEWS is. FEWS mandate consists of ensuring continuous monitoring of the food security situation in sub-Saharan Africa so that anomalies could be detected early enough to allow for appropriate response planning in a timely manner. The ultimate goal is, therefore, to determine areas where populations are likely to experience food shortages. Once these areas are determined a set of recommendations for mitigation and contingency planning should be issued and disseminated among decisions makers within the national leadership and donor community.

Vulnerability analysis seeks an answer to two questions:

- Is food available in quantities large enough to meet the population needs for the period before next harvest?
- How easy would the access to food be during this period of time?

The answer is sought by assessing availability of and the accessibility to food by the different socio-economic groups in a given area. It gives an indication of whether or not a population can meet its food needs given the level of resources and the options available. This appendix covers the agro-physical aspect of food security and will only treat the food availability aspect.

Availability basically consists of agricultural production, animal production, cereal stocks and livestock. Considering that in some areas production is almost always lower than people's needs the project is more interested in the anomalies and their magnitude. Availability as well as other parameters governing food security are, therefore, assessed and compared to normals and averages. Given the rudimentary state of transport infrastructure in Sahelian countries availability in rural areas is mainly determined by production, which is characterized by a large interannual variability.

Ground Data
Production assessment is carried out through the growing season monitoring, which is ensured by ground observations complemented by remote sensing observations.

Data and information collected on the ground include among others:

- Rainfall;
- Hydrology;
- Crop phenology;
- Crop pests;
- Animal health;
- Biomass measurements;
- Agricultural statistics, etc.

These data gathered through the ground observation network are very important for the analysis. However, in many sub-Saharan countries, national institutions responsible for the collection of these data experience financial problems that seriously limit their capabilities to perform. This poor performance level is further exacerbated by the gradual withdrawal of donor support that has started in the mid-nineties. Inadequate funding is affecting the quantity as well as the quality of the data collected and other qualitative information gathered. Most of the time loose observation network do not provide enough spatial coverage. Analysis of data gathered by such networks may overlook important details and lead to erroneous conclusions. For example the erratic nature of rainfall requires a denser rain-gauge network than what exists in most of Sahelian countries to avoid overlooking some important local variations in rainfall pattern. If these overlooked local variations include significant drought pockets early warning will fail. Poor funding can also affect human resources and prevent equipment upgrading to meet the demand or result into poor maintenance. At the end funding problems always have repercussions on data quality. For instance in some countries poor funding of the agricultural statistics services resulted into poor quality agricultural production data. To alleviate these problems the use of remote sensing becomes a necessity. Remotely sensed data such as NDVI and METEOSAT RFE offer a good complement to ground based observational data in monitoring the growing season.

Remotely Sensed Data

Remote sensing products is a complementary tool to ground data and provide at the same time a partial solution to the quality and quantity problems of ground data. Remote sensing gives a total spatial coverage so that the analysis could be conducted at as fine administrative levels as the analyst wishes, which is impossible otherwise. A good example is that of the agricultural production in Chad, which is available at the second administrative level only, which is the prefecture level. This poses a constraint to the analyst, because a prefecture can cross over on several degrees of latitude and where heterogeneous agroclimatic conditions could sometime prevail.

FEWS uses remote sensing in a variety of ways. The method that will be described here combines NDVI and RFE into a single index that is used to predict harvest and assess vulnerability to food insecurity.

Satellite imagery available to the project on a regular basis are NDVI and METEOSAT Rainfall Estimate (RFE) of GAC (Global Area Coverage) resolution with a pixel size of about 7 km X 7 km.

There are also problems related to the use of NDVI and RFE that an analyst should be aware of. Observation has shown that an increase in NDVI is almost always indicative of an increase in biomass. However, the reverse is not always true. A decrease in NDVI is not necessarily related to vegetation stress, but could be due to a variety of reasons, which may include sand storms, cloud shading, flooded plains etc.

RFE is an estimate of rainfall based an algorithm that takes into account parameters such as top of the cloud temperature, the cloud duration and ground observation where available. The value of each pixel is a spatial average and given the erratic character of rainfall the correlation of RFE with rain-gauge measurement is weaker than would be expected. Nevertheless cumulative RFE are close to reality except in the Saharan zone where departures can be significant. The most plausible cause for Saharan zone inaccuracy is the METEOSAT sampling period, which is every 30 minutes. The further we go north and the more violent and short lasting thunderstorm events are. In half an hour the satellite can miss a good part of the storm.

b. The Methodology

The method consists of:

- Dividing the growing season into three parts that vary according to the agro-ecological zone (Table I). These parts are the beginning, the middle and the end of season. The beginning starts at the dekad when generalized sowing takes place and ends when sowing could be considered too late. Then follows the middle that ends at the dekad of

maximum NDVI. The last part or end of season is the maturation period.

Table 1: The three periods of the growing season in Chad

Zone/Period	Start (month/dekad)	Middle (month/dekad)	End (month/dekad)
Sudanian	5/2-6/3	7/1-8/3	9/1-10/3
Sahelo-Sudanian	6/1-7/1	7/2-8/3	9/1-10/2
Sahelian	6/3-7/2	7/3-8/3	9/1-9/3
Saharan	No season		

- Extract spatial average at the desired administrative unit for the current year and the average for all dekads from sowing to the end of rains.
- For each of these dekads compute a dekadal index (DI) for NDVI and RFE based on the following formula:

DI=(current value - average)/(current value + average)

- Calculate an average period index (API) for each of the three periods defined by simply taking the averages of the DI's within the period for NDVI and RFE. Three columns for NDVI API's and three columns for METEOSAT RFE API's are obtained this way. These NDVI and RFE API's are combined to obtain a satellite period index (SPI) for each period to yield only three columns. These three columns can be mapped to analyze the three parts of the growing season separately and then an average is calculated to obtain a satellite season index (SSI) which can be mapped to analyze the growing season and its probable outcome.

High values of the SSI thus obtained are indicative of a good rainfed crop production and vice versa. One should note that because of the low NDVI for water flooded plains they show a low SSI. That is why SSI is used to assess the season outcome where rain-fed crops are predominant. However, for the areas where recessional agriculture is predominant, floods constitute a sign for a good harvest. In such areas a correction should be applied to the SSI for a final index to predict or assess the whole season outcome.