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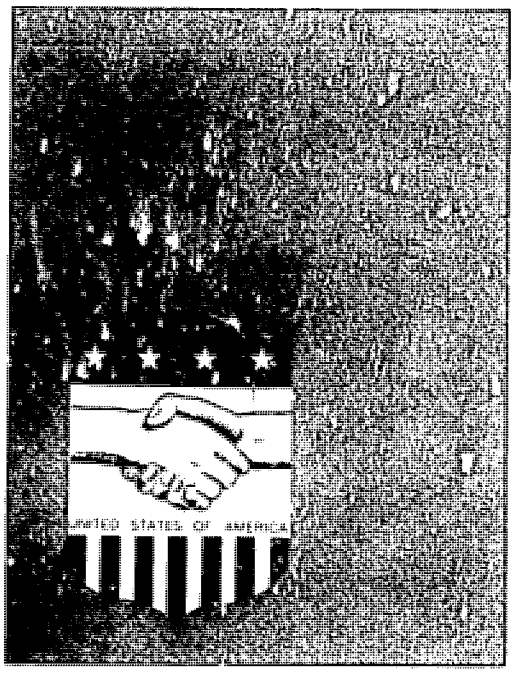

A Manual for Food Needs Assessment

June 1985

Bureau for Food for Peace and Voluntary Assistance
Agency for International Development
Washington, D.C.

A MANUAL FOR FOOD NEEDS ASSESSMENT

June, 1985

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EXECUTIVE SUMMARY

This manual is intended to be of assistance in early identification of potential food shortages and in quantifying the projected food deficit for individual countries. It is designed to aid in-country analysts in performing these calculations before food aid needs occur, usually well before the crops are harvested. For this purpose, the manual does the following:

-- lists some of the indicators that can be monitored to provide early warning of food supply shortages and discusses the kind of information these indicators can provide;

-- defines some of the variables necessary for the food deficit equations so that analysts within a single organization and across organizations can be consistent among themselves; or, if one organization chooses an alternative definition, the reason for different food deficit figures will be clear;

-- goes through each necessary step for doing a food deficit assessment to help the analyst who actually makes the food gap estimate to be consistent and complete, and to avoid double counting;

-- offers some insights for making estimates of variables when there are no data available, or when the data are of poor quality;

-- provides some of the coefficients, conversion factors and technical equations necessary to perform the calculations involved in making a food gap estimate.

The food deficit assessment process is very resource intensive and must be done before potential problem situations develop into crises. To reduce the expense and improve the timeliness of estimates, a set of indicators can be monitored for early warning of food supply shortages. Indicators can suggest the magnitude of a potential problem and aid in defining its location. Examples of indicators include crop prices, livestock sales and remote sensing images, among others.

Indicators that suggest a food shortfall should trigger a more complete data collection effort for improving information about the situation. This effort should concentrate on the variables necessary for making the food deficit estimate. The four critical variables are: total food needs, net domestic production, net change in stocks, and net imports. Each variable is discussed in a separate section of the manual.

The manual recognizes the data constraints under which most analysts will have to operate. To use this methodology the collection of primary data is not required. There is some discussion of small surveys and use of area sample frames, but the intent of the manual is to make the best possible use of existing data series.

For each variable required in the food balance sheet, a variety of estimation techniques are presented. There is first a discussion of the methods to use if all relevant data are available, although these techniques may be impossible to apply in many countries. Then, for those countries where data constraints do not permit application of the ideal appoach, less data-intensive estimation techniques and methods to make inferences are provided.

Since the importance of each variable in the food balance sheet varies between countries, as does the availability of existing data, it is not possible to write a generic manual that can be used in every country. As a consequence, the manual discusses each variable in a fair degree of depth. An analyst using the manual would not be expected to apply the methodology for every section from start to finish. Indeed, analysts should skim the manual, looking for techniques that are appropriate, given the available data in the country.

CALCULATING TOTAL FOOD NEEDS

1. Defining Food--Most food deficit assessments look only at grain balances. In some countries, however, other non-grain foods may be significant in the national diet. If these are not included, the food deficit may be over- or under-estimated. In such countries, it may be possible to improve the needs assessments if the several of the other most important foods are added into the equation.

2. Defining Need--Estimates of Total Food Needs can be made on the basis of historical consumption patterns. Usually an average of food consumption in the past five years is adjusted for increases in population. Sometimes, these "Status Quo" estimates can be improved if they are adjusted to meet minimum nutritional standards for chronically nalnourished groups, or to reflect the response of the population to changes in food prices and incomes in the current year.

3. Total Food Needs

If historical household survey data are available, they may give an indication of average consumption per person (in kilograms of grain or total calories). These can be multiplied by estimates of the current population to obtain total food needs directly.

More likely, however, such survey data will not be available. Instead, total food consumption can be estimated by averaging consumption data from the last several years (perhaps five). Total consumption may need to be calculated in turn by adding up all of the food that was available for consumption in each year. Total available food can be computed by adding net domestic production plus the net change in stocks plus net food imports plus total food aid for each year.

The average of the total consumption figures for the past five years can then be adjusted for population increases to obtain total food needs for the current year.

CALCULATING NET DOMESTIC PRODUCTION

Net domestic production is equal to total domestic production less the quantities used for seed and feed, and the amount of production that goes to waste. If data to make these adjustments are not available, FAO coefficients for each country are provided in the appendices to the manual.

To obtain total production figures in a timely fashion, it is frequently necessary to make forecasts before crops are harvested. Post-harvest estimates, however, can sometimes be just as useful and may be easier to calculate. Both of these techniques can be implemented to attain various degrees of accuracy. The better the information desired, however, the more resources the procedure usually requires. This section discusses both techniques to assess total crop production.

1. The Area/Yield Method

There are two ways to make area and yield estimates before harvest.

a. Actually undertake direct observation of the plants via field surveys (for both area and yield estimates), or via satellite images (for yield); or obtain information from other institutions or analysts that have made such observations;

b. Infer values for area and yield from other information known to affect these variables in systematic ways.

There are a variety of techniques to makes estimates of cultivated area and crop yields on the basis of observation. Each technique requires different levels of resources and renders different levels of accuracy in the estimates. Several of these techniques are presented briefly in the appendices, but the discussion is primarily intended to help the analyst assess the quality of survey data received from other sources.

If data on variables known to affect yield are available, and their relationship with yield is known, this may be a more practical, if less precise, approach. These variables include factors such as weather (rainfall, temperature), inputs (fertilizer, etc.) and others (infrastructure, plant disease, war, etc.).

2. The Post-Harvest Method

A second method to calculate total domestic production is to collect data after harvest. This method requires data for:

a. on-farm retention (stocks plus consumption);
b. local sales to private traders or other households;
c. sales to government marketing boards.

Data on sales to government marketing boards are usually available; however, this quantity may be only a small percentage of total production. Ideally, data on local sales and on-farm retention would be collected from field surveys. If such data are not available, however, it may be possible to obtain information on the share of total production marketed through official channels. Then the figures for sales to government marketing boards can be extrapolated to calculate total production. This kind of extrapolation should be used cautiously, however, as the share of total production sold to government marketing boards can be extremely volatile.

3. Milling Extraction Rates

To convert domestic production estimates into quantities of food available for consumption, they must be multiplied by their milling extraction rates. The rates for most major commodities are presented in Appendix 4.

NET CHANGE IN STOCKS

To obtain the amount of food actually available for consumption in the current year, the level of stocks must be added to net domestic production. Stocks include food inventories held by the government, private grain marketing boards, small traders and farmers. Data are rarely published for most of these stocks, but other information may provide indicators of storage behavior.

NET FOOD IMPORTS (Imports minus Exports)

When a country experiences a decline in domestic food production, its need for food imports can be expected to increase. At the same time there is an increase in the need for imports, a country's ability to pay for these imports may also

decline. This is particularly true if agricultural products make up an important share of the country's exports. In years of poor rainfall, the production of these cash crops is likely to drop at the same time that food production is falling. Thus a food needs assessment must also examine the current export situation. This requires estimating the value of expected cash crop production at the same time the volume of food crop production is being estimated.

Section 6 provides the equations for calculating the quantity of food that a country will be able to import in the current year. These equations are primarily based on the country's foreign exchange position, given its reserves, potential export earnings, other critical imports, and import prices for food. For CFA franc countries whose level of imports are not completely constrained by their foriegn exchange holdings, alternative methods of estimation are presented.

THE FOOD DEFICIT

Once values have been assigned to each of the above variables, calculating the food deficit is very straightforward. It may be useful for programming purposes to break this estimate out into its emergency versus non-emergency components or for distributional purposes into regional deficits. These issues are discussed in Section 7.

On the basis of these estimates, the government and the donors can decide what measures should be taken to reduce or eliminate the food deficit. Clearly food aid is one important mechnanism for doing this. There is no prescribed formula for determining how much of the deficit should be reduced using food aid, or, of that amount, how much should be provided by individual donors.

To assist in reducing the non-emergency part of the deficit, the United States PL 480 program can provide food aid under its Titles I and III concessional sales programs and under Title II grant and donation programs (e.g., maternal/child health, food for work and school feeding). The Title II program can also be used to address emergency food deficit in urgent and extraordinary situations.

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1. INTRODUCTION

1.1 Purpose of the Manual

This manual is intended to be of assistance in early identification of potential food shortages and in quantifying projected food deficits for individual countries. It is designed to aid in-country analysts before food aid needs occur, usually well before the crops are harvested. For this purpose, the manual does the following:

- -- discusses some of the indicators that can be monitored to provide early warning of food supply shortages;
- -- defines the variables in the food deficit equations so that analysts and organizations can be consistent with each other -- or if an alternative definition is chosen, the reason for different food deficit figures will be clear;
- -- goes methodically through each necessary step for doing a food deficit assessment to help the analyst be consistent and complete, and to avoid double counting;
- -- offers some insights for making estimates of variables when there are no data available, or when the data are of poor quality;
- -- it provides some of the coefficients, conversion factors and technical equations required to perform the calculations involved in making a food gap estimate.

1.2 Definition of the Food Deficit

To estimate a food deficit, the definition of the concept must be clear. Despite considerable differences among analysts and institutions in the definition of some of the variables involved, the food gap can be defined from an accounting perspective in a rather straightforward manner. The deficit is equal to: total food needs less the food that is available through either local production, stocks or imports.

Specifically:

$$\begin{bmatrix}\text{Food}\\ \text{Deficit}\end{bmatrix} = \begin{bmatrix}\text{Total}\\ \text{Food}\\ \text{Needs}\end{bmatrix} - \begin{bmatrix}\text{Net}\\ \text{Domestic}\\ \text{Production}\end{bmatrix} - \begin{bmatrix}\text{Net Change}\\ \text{in}\\ \text{Stocks}\end{bmatrix} - \begin{bmatrix}\text{Net}\\ \text{Imports}\end{bmatrix}$$

Alternatively, this food deficit equation can be expressed as a total food needs equation:

$$\begin{bmatrix}\text{Total}\\ \text{Food}\\ \text{Needs}\end{bmatrix} = \begin{bmatrix}\text{Net}\\ \text{Domestic}\\ \text{Production}\end{bmatrix} + \begin{bmatrix}\text{Net Change}\\ \text{in}\\ \text{Stocks}\end{bmatrix} + \begin{bmatrix}\text{Net}\\ \text{Imports}\end{bmatrix} + \begin{bmatrix}\text{Food}\\ \text{Defict}\end{bmatrix}$$

1.3 Organization of the Manual

To identify potential food shortages before they occur, it is useful to develop a set of early warning indicators for each country. These indicators can be monitored continuously to inform analysts of the magnitude and location of food supply problems. Section 2 of this manual discusses the use of such indicators.

Once it is determined that there is a potential food shortage somewhere in the country, estimates of the actual food deficit can then be made.

Sections 3 - 7 lay out guidelines for estimating each variable required in the food deficit equation. The determinants of each variable are discussed, as well as data requirements and procedures for estimation. Section 3 of the manual covers Total Food Needs, Section 4 covers Net Domestic Production, Section 5 covers Net Change in Stocks, Section 6 covers Net Imports, and Section 7 covers the Food Deficit. Operational concerns, coefficients, conversion factors and technical equations are contained in Appendices.

1.4 Data

In most countries which experience food deficits, data -- good data in particular -- are very scarce. Frequently inferences have to be made from whatever information exists, even when it is incomplete or potentially inaccurate. This manual recognizes the data and information constraints under which most estimates have to be made.

Throughout this manual, the most appropriate data to use in calculating the value of a variable are first discussed. Backup techniques are then provided for the circumstances when the most appropriate data are not available. Finally, methods are presented to infer the value of a variable from other relevant information.

The methodology presented in this manual does not require the collection of primary data. There is some discussion of small surveys and use of area sample frames, but they are not the focus of attention. None of this is to say that primary data collection is an inappropriate response to the problem of data

scarcity. The intent of this manual, however, is to lay out an approach for making the best possible use of data that are already available in capital cities and in the field. There are also a variety of data series generated abroad that may be of use in performing food gap analysis.

2. EARLY WARNING INDICATORS

One strategy to reduce the expense and improve the timeliness of the food deficit assessments is to develop a set of indicators that can be monitored for early warning of a food shortage. The indicators can be used to determine whether a problem is developing, to provide insights into the magnitude of the problem, and to aid in defining its location.

Ideally, early warning indicators should have the following characteristics:

-- they should be affected in systematic ways by different levels of crop production;

-- they should be more easily observable -- and, therefore, less costly to collect -- than actual levels of crop production;

-- they should be available on a more timely basis than data on production levels (e.g., before harvest).

Certain values of the indicators can be established as thresholds for defining potential problem situations. The thresholds can serve as triggering mechanisms for collection of more comprehensive data on crop conditions.

The variables to use as indicators in a given country will depend on the data that are available and the nature of the relationships between crop production and the variables in question. There are a few basic variables, however, that can be effective indicators in most countries. Examples include crop prices, distress sales of livestock, and remote sensing images. Each of these variables, as well as other potential indicators, is discussed below.

2.1 Prices

One method to get a quick and easy grasp of the current production situation is to focus on the prices, particularly the changes in prices, of local commodities.

For non-traded, domestically produced crops, prices are usually at their lowest point immediately after harvest. They then rise gradually over the year to reflect the storage and interest costs of holding stocks.

Food prices that are considered "high" may be an indicator that a problem exists. Nevertheless, complementary information on the direction in which prices are changing is necessary to determine whether the situation is improving or deteriorating. Food prices that are rising more rapidly than in similar periods in the past or more rapidly than prices in other regions, may indicate that a food shortage is developing.

To use prices as an indicator of the current crop situation, the analyst should consider the following questions:

-- Are food prices higher or rising faster than would be expected under current circumstances?

-- If so, why is this the case?

The relevant issues to consider in answering these questions are discussed below.

2.1.1 Are food prices higher or rising faster than expected?

To answer this question, the analyst needs the following data:

-- price series

  -- for each food crop;

  -- for non-food items;

  -- for each important marketing region of the country;

  -- for the current year;

  -- for some number of previous years (e.g., five).

Each price series should include data on different periods of the same year. Monthly values are probably sufficient. The comparisons that can then be made include the following:

-- the change in prices of a given commodity in any current time period (e.g., the last two months) compared to the same time period in previous years;*

-- the actual price of a given commodity compared to the price of the same commodity at the same point in time in previous years;*

-- the change in prices of a given commodity in one region in any current time period compared to the change in prices of the same commodity in the same time period in a different region;

-- the actual price of a given commodity compared to the price of the same commodity in some other region.

Appendix 12 provides the equations to perform all of these comparisons.

2.1.2 Why are food prices higher or rising more rapidly than expected?

Once it has been determined that prices are higher or rising more rapidly than expected, an effort should be made to ascertain whether or not shortfalls in domestic production are responsible for this situation. Prices reflect a myriad of factors, any of which could be the cause of the high or rising price.

The analyst should consider the following issues before concluding that high or rapidly rising prices indicate a domestic crop shortfall.

-- if the country imports food, fluctuations in prices may be more an indication of changed circumstances in the country of origin or in world markets in general, than of changes in the level of local production;**

-- commodity prices may be fixed by the government and an increase may simply reflect a change in official prices.

The analyst can examine these factors to see if they may be responsible for unexpectedly high or rising prices. If neither of these other factors have changed, then high or rising prices may be an indication of a domestic crop shortfall. Further, the higher the price or the faster it is rising, the more severe the problem is likely to be.

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* Before this can be done the effect of any general inflation within the economy must be removed.

** The effect on the food deficit of changes in the prices of imports is included in the discussion of imports.

2.1.3 A Caution about Prices

A word of caution pertains to this discussion. The fact that prices are not "high" or rising does not necessarily mean that domestic production has not declined. Crop shortages tend to put upward pressure on prices, but they can also cause consumer incomes to fall, leading to a decline in effective demand. This has the effect of exerting a downward pressure on prices. As a consequence, a decline in domestic production may be associated with only a relatively small increase in observed food prices.

2.2 Distress Sales of Livestock

Distress sales of livestock, like prices, can be used as an indicator of a decline in domestic crop production. Farmers frequently accumulate their wealth in livestock holdings. In years of poor production, they often sell some or all of their animals for cash income. Information about increases in animals for sale at livestock markets or about falling prices for animals can suggest that crop production has dropped significantly in the affected region.

2.3 Remote Sensing

Remote sensing involves the collection of information about phenomena on or near the earth's surface with a remote recording device. Unmanned satellites have scanners aboard such as the Landsat MSS (multispectral sensor) and the NOAA AVHRR (the National Atmospheric and Oceanic Administration's Advanced Very High Resolution Radiodometer). The principle behind the scanners is that emitted and reflected radiance from surfaces on the earth, including crops, can be imaged. The scanners assess the amount of energy being reflected or radiated. Information on the level of this energy is translated into numerical values that are radioed to receiving stations on earth. The numerical values are then processed to make pictures for use in the usual form of interpretation.

Landsat and AVHRR images can be observed over the course of a growing season and compared with previous years to identify areas that are especially "brown" relative to what would be expected for their location at a given time of year. This "browning" can suggest local drought problems, pest attacks, plant disease or other causes of reduced production. Thus, the images can be used to delineate areas that should be studied more intensively with local field surveys for more accurate monitoring of the problem.

2.4 Other Indicators

Other possible early warning indicators include such variables as: increased sales or decreased domestic procurements by national grain marketing agencies; stockholdings, at all points along the marketing chain, below their usual levels for a particular time of year; increases in the length of queues at food shops; movements of food from urban to rural areas; and migration of populations out of agricultural areas. Analysts in a given country may be able to suggest other variables that can serve as effective early warning indicators for their country.

3. CALCULATING TOTAL FOOD NEEDS

The first variable that must be calculated to estimate a food deficit is Total Food Needs. There are two components of this variable that must be defined before this can be done, "food" and "need."

3.1 Defining "Food"

In many countries, "food" consumption is defined as "grain" consumption. Certainly this is the easiest approach and, frequently, when grain is the most important element in the national diet, little accuracy is lost with this substitution.

3.1.1 Problem

In some countries, non-grain food items such as tubers, pulses, oil, milk, eggs and meat may contribute significantly to total caloric intake. Looking only at grain consumption may indicate little about total nutritional status in such cases. Two examples illustrate the danger of substituting grain for total food.

-- Suppose there is a serious drought. If the drought destroys the grain crop but farmers are able to increase their cassava harvest, a food gap calculation based only on grain consumption would overestimate the aggregate food deficit.

-- Suppose on the other hand, that the drought causes the production of important food items such as milk, pulses and vegetables to fall at the same time grain output is declining. In this case, a food gap calculation based only on grain consumption would underestimate the aggregate food deficit.

Another implication of restricting the analysis grain consumption is that the food gap for one segment of the population may appear larger or smaller than that of another segment of the population simply because each segment traditionally consumes different foods. In fact, the food gap experienced by the group that traditionally consumes a low share of cereals will be underestimated. The following example illustrates this point.

A hypothetical country has two distinct population groups, one that is composed of sedentary farmers and one that is composed of pastoralists.

On average, farmers' consumption is:

± 150 kgs/year of cereals (or approximately .41 kgs/day)	± 1200 calories/day
Meat and vegetables	± 300 calories/day
Total	1500 calories/day

The pastoralists consume:

± 55 kgs/year of cereals (or approximately .15 kgs/day)	± 450 calories/day
Milk and meat	± 1050 calories/day
Total	1500 calories/day

An analysis that focused exclusively on grain would show that farmers' "needs" are 150 kgs/year while herders "needs" are only 55 kgs/year.

Suppose that in a random drought year the production of all products, including milk, meat and vegetables, declines equally (e.g., by 40%). Herders' caloric consumption is reduced by exactly the same amount as farmers' caloric consumption if total calories are taken into account.

Farmers:

Cereals	1200 - (.40 x 1200) =	720 calories/day
Meat, vegetables	300 - (.40 x 300) =	180 calories/day
Total		900 calories/day

Pastoralists:

Cereals	450 - (.40 x 450) =	270 calories/day
Milk and meat	1050 - (.40 x 1050) =	630 calories/day
Total		900 calories/day

Both groups have a caloric deficit of 600 calories/day (1500 - 900) based on an analysis of all types of food consumption. Looking only at grain, however, would show farmers to have a deficit of 480 calories/day or roughly 60 kgs/year while pastoralists would have a deficit of 180 calories/day or roughly 22.5 kgs/year, when in fact, the food deficits for the two groups are identical.

3.1.2 Ideal Solution

Food deficit estimates will obviously be more conceptually sound if all major food items consumed in the country are included in the analysis. One way to do this is to convert all food to a "grain equivalent" based on calories or nutritional value. This requires information not only about total food consumption, but also about the caloric or nutritive value of every food item. These kind of data may be difficult or costly to obtain. Moreover, if other foods are not that important in the national diet, the extra effort to collect and analyze the information may not be worth the improvement in the estimates it produces.

3.1.3 Recommended Approach

The best approach to use depends on the country being analyzed.

-- If grain is by and large the most significant component of food consumption, converting other foods to their grain equivalent may not be worth the extra effort. Nonetheless, the analyst should consider whether consumption of these other foods increases or decreases in years of grain shortfall and try to make adjustments to per capita food consumption estimates accordingly.

-- If non-grain food items are significant in the national diet, particularly if there are only a few important ones, it may be useful to make conversions to a common denominator such as calories or grams of protein. Appendix 15 presents a step-by-step approach and Appendix 1 provides the FAO conversion factors, by commodity and by country, to make the calculations.

The use of calories as a common denominator becomes less and less satisfactory the more nutritionally diverse are the different food items consumed in the country, and the less substitutability there is among them. Caution should be exercised if the vast majority of the calories consumed by certain population groups are derived from foodstuffs that are nutritionally quite different from cereal grains. If this is the case, consideration can be given to calculating separate food gaps by broad categories (e.g., a food deficit for cereal

grains, a food deficit for milk and milk products, a food defict for edible oils, etc.).

It is very difficult to estimate average consumption of livestock products, particularly milk, and it is very unlikely that the analyst will be able to obtain information on how this consumption declines in a drought year. Nonetheless, the analyst should be aware that such information could make a big difference in the bottom line of a food gap analysis and the extent to which any insights on these values can incorporated, the better the estimates will be.

3.2 Defining "Need"

As alluded to above, the definition of the total food "needs" of a country differs widely among analysts and institutions. Three possible definitions are:

-- the total food consumption of some previous time period (usually, an average of the past four or five years), adjusted for the increase in population since that time, called the "Status Quo" definition;

-- subsistence standards or minimum recommended caloric intakes multiplied by the current population of the country (examples of some of the FAO standards are presented in Appendices 2 and 3);

-- "demand," or the willingness to buy food, based on consumers' response to changes in their incomes and in food prices.

Organizations that publish food deficit figures most frequently use either the Status Quo or the subsistence standard definition of food needs. Different definitions can yield widely divergent results in their final estimates of a food deficit.

The approach suggested here is to calculate total food needs for the current year according to the Status Quo definition and then to adjust these figures if other considerations are important in the country being analyzed. The methodology to apply this approach is described below.

3.3 Total Food Needs

What follows is a step by step approach to:

- calculate total food consumption needs for the current year according to the Status Quo definition by:
  - calculating total food consumption for previous years; and
  - adjusting these figures to reflect increases in the population;
- make other adjustments to the "Status Quo" calculation, if called for, by:
  - examining for price and income effects;
  - taking targeting concerns into account;

3.3.1 Calculating Food Needs According to the Status Quo Definition

To calculate total food needs according to the "Status Quo" definition, an historical average of per capita consumption is estimated and then multiplied by current population.

3.3.1.1 Calculating Historical Averages of Consumption

-- Selecting a Base Period

The first step is to select a base period for the historical average. The previous four or five years is the time frame most commonly used in this kind of analysis, but a longer period could be chosen. The disadvantage of a short period is that it may not be representative (e.g., if there has been a recent drought or a series of bumper crops). On the other hand, the advantage of a short period is that recent structural trends will be reflected. In general, four or five years is usually sufficient unless the analyst knows that this time period was significantly different from normal. If this is the case, additional years can be added to the base period.

-- The Equations and Data Requirements

Historical data on total national food consumption are rarely available. It is usually necessary to estimate consumption by summing its constituent parts. Total national consumption is equal to domestic production, less the quantities destined for seed, feed and waste, all multiplied by the milling extraction rate, less the net change in stocks, plus net commercial grain imports and food aid (see the equation below).

Each of these variables must be compiled for every year in the base period. The data in question are historical data for estimating the average total food consumption in previous years. Methods for estimating the same variables for the current year will be discussed in later sections of the manual.

For Each Year in the Base Period

$$\begin{bmatrix}\text{Status Quo}\\ \text{Consumption}\end{bmatrix} = \left[\begin{bmatrix}\text{Total}\\ \text{Domestic}\\ \text{Production}\end{bmatrix} - \begin{bmatrix}\text{Seed}\\ \text{Feed}\\ \text{Waste}\end{bmatrix}\right] * \begin{bmatrix}\text{Milling}\\ \text{Extraction}\\ \text{Rate}\end{bmatrix}$$

$$- \begin{bmatrix}\text{Net Change}\\ \text{in Stocks}\end{bmatrix} + \begin{bmatrix}\text{Net}\\ \text{Food}\\ \text{Imports}\end{bmatrix} + \begin{bmatrix}\text{Total}\\ \text{Food}\\ \text{Aid}\end{bmatrix}$$

-- Estimating Values for the Variables in the Equation

Total Domestic Production: Historical data on domestic production can be obtained in several ways. For example:

-- estimate the area that was under production in each year of the base period and multiply by an estimate of yield for the same year;

-- use estimates of marketed production (both to official marketing agencies and local sales) and add estimates of on-farm retention (consumption plus stocks).

The relative merits of each method depend on the data available in a given country. It is usually extremely difficult, however, to obtain reliable estimates of on-farm retention and locally marketed production, particularly if "parallel" marketing channels were significant either domestically or across international borders.

Seed: It is important to reduce gross production estimates by the amount of the crop that was saved to use as seed. Estimates of these quantities may be available in country. If not, Appendix 1 provides FAO averages for 1979-1981. The FAO data are absolute quantities of grain saved as seed. They can be extrapolated to make estimates for the years included in the base period.

The extrapolations can be done in several ways. In many countries, it may be sufficient simply to calculate the amount of seed saved as a share of total production. This percentage can then be applied to levels of production for years in the base period. In other countries, it may be the ratio of seed saved in one year to hectares planted the following year that remains more constant.

Feed: It is necessary to include this variable only if animals compete with people for consumption of the commodity under consideration. Crop residues or crops grown specifically for fodder should not be included in estimates of total production and thus do not need to be subtracted. When animals are fed the same commodities consumed by humans, however, total production figures must be reduced by the amount of grain allocated for livestock feed. Historical information on these quantities may be available. If it is not, average estimates are provided by the FAO for the period 1979-1981 and these are presented in Appendix 1. These figures should be adjusted to reflect changes in livestock herds that may have taken place since the years for which the FAO data were compiled.

Waste: Gross production estimates must also be adjusted to reflect crop losses. As in the case of seed and feed estimates may be available in country to make these calculations. If not, the FAO averages for 1979-81 are contained in Appendix 1. In most cases, it is sufficient to estimate waste as a share of total production and extrapolate this ratio to each of the years in the base period. In reality, however, the percentage of the harvest wasted tends to rise in good years and fall in poor years.

Milling Extraction Rates: In order to compare data on food needs, production, stocks and imports, they must all be in milled form. For example, tons of paddy rice cannot be added to tons of milled rice. Moreover, paddy rice and unhulled millet are not comparable because the share of the whole grain that is actually edible differs for the two commodities. The technical conversion factors used by the FAO for most basic commodities are presented in Appendix 4. Historical data should be considered carefully to determine whether they are in hulled or unhulled form. If this proves difficult or costly, and resources to perform the calculations are limited, priority should be given to refining data on rice, where the milling factor can affect the analysis by as much as 40 percent.

Net Change in Stocks: To obtain the amount of food grain that was actually consumed in each of the years of the base period, historical production figures must be adjusted further for changes in both official (public) stocks and unofficial (private) stocks of grain. The net change in stocks is subtracted from total production. An increase in stocks from the beginning of the year to the end of the year is a reduction

in the amount of grain available, and a decrease in stocks over the course of the year is an increase in available grain.

To calculate the net change in stocks, data on beginning-of-the-year stocks and end-of-the-year stocks are necessary. This information can usually be obtained for official stocks. Most governments publish these figures. If they are not available, however, an attempt can be made to collect historical data on inventories from relevant government institutions (e.g., the marketing boards in the country).

Data on the net change in stocks held privately are rarely published. If there are large private marketing firms or traders, they may be able to provide information about their past inventories. Historical information on changes in on-farm grain storage are virtually impossible to obtain. Nonetheless, they are important as they can significantly affect the quantity of grain consumed in any given year. If farm survey data have been collected in the past, they may be able to shed some light on how farmers varied their on-farm inventories as production levels varied. Interviews with farmers or extension agents may also provide some insights into these quantities.

It should be noted that if the stocked grain came from domestic production, it must be multiplied by the milling extraction rate. If, however, the grain was imported, an effort should be made to determine how much was already in milled form and therefore does not need to be converted, and how much was unmilled and needs to be multiplied by the milling extraction rate.

Net Food Imports: Net food imports are comprised of total food imports less total food exports. Historical time series for legal, commercial transactions are usually available and fairly accurate. Data on illegal smuggling across borders are usually non-existent; however, these quantities may be significant. Commodity price differentials between neighboring countries can be an indicator of potential for smuggling. When prices were higher abroad it is likely that commodities were exported, and vice versa when they were lower. Estimates of the magnitude of these exchanges have to come from informal sources and their accuracy can rarely be confirmed. Nonetheless, some consideration should be given to these flows when calculating net grain imports for each of the years in the base period.

Total Food Aid: Total Food Aid includes both program and project, emergency and non-emergency food aid from all donor sources. Commitments made in a given year do not necessarily mean that the grain was actually made available. Only data on actual quantities received in country should be used. "Late food aid arrivals" should be included in the totals for the time period in which the grain was actually available.

3.3.1.2 Population Adjustments to the Historical Average

Once historical data on all of these variables have been added together to calculate total consumption for each year in the base period, these figures need to be adjusted for population changes. One way to do this is to divide the total consumption figure for each year by the population estimate for that same year. This will yield estimates of per capita food consumption for each year.

$$\left|\begin{array}{l}\text{Per}\\ \text{Capita}\\ \text{Consumption}\end{array}\right| = \frac{|\text{Status Quo Consumption}|}{|\text{Population}|}$$

These estimates can be summed and divided by the number of years in the base period to calculate average per capita consumption. This figure can then be multiplied by the population estimate for the current year to obtain the final value for Total Food Needs, based on the Status Quo definition.

Population figures should be taken from the most reliable source and adjusted by the annual growth rates to obtain estimates for each of the years in the base period. Figures for annual growth rates should be checked to make sure they adequately reflect in- or out-migration trends that may have begun since the last census.

3.3.2 Adjustments to Status Quo Consumption

3.3.2.1 Price and Income Adjustments

In times of severe drought or other disasters that cause important drops in domestic crop production, food prices usually rise and incomes usually fall. As a result, consumers in the aggregate tend to voluntarily reduce their total food intake somewhat. Clearly this is not possible for individuals already consuming only subsistence quantities of food. The entire population, however, rarely exists at that level. There is usually some discretionary food consumption taking place somewhere in the economy. Consequently, Status Quo calculations will tend to overestimate total food needs in this respect and adjustments to incorporate these price and income effects may improve the estimates of total food needs.

There is no easy formula for determining how large these adjustments should be. Probably the most useful approach is to look at consumption levels in past droughts or disasters relative to other years for indicators of behavior under similar circumstances and consider how much discretionary consumption there is in the economy, that is, the amount by which consumption

might be reduced voluntarily without threatening survival. The closer the population is to subsistence levels, the less responsive it will be to the increases in price and decreases in income and the less important is the need for these adjustments.

3.3.2.2 Nutrition Adjustments

Once the total needs estimates have been made according to the above procedures, adjustments may need to be made for specific target populations. In particular, if a special feeding response is required for certain vulnerable groups, the needs estimates may have to be adjusted upwards to ensure that the affected individuals "need" is calculated to be no less than some certain recommended caloric intake level.

Even in a situation where the country as a whole is meeting its Status Quo requirement, there may still be chronically malnourished segments of the population. For these people it may be appropriate to use a minimum recommended caloric intake standard to establish their need level, rather than a Status Quo level.

4. CALCULATING NET DOMESTIC PRODUCTION

Estimates of net domestic production for the current year are similar in their constituent parts to the estimates of net domestic production calculated for previous years above. However, making these estimates in a timely fashion, that is, before a food shortage actually occurs, is considerably more difficult.

The components of net domestic production that need to be estimated, as above, are total production, seed, feed, waste. Each of these variables will be discussed in turn.

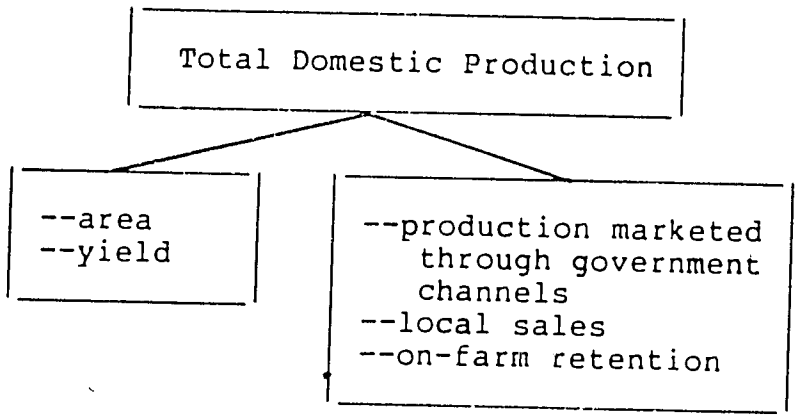
$$\left[\text{Total Domestic Production} - \text{Seed} - \text{Feed} - \text{Waste}\right] * \text{Milling Extract. Rates}$$

4.1 Total Domestic Production

There are several methods to assess total production levels for the current year:

-- The Area/Yield Method: this requires data on area planted and current forecasts of yield;

-- The Post-Harvest Method: this requires data on quantities of production marketed through official government channels, local sales and on-farm retention (consumption plus stocks).



The most appropriate method to use in a given situation depends on the country being analyzed, the data available, and the degree of timeliness and/or accuracy required.

Each method will be discussed below.

4.1.2 The Area/Yield Method of Assessing Production

The area/yield method requires simply multiplying estimates of area by estimates of yield. This method makes it possible to forecast production before harvest.

There are two ways to obtain estimates for area and yield variables:

-- actually undertake observation of the plants via field surveys (for both area and yield) or via satellite images (for yield); or obtain such information from other institutions or analysts;

-- infer values for area and yield from other available information known to affect these variables in systematic ways.

The area/yield method may be difficult and/or resource intensive, however, it can be expected to yield concrete and timely figures for food deficit calculations. Clearly this technique is appropriate in countries where good area and yield data are easily accessible. It may also be the method of choice if a high degree of accuracy is required and the resources are available to invest in a serious data collection effort.

4.1.2.1 Area Estimates

-- Survey Data: Area data are critical but are often ignored. People frequently argue that the amount of land cultivated remains fairly fixed year after year and that the variability in production comes primarily from variability in yield. If this is true, a large amount of resources will not need to be channelled into gathering area statistics every year. Once a baseline figure is obtained, it can be used repeatedly. Frequently, however, while it may be true that total area cultivated stays fairly constant, the amount allocated to different crops will vary significantly. These changes may be absolutely critical for determining how much food is available.

Collecting area estimates from surveys, by crop, by variety, or by cropping technique is not easy, particularly in countries where small plots and intercropping are the norm. Nonetheless, virtually every government makes an effort to collect some area data after planting has taken place. This information can often be obtained from the Ministry of Rural Development or the Ministry of Agriculture on a reasonably timely basis.

The reliability of area data emanating from government surveys, however, may vary by country. An effort should be made to ascertain the quality of such data. Analysts should determine whether they are generated using sound statistical sampling techniques. Some of these techniques are discussed in Appendix 13.

If the analyst is not sure about the quality of available area data, the brief discussion in Appendix 13 raises some of the relevant issues to consider. It also provides some basic information about the different methods for collecting area data, the different degrees of accuracy of each method, and their relative resource costs in the event that a more serious data collection effort is considered.

-- Inferring Area from other Variables: If no area data are available for the current year, and the analyst does not have the resources to undertake any primary data collection on areas cultivated, other available information may prove useful to infer these values.

To make such inferences, area data from previous years should be obtained. These can then be adjusted for the current year on the basis of information about changes in variables that affect the amount of land that farmers plant.

The questions below suggest some of these possible changes. The answers to these questions do not lead directly to numbers that the analyst can use to adjust the historical data to make current year estimates. They may, however, suggest to the analyst that the area under a given crop has increased or

decreased since the year for which data are available, and they may provide some sense of the magnitudes involved.

Prices:

-- Has the price of one crop increased relative to another, causing farmers to shift land to the more profitable commodity?

-- Have the prices of all crops increased/decreased relative to other goods, causing farmers to raise/lower the total amount of land under cultivation?

Land:

-- Was there uncultivated land available to be brought under production if all crop prices have increased?

-- Have certain lands been lost for cultivation due to desertification, salination, waterlogging, nutrient degradation, etc.?

-- Have certain lands become available for cultivation as a result of investment in irrigation infrastructure?

-- Are there areas that cannot be cultivated because of war or other reasons?

Labor:

-- Is the rural labor force sufficient to increase cultivated land in response to price incentives?

-- Is there rural out-migration that could have a negative impact on the amount of land that could be cultivated?

Inputs:

-- Were necessary inputs available to cultivate an increased amount of land for a given crop?

-- Was there an increase/decrease in the price of inputs relative to output prices that would encourage/discourage input use?

-- Was credit available to purchase necessary inputs?

4.1.2.2 Yield Estimates

Most of the attention given to the methodology of estimating crop production focuses on techniques to forecast yield. It should be remembered, however, that without information about cultivated area, yield data are not sufficient to compute total production.

As for area estimates, there are a variety of methods to make yield assessments, each offering different degrees of accuracy and each requiring differing levels of resources. Both the accuracy of a given technique and the resource cost will vary depending on the country being analyzed. Even within an individual country, the most appropriate method may change from year to year as conditions and available data change.

-- Observation

Survey Data: Collecting survey data to estimate yields before a crop is harvested is more difficult than collecting data on cultivated areas, even if there is a good data collection infrastructure in place. Not only do the estimates change over the course of the growing season, but a trained agronomist is needed to interpret the implications of a sample crop-cut for eventual yield at harvest. Nonetheless, the Ministry or Office of Agriculture in most countries generates this information. As for area data, an analyst using survey data acquired from another institution or analyst should ascertain that they were collected on a statistically sound basis. Some of the relevant issues for this assessment are discussed in Appendix 13.

Remote Sensing: Landsat and AVHRR images can be observed over the course of a growing season and compared to previous years to make an assessment of crop development in relative terms. For example, remote sensing analysis could provide the following kind of information: "this year's biomass in crop growing regions appears 25% below that of last year (or 10% below that of three years ago, etc.)." Yield data must be available from the year to which the current situation is being compared to make actual estimates of yield in absolute terms for the current year.

The resolution currently produced in these remote sensing images is not sufficient to separate estimates by crop as needed to perform the food gap calculations. Nonetheless, these images are easy to obtain, fairly inexpensive, and can provide some indication of the general trend in production early in the growing season.

NASA currently makes daily assessments of natural vegetation growth in the Sahel with satellite images of four kilometer resolution. From these assessments it can estimate kilograms per hectare of vegetation for the current year. If there is some

relationship between natural vegetation and crop growth (for many rainfed crops in the Sahel this is probably the case), then these readings may be of use for food gap analysis.

NOAA takes sample readings of crop land from images of one kilometer resolution which it uses in conjunction with a meteorological analysis to make estimates of crop yields and natural vegetation. The complete NOAA analysis is discussed in more detail below.

-- Inferences from Variables Known to Affect Yield

If estimates of yield from crop observations are not available in the country being analyzed, either from survey data or from remote sensing assessments, it still may be possible to make yield forecasts on the basis of information about variables that affect yield in systematic ways. Examples of such variables include, among others, rainfall, fertilizer and other inputs.

To make such yield assessments, data are needed on these other variables, and some understanding is required of how each variable affects yield. Most of these relationships are very complex, particularly when they interact with each other and estimates of yield made in this manner are not likely to be terribly precise. Nonetheless, some insight into the direction of changes in yields from previous years, as well as the magnitude of these changes may be gained.

It may not be necessary to assess all of the variables listed below in each country. Moreover, even when the effect of a variable is considered, it may not be necessary to do it in the depth in which the analysis is described below. The discussions that follow are meant to be complete, to cover most of the issues that could arise in any given country. The analyst should skim them to find the variables that are most relevant for the country being analyzed.

Meteorological Data: Meteorological data, rainfall in particular, can be used to make fairly good estimates of crop yields in many countries, especially in Africa. The following variables are relatively easy to obtain and their impact on yield is often not too complicated to assess.

-- Percent of Normal Rainfall: This variable is easy to calculate and, although it gives no precise information about crop conditions, it can often be a good indicator of yield, particularly in countries where the relationship between levels of rainfall and yield is strong. The equations to make this calculation are contained in Appendix 6. The advantage of this index is its simplicity and the ease with which it can be understood by the non-technician. In addition, normal rainfall, particularly monthly values, can be easily obtained from many sources or estimated by a variety of methods.

-- The Yield Moisture Index: This index is a better indicator of the impact on crop yield of a given level of cumulative rainfall. It interprets the impact of a certain amount of rainfall during each critical stage of plant development on the basis of water requirements for the crop at that time period. The data required to make this calculation include:

Crop calendars (including the normal month or months of planting/transplanting; vegetative stage; flowering and reproductive stage; maturing stage; and harvesting). Calendars for selected crops in many African countries are provided in Appendix 7.

Crop coefficients (for each stage of crop growth and development). Coefficients for the most common crops grown in Africa are listed in Appendix 8. If coefficients have been developed for specific countries, these should be used instead.

Monthly rainfall data (for each month of the growing season). Historical data are also necessary to obtain "normal" monthly values. These rainfall data must be collected from representative agricultural regions to be of use (not simply from interior airports, for example).

The methodology for calculating the Yield Moisture Index, as well as relevant caveats and interpretations, are detailed in Appendix 9.

On the basis of these and other, related indices (namely soil moisture, plant water deficit and moisture stress), NOAA makes forecasts of yield based solely on meteorological data. This qualification is important because there are other determinants of yield that also may be significant. These variables are discussed below. NOAA analyses are made regularly and Special Assessments, which are fairly detailed, can be requested for most countries by AID field missions. NOAA, however, may not receive important information available in-country. For example, the weather stations from which it receives its reporting are not necessarily in agriculturally representative locations for all countries. If better data are available locally, analysts may be able to improve on NOAA forecasts by doing their own calculations.

In sum, NOAA Assessments can give estimates of changes in yields for the given year relative to previous years, on the basis of meteorological information alone. NOAA does not have

information on economic, social or technological factors that may also affect yield. Neither does it have the data on cultivated areas that are necessary to compute total production. Nonetheless, the assessments can be extremely useful if non-weather factors do not change significantly from year to year, or if good data on these other factors are available for making adjustments to yield estimates.

-- Input Data

As mentioned above, the yield forecasts based on only meteorological data must be interpreted cautiously. In some countries, weather-related phenomena may explain the vast majority of the variation in yield. However, even in African subsistence agriculture, economic, social/political, and technological factors can also be important in influencing yield. Yield estimates can often be improved if these variables are taken into account, even though their impacts are more difficult to quantify than those of meteorological phenomena.

-- Fertilizer: Fertilizer use has an important effect on the yield of most crops. If, however, the level of fertilizer application in the current year is not significantly different than it was in previous years, it may not be worthwhile to adjust yield estimates to include the effect of changes in the use of this input. Clearly it is difficult to define how large a change is "significant." In countries where excellent survey data are available on the rates of fertilizer application per hectare or on the number of hectares fertilized (for each crop), then adjustments to reflect the effect of even small changes in fertilizer use might improve the yield estimates. Such data are rarely available, however, and the imprecision from using aggregated figures (e.g., total fertilizer offtakes) means that adjustments are probably only worthwhile if the change in fertilizer use is important relative to total use (probably a change of 15% or more).

When fertilizer use in the current year does differ significantly from that in previous years of similar rainfall, adjustments in the yield figures derived from weather factors alone are probably worth making.

Data Requirements

-- yield response of each crop to changes in doses of fertilizer;

-- the rate of fertilizer application per hectare, by crop, for the current year and several previous years; or, if not available

-- total fertilizer offtakes and estimates of cultivated area on which the fertilizer was applied for the current year and several previous years.

For most countries, some data are usually available on the yield response of a given crop to application of the relevant fertilizer formulas. One caveat should be mentioned, however. The yield response of a crop to an additional kilogram of fertilizer will differ depending on the total amount of fertilizer being used. For example, the change in yield caused by reducing fertilizer application from 150 kgs/hectare to 125 kgs/hectare is likely to be quite different from the change in yield caused by reducing the application from 100 kgs/hectare to 75 kgs/hectare. Therefore, series of response coefficients (not just a single coefficient) are needed to make these adjustments.

Based on his or understanding of farmer's behavior, the analyst needs to decide if a reduction (or increase) in the use of fertilizer results primarily in less (or more) land being fertilized, or in less (more) fertilizer per hectare. The difference in yield estimates from these two assumptions could be significant.

The analyst can use the data on application rates per hectare directly from survey data if they are available. If not, these rates can be calculated by dividing total fertilizer offtakes by the total area on which the fertilizer was applied. Then the application rates for the current year can be compared to those for previous years to determine if there has been a significant change in fertilizer usage. If there has been, the response coefficients can be used to estimate the effect this change would have on crop yields.

-- Other Inputs: If the total use of other inputs (e.g., improved seed, pesticides, tractor services, etc.) has changed significantly since previous years, it may be possible to improve yield estimates based on only weather and fertilizer information. Adjustments for changes in use of these inputs can be made in a similar fashion to those for fertilizer.

Data Requirements

-- use of input in current year (from field surveys or from data on total offtakes or sales);

-- use of input in previous years;

-- the relationship between the use of the input and crop yield.

These data can be used to compare current input use to use in previous years. If a significant change has occurred, the affect of this change on yield can then be calculated.

-- Rural Infrastructure: If there have been changes in rural infrastructure since the years to which the current year is being compared, and these changes affect yield, more adjustments would render still better estimates. For example, there may be land that was previously cultivated under rain-fed crops that has recently been brought under irrigation. Ideally, area estimates would make a distinction between land cultivated under these different farming techniques; however, this level of detail may not be available from existing data. Nonetheless, it may still be possible to make these adjustments to improve the yield estimates.

Data Requirements

-- hectares of new land brought under irrigation in the current year;

-- yields for rainfed farming of a given crop (based on a historical average);

-- yields for irrigated farming of the same crop (based on the same average).

If yields from irrigated farming of a given crop tend to be some percentage higher than yields from rain-fed farming of the same crop, this difference can be used to adjust the yield estimates for the land under the new technique.

-- Rural Labor Force: This factor is of particular importance in years of especially bad rainfall or during other disasters. Frequently, in the middle of the growing season, when it becomes apparent that total crop production will be poor, the rural labor force will begin to migrate to the cities in search of employment and income or to emergency feeding camps if the situation is particularly bad. This may in turn have a negative impact on crop yield if insufficient manpower is available for weeding and thinning during the season, and harvesting and threshing at the end.

It is difficult to assess the numbers of farm laborers migrating from rural areas, but other variables may act as indicators of the magnitude of this phenomenon. High crop prices will encourage farmers to harvest the most they possibly can from each hectare while high urban/rural wage rates or severe famine situations will provoke rural out-migration, sometimes causing farmers to completely abandon their fields.

The analyst should seek information about rural out-migration if it appears that the lack of available labor could be significant enough to affect the crop harvest from cultivated land. If it is possible to assess the impact of these population movements on total production for individual regions, these adjustments should be made.

-- Other Factors: Any other non-weather factors that might affect agricultural production differently than they have in the past should also be considered in this analysis. Examples would include pest attacks, outbreaks of plant disease, civil unrest or outright war. Estimates of the impact on production of each of such relevant events need to be made, and adjustments made accordingly.

4.1.3 The Post-Harvest Method of Assessing Production

Up until this point, the discussion about estimation of domestic production has focused on pre-harvest forecasts. However, since the most critical time period for food aid needs frequently does not occur until the beginning of the next growing season (i.e., the last months before the next harvest), post-harvest estimates of production may still be timely.

-- Data Requirements

- -- On-farm retention (stocks plus consumption);
- -- Local sales to private traders or other households;
- -- Sales to government marketing boards.

Data on the amount of food sold to the government are usually available, although these are only a small percentage of total production in many African countries. Data on local sales and on-farm retention are usually difficult to find. One way to obtain such data is to collect them from field surveys. Another, more practical, but less precise approach is to try to get a sense of the share of total production that is sold to government marketing boards. Then, the data on sales through official marketing channels for the current year can be extrapolated to estimate total production. Some caution should be exercised in applying this method, however, as this share varies significantly from year to year in many countries and simple extrapolation from a relatively normal year may generate very inaccurate results for a drought year. To mitigate this problem, the analyst may be able to find information on farmers' sales behavior during past droughts.

4.2 Seed

Gross production figures must be reduced by the amount of the crop that was saved to use as seed. Estimates of these quantities may be available in country. If not, Appendix 1 provides FAO averages for 1979-1981. The FAO data are absolute quantities of grain saved as seed. They can be extrapolated to make estimates for the current year.

The most practical way to make this kind of extrapolation for the current year is to calculate seed as a share of production using data from previous years, and apply this ratio to the production estimates for the current year.

4.3 Feed

As discussed above, it is necessary to include this variable only if animals compete with people for consumption of the commodity under consideration. Crop residues or crops grown specifically for fodder should not be included in estimates of total production and thus do not need to be subtracted. When animals are fed the same commodities consumed by humans, however, total production figures must be reduced by the amount of grain allocated for livestock feed. Historical information on these quantities may be available. If it is not, average estimates are provided by the FAO for the period 1979-1981 and these are presented in Appendix 1. These figures should be adjusted to reflect changes in livestock herds that may have taken place since the years for which the FAO data were compiled.

4.4 Waste

Gross production estimates must also be adjusted to reflect crop losses. As in the case of seed and feed estimates may be available in country to make these calculations. If not, the FAO averages for 1979-81 are contained in Appendix 1. In most cases, it is sufficient to estimate waste as a share of total production and apply this ratio to production estimates for the current year. In reality, however, the percentage of the harvest wasted tends to rise in good years and fall in poor years.

4.5 Milling Extraction Rates

As discussed in Section 3 above, milling extraction rates must be applied to estimates of gross production. The technical conversion factors for most commodities are presented in Appendix 4.

5. NET CHANGE IN STOCKS

To obtain the amount of food grain that is actually available for consumption in the current year, domestic production figures must be adjusted for the net change in both official (public) stocks and unofficial (private) stocks. Net change in stocks is equal to the closing balance for the year minus carry-in stocks at the beginning of the year net of stock losses during the year.

$$\left|\begin{matrix}\text{Net Change}\\ \text{in Stocks}\end{matrix}\right| = \left|\begin{matrix}\text{Closing}\\ \text{Balances}\end{matrix}\right| - \left[\left|\begin{matrix}\text{Carry-in}\\ \text{Stocks}\end{matrix}\right| - \left|\begin{matrix}\text{Stock}\\ \text{Losses}\end{matrix}\right|\right]$$

Data are usually available for carry-in stocks held by the government and may be available for large private marketing boards. They are usually more difficult to obtain for on-farm stocks. On-going farm surveys may be able to give some indication of the level of on-farm inventories carried over from the previous year. If no such data exist, informal discussions with farmers, extension agents or other village workers may be able to provide some insight on the magnitude of these reserves.

Presumably, all food that is carried over from the previous year could, if necessary, be made available for consumption in the current year. This means that closing stock balances at the end of the year would be zero. For the purposes of this calculation, all food held in stocks should be considered as available for consumption. Thus, the entire amount of stocks should be added to production and imports to calculate total available food.*

This is not a programming recommendation, however. In fact, there may be compelling reasons for farmers and government officials to always maintain some minimum level of stocks. It is always possible that no matter how bad a food shortage is, the next year may still be worse. Moreover, countries that are dependent on imports and are subject to frequent logistical delays may find it normal and prudent to maintain adequate levels of stocks to buffer against unpredictable arrivals or distributions of imports and food aid.

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* Net change in stocks is subtracted from production in the food deficit equation. Thus a negative value for net change in stocks means that this amount is added to production, increasing the quantity of available food.

When this is the case, closing stock balances would not be equal to zero. The amount of food available for consumption in the current year would not be equal to the total amount in stock, but would equal carry-in stocks less the level of this buffer stock.

The approach suggested in this situation is to first calculate the food deficit without including these emergency stocks (i.e., closing balances equal to zero as above). This will generate an estimate of the food deficit only for immediate consumption purposes. Then a separate estimate should be made of the quantity of food necessary for the buffer stock.

Once an the net change in stocks has been calculated, the share of this amount that is not in milled form should be multiplied by the milling extraction rate.

6. NET IMPORTS

6.1 Food Strategy

A country may produce all of the food it needs to feed its people; it may export other goods and use the proceeds to import food; or it may do some combination of both. Most countries produce only some portion of the food they need and import the rest. This complicates the task of making the food deficit calculation because it is difficult to determine how much imports "could" be.

For example, one country may have adequate reserves or earnings from merchandise exports to import additional quantities of food when there is a shortfall in domestic crop production. Another country's primary source of foreign exchange may be a cash crop, the production of which decreases when food production decreases. For the second country, not only would its need for imports increase in a drought situation, but its ability to earn foreign exchange to pay for imports would decrease at the same time. Therefore, to assess a country's food deficit, its overall food strategy must be considered.

6.2 Commercial Trade

For most countries, the capacity to import is constrained by the amount of foreign exchange to which they have access. In countries that belong to the CFA franc zone, however, this may not be the case. Considerations for estimating import capacities in those countries will be discussed later.

6.2.1 Foreign Exchange Availability

The following equation can be used to calculate foreign exchange availability in countries whose currencies are not supported by a foreign central bank (e.g., the CFA franc).

$$\begin{vmatrix}\text{Available}\\ \text{Foreign}\\ \text{Exchange}\end{vmatrix} = \begin{vmatrix}\text{Int'l}\\ \text{Reserves}\end{vmatrix} + \begin{vmatrix}\text{Export}\\ \text{Earnings}\end{vmatrix} + \begin{vmatrix}\text{Commercial}\\ \text{Credits}\end{vmatrix} - \begin{vmatrix}\text{Debt}\\ \text{Service}\\ \text{Payments}\end{vmatrix}$$

Each of these terms should be expressed in US dollars.

6.2.1.1 International Reserves

The Central Bank, the Ministry of Finance, the Treasury and other financial institutions are usually the primary sources for data on international reserves within the country. If they do not have such information, it may be available from International Monetary Fund or World Bank publications.

6.2.1.2 Export Earnings

Data on expected manufactured exports can usually be obtained from such sources as the Ministry of Trade of Commerce. For many countries, however, agricultural prodcuts comprise a significant share of their exports. To estimate total exports (manufactured plus agricultural), therefore, cash crop production must be projected before harvest along with food crop production. This is important because many Early Warning Systems designed to assess food deficits only make estimates of food crop production to determine the food gap.

Looking only at food production, however, does not take into account the fact that most countries pursue, either intentionally or unintentionally, a strategy of "food security" which involves exporting agricultural products to import food. Ignoring this fact could lead to underestimation of the food deficit. It would show the increased need resulting from reduced food production, but not the additional need above that caused by decreased export receipts from cash crops.

Another complication in calculating export earnings arises from illegal smuggling into neighboring countries. For some countries these quantities may be significant. Reliable data are almost never available. Commodity price differentials between countries may be an indicator of the net flows. When prices are higher abroad, exports can be expected. Estimates of the

magnitude of these flows may be available from informal sources, and while they can rarely be confirmed, some consideration should be given to the value of these exchanges in making estimates of total exports earnings.

6.2.1.3 Projected Debt Service

The same sources that provide data on international reserves can usually supply information on projected debt service payments. The analyst, however, should exercise some caution in using the official debt service schedules for these estimations. Countries frequently do not meet (and are often not expected to meet) the payment schedules established by creditors and international institutions before an unexpected shortfall in domestic production occurs. Only levels of debt service retirement that are realistic in light of the current crop situation should be subtracted.

6.2.1.4 Commercial Credits

If international borrowing opportunities exist which, if used, would not cause the debt service ratio to reach an unacceptable level, the amount of these borrowings should be added to total available foreign exchange. It is difficult to estimate such amounts, and for most countries it will not be possible to incorporate such information into the analysis. Frequently, however, when it appears that a country has no available foreign exchange with which to buy imports, importers are able to purchase food on the international market with credit provided by suppliers.

6.2.2 Imports

6.2.2.1 Total Commercial Imports

Once available foreign exchange has been calculated, an estimate of total commercial imports can be made. This is not a straightforward calculation because countries tend to allocate their foreign exchange differently in years of serious crop shortfalls from more "normal" years. Unless their behavior has been observed during similar situations in previous years, it is difficult to predict what they will do. Nonetheless, there are several rules of thumb that can be used.

Some donors (including AID) expect a country to import commercially at least the average of the previous five years food grain imports.* Countries are expected to import food commercially up to the point where security holdings of reserves are threatened.

One way to determine this point, is to assume that countries maintain a fixed ratio of international reserves to merchandise imports.** This means that countries are expected to import merchandise up to, but not beyond the point indicated by this ratio, given the current level of foreign exchange availability. An average ratio can be calculated from data on reserves and imports from a base period of the last four or five years. After the country's foreign exchange availability has been determined (as presented in the equation above), the amount that can be imported without surpassing the value of this reserve/import ratio can be calculated as follows.

$$\left|\begin{array}{l}\text{Commercial}\\ \text{Import}\\ \text{Capacity}\end{array}\right| = \frac{\left|\begin{array}{l}\text{Foreign Exchange}\\ \text{Availability}\end{array}\right|}{1 + \left|\begin{array}{l}\text{Reserve/Import}\\ \text{Ratio}\end{array}\right|}$$

This calculation is made in U.S. dollars.

6.2.2.2 Commercial Food Imports

After the total amount of commercial imports that a country can import in a given year has been calculated, the share of that to be allocated to food must be estimated. One way to do this is to take the average historical share of food in total merchandise imports and apply this percentage to the current estimate of total imports. One problem with this method is that many countries import higher proportions of food in their total import budget during years of crop shortfalls than they do in more normal years. If the country has experienced a previous drought or shortfall in domestic production for other reasons,

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* For AID, this is formally established as a Usual Marketing Requirement (UMR) if the country is a PL 480 Title I/III recipient. If not a Title I/III recipient, the UMR calculation represents a good approximation for minimally acceptable commercial imports.

** This is the approach taken by USDA, in its Food Aid Needs Assessment Model (FANA).

the share of food imports in total imports from those years may render a closer approximation than using the historical share for all years.

The dollar value of imports must then be converted into tons of food to use in the food deficit equations. Thus it is necessary to obtain estimates of the prices the country will pay for all important food commodities. If the origin of the imports is known, the actual prices may be available. If not, world prices are probably adequate.

It is in this conversion from the dollar value of imports to the volume of imports that changes in the price of imports is reflected in the food aid needs equation. If world prices have increased since the previous year, this is likely to raise the estimate of the country's food deficit, all other things being equal.

For CFA countries, and sometimes for other countries with independent currencies, the equation presented above does not always forecast food imports accurately. CFA countries are not directly constrained in their purchases of commercial imports by the amount of foreign exchange and explicit credit available to them. Consequently, the calculations described here usually underestimate the amount of food the countries will import in a given year. In this case, there may be other methods that can make better predictions. Some possibilities include making food import estimates by using:

-- the maximum level of commercial food imports in the last five years;

-- the average level of commercial food imports in the last three years;

-- a trend forecast of commercial food imports.

To choose which method is best for a given country, the analyst can use historical data to calculate the forecasts that each of these techniques would have generated had they been applied in the past five years. The analyst should pay particular attention to how each technique forecasted during years of especially poor crop production. The method that results in the best forecasts for that country should be selected.

No matter which technique is used, the share of food imports that are not in milled form should be multiplied by the milling extraction rate.

7. THE FOOD DEFICIT

As discussed in Section 2, the food deficit can be estimated using the following equation. Once values have been assigned to each of the necessary variables, the calculation is very straightforward.

$$\begin{vmatrix}\text{Food} \\ \text{Deficit}\end{vmatrix} = \begin{vmatrix}\text{Total} \\ \text{Food} \\ \text{Needs}\end{vmatrix} - \begin{vmatrix}\text{Net Domestic} \\ \text{Domestic} \\ \text{Production}\end{vmatrix} - \begin{vmatrix}\text{Net Change} \\ \text{in} \\ \text{Stocks}\end{vmatrix} - \begin{vmatrix}\text{Net} \\ \text{Imports}\end{vmatrix}$$

7.1 Emergency versus Non-emergency Food Deficits

For programming purposes, it is often useful to differentiate between emergency and non-emergency (or structural) food deficits. One method to do this is to calculate the food deficit for the previous four or five years using the methodology presented in this manual. An average of these deficits can then be taken to determine a "normal" or structural food gap. The estimate of the food deficit for the current year can then be compared to this structural level. If the estimate exceeds the structural level, the difference between these two numbers is the emergency component of the deficit.

7.2 National versus Individual or Regional Food Deficits

The equations presented in this manual are most suited for calculating the national food deficit. While it is possible to determine the total food need of an individual, village or region (on an average basis), it is very difficult to ascertain how much food they have available for consumption. For households or regions that consume only their own production, it may be possible to estimate their available food by calculating their production and stocks. For households or regions that purchase food with cash, however, the task becomes much more complex. At the household level, information would be needed about levels of income, savings and wealth to make estimates of how much families could "afford." At the village or regional level, information would be necessary on "imports" and "exports" between villages or regions. All of this information is usually very difficult to obtain.

Nonetheless, estimates of food deficits at the regional, village or household level are critical for distributing food aid. The recommended approach to solve this problem is to perform small surveys country-wide that collect data on how much food individuals are consuming on average. The difference between this amount and average per capita food need will provide an estimate of the food deficit per person.

7.3 Food Aid

Once the food deficit has been estimated, the government and the donor community can sit down together to discuss alternatives for reducing or eliminating it. The established food deficit is not necessarily synonymous with the level of food aid needs, but food aid is clearly one mechanism for reducing the gap. Other possibilities include exceptional imports by the government (e.g. allocating foreign exchange from non-food items), rationing large consumers, raising the market price of food to reduce voluntary demand, in conjunction with targeted distributions to the most malnourished, increasing farm-gate prices to ensure that the maximum possible quantity of food makes it to market, and so forth.

One of the first steps in determining the appropriate actions for reducing the food deficit is to ascertain the quantity of food aid already committed by the donor community and scheduled to arrive during the period of the analysis. This is often difficult to do. Frequently the only figures available from other donors are for pledges, not actual disbursements or shipments, and these sometimes never materialize. Nonetheless, an attempt to assess the prior commitments of the donor community should be made. Realistic dates should be put on the arrival estimates. For many countries, international organizations such as the FAO or the DAC (the Development Assistance Committee of OECD) may make compilations of donor commitments over the course of the year which can be supplemented with additional information as it becomes available locally.

There is no prescribed formula for determining how much of the remaining food deficit should be filled by additional food aid, or, of that amount, how much should be provided by individual donors. This will vary depending on the situation in each country and will need to be worked out between the government and the donor community.

Clearly an important factor in deciding how much additional food aid should be used to reduce the remaining food deficit is logistical capacity. Before any decisions are made about levels of food aid to request, a logistical analysis should be performed. Some of the considerations that might be included in such an analysis are contained in Appendix 16. While it may be possible to increase logistical capacity, the level of food aid requested to solve food deficit problems should never exceed the quantity that can be moved on a timely basis to the people who need it.

7.4 The United States Food Aid Program

The United States Government may provide food aid under its P.L. 480 program to help reduce the food deficit as calculated above.

7.4.1 Non-emergency Food Aid

The foreign exchange holdings of some countries may be so limited that in years of domestic production shortfalls they cannot import enough food to satisfy consumer demand. The United States' concessional sales programs are designed to address this situation. Titles I and III food aid is generally non-emergency food aid intended for sale on the commercial market in the recipient country. It can be made available when there is effective consumer demand, meaning that the commodities destined for sale have an established market value and consumers have enough cash to purchase them.

Title II food aid is given in the form of grants or donations. Title II programs also include Maternal/Child Health, Food For Work and School Feeding. These projects attempt to provide nutritional supplements on a regular basis to at-risk groups in the population.

7.4.2 Emergency Food Aid

The Title II program also includes emergency food aid available to address urgent and extraordinary food requirements, primarily in situations where there is such severe devastation of domestic crop production that residents have little cash income, and hence virtually no purchasing power to acquire food. Sales of emergency food must be justified on an exceptional basis, as the priority in Title II emergency programs is to directly feed those in need. AID Handbook 9, Chapter 9 describes in detail the regulations and procedures governing such requests. Emergency assistance is, by definition, temporary and short-term in nature, usually less than nine months in duration.

APPENDIX 1

FROM FOOD BALANCE SHEETS
1979-1981 Average
Food and Agriculture Organization
Rome 1984

Calculations based on these data
Sample Countries

Includes:

Seed, Feed, Waste estimates for the years 1979-1981, by country, by commodity

Conversions for kilograms to calories or grams of protein, by country, by commodity

FOOD BALANCE SHEET

NIGER
AVERAGE
UNITS= 1000 METRIC TONS

POPULATION 5320000

	ABSOLUTE LEVEL						SHARE IN PRODUCTION									PER CAPITA SUPPLY			
	SEED	FEED	WASTE	MANUFACTURED FOOD	MANUFACTURED NON-FOOD	DOMESTIC PRODUCTION	SEED	FEED	WASTE	MANUFACTURED FOOD	MANUFACTURED NON-FOOD	CALORIES PER KG.	GRAMS PROTEIN PER KG.	GRAMS FAT PER KG	GRAMS /DAY	CALORIES /DAY	PROTEIN /DAY GRAMS	FAT /DAY GRAMS
GRAND TOTAL																2440.0	71.6	40.8
VEGETABLE PRODUCT																2257.0	58.6	28.9
ANIMAL PRODUCTS																183.0	13.1	11.8
GRAND TOTAL EXC ALCOHOL																2437.0	71.6	40.8
CEREALS												2455.7	55.1	20.1	682.5	1676.0	37.6	13.7
WHEAT			1.0			2.0	0.0	0.0	0.5	0.0	0.0	2716.0	74.1	12.3	16.2	44.0	1.2	0.2
PADDY RICE	1.0		3.0			31.0	.0	0.0	0.1	0.0	0.0	2324.6	43.9	2.2	45.6	106.0	2.0	0.1
BARLEY				1.0														
MAIZE			1.0			9.0	0.0	0.0	0.1	0.0	0.0	3148.1	92.6	37.0	5.4	17.0	0.5	0.2
MILLET	46.0	26.0	283.0			1311.0	.0	.0	0.2	0.0	0.0	2464.6	48.2	20.9	458.5	1130.0	22.1	9.6
SORGHUM	19.0	8.0	67.0			353.0	0.1	.0	0.2	0.0	0.0	2411.6	74.6	22.5	155.5	375.0	11.6	3.5
PONIO						3.0	0.0	0.0		0.0	0.0	2500.0	33.3	0.0	1.2	3.0	0.1	
ROOT AND TUBERS												1084.9	9.7	1.1	93.1	101.0	0.9	0.1
CASSAVA			28.0			189.0	0.0	0.0	0.1	0.0	0.0	1099.0	8.5	1.2	82.8	91.0	0.7	0.1
POTATOES												0.0	0.0	0.0	0.3			
SWEET POTATOES			2.0			21.0	0.0	0.0	0.1	0.0	0.0	1000.0	10.0	0.0	10.0	10.0	0.1	
SUGARS AND HONEY												944.6	2.1	0.0	48.7	46.0	0.1	
SUGAR CANE			28.0		37.0	141.0	0.0	0.0	0.2	0.0	0.3	306.9	2.6	0.0	39.1	12.0	0.1	
RAW SUGAR												3548.4	0.0	0.0	9.3	33.0		
SUGAR CONFECTIONERY												5000.0	0.0	0.0	0.2	1.0		
PULSES												3364.4	223.4	16.0	75.2	253.0	16.8	1.2
COW DRY PEAS	50.0		60.0			283.0	0.2	0.0	0.2	0.0	0.0	3399.2	228.5	14.1	70.9	241.0	16.2	1.0
PULSES NES	1.0		2.0			11.0	0.1	0.0	0.2	0.0	0.0	2790.7	139.5	46.5	4.3	12.0	0.6	0.2
NUTS AND OILSEEDS												3893.1	160.3	320.6	13.1	51.0	2.1	4.2
NUTS NES												2500.0	125.0	250.0	0.8	2.0	0.1	0.2
GROUNDNUTS IN SHELL	11.0		3.0	56.0		95.0	0.1	0.0	.0	0.6	0.0	3934.4	163.9	319.7	12.2	48.0	2.0	3.9
SESAME SEEDS												10000.0	0.0	0.0	0.1	1.0		
MELONSEEDS COTTONSEEDS		2.0				2.0	0.0	1.0	0.0	0.0	0.0							
VEGETABLES												347.0	11.0	1.6	63.4	22.0	0.7	0.1
TOMATOES			1.0			6.0	0.0	0.0	0.2	0.0	0.0	370.4	0.0	0.0	2.7	1.0		
GREEN ONIONS, SHALLOTS						1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7			
DRY ONIONS			11.0			107.0	0.0	0.0	0.1	0.0	0.0	387.1	10.8	0.0	46.5	18.0	0.5	
FRESH VEGETABLES NES			3.0			26.0	0.0	0.0	0.1	0.0	0.0	252.1	16.8	0.0	11.9	3.0	0.2	
PREPARED VEGE. NES												666.7	0.0	0.0	1.5	1.0		
FRUIT												950.0	10.0	5.0	20.0	19.0	0.2	0.1
DATES			2.0			6.0	0.0	0.0	0.3	0.0	0.0	2352.9	19.6	0.0	5.1	12.0	0.1	
FRESH FRUIT NES			3.0			31.0	0.0	0.0	0.1	0.0	0.0	482.8	6.9	6.9	14.5	7.0	0.1	0.1
MEAT AND OFFALS												1496.5	146.1	95.1	56.8	85.0	8.3	5.4
BEEF AND VEALS						37.0	0.0	0.0	0.0	0.0	0.0	1907.2	144.3	144.3	19.4	37.0	2.8	2.8
EDIBLE OFFALS OF CATTLE						7.0	0.0	0.0	0.0	0.0	0.0	1081.1	189.2	27.0	3.7	4.0	0.7	0.1
MUTTON AND LAMB						11.0	0.0	0.0	0.0	0.0	0.0	1578.9	140.4	105.3	5.7	9.0	0.8	0.6
EDIBLE OFFALS OF SHEEP						1.0	0.0	0.0	0.0	0.0	0.0	1250.0	125.0	0.0	0.8	1.0	0.1	
GOAT MEAT						29.0	0.0	0.0	0.0	0.0	0.0	1216.2	135.1	74.3	14.8	18.0	2.0	1.1
EDIBLE OFFALS OF GOATS						5.0	0.0	0.0	0.0	0.0	0.0	1200.0	160.0	40.0	2.5	3.0	0.4	0.1
PIG MEATS						1.0	0.0	0.0	0.0	0.0	0.0	2857.1	142.9	[illegible]	0.7	2.0	0.1	0.2
CHICKEN MEATS						8.0	0.0	0.0	0.0	0.0	0.0	1136.4	113.6	[illegible]	4.4	5.0	0.5	0.3
HORSEMEAT						2.0	0.0	0.0	0.0	0.0	0.0	1250.0	125.0	0.0	0.8	1.0	0.1	
MEAT OF ASSES						1.0	0.0	0.0	0.0	0.0	0.0	1428.6	142.9	0.0	0.7	1.0	0.1	
MEAT OF CAMELS						1.0	0.0	0.0	0.0	0.0	0.0	2000.0	200.0	200.0	0.5	1.0	0.1	0.1
GAME MEATS						5.0	0.0	0.0	0.0	0.0	0.0	1153.8	192.3	38.5	2.6	3.0	0.5	0.1
HEN EGGS	1.0		1.0			7.0	0.1	0.0	0.1	0.0	0.0	1304.3	87.0	87.0	2.3	3.0	0.2	0.2
FISH AND SEAFOODS												714.3	107.1	35.7	2.8	2.0	0.3	0.1

FOOD BALANCE SHEET

NIGER
AVERAGE
UNITS: 1000 METRIC TONS

POPULATION 5320000

	ABSOLUTE LEVEL					DOME-STIC PRODU-CTION	SHARE IN PRODUCTION					CALO-RIES PER KG.	GRAMS PROTEIN PER KG.	GRAMS FAT PER KG	PER CAPITA SUPPLY			
	SEED	FEED	WASTE	MANUFACTURED FOOD	MANUFACTURED NON-FOOD		SEED	FEED	WASTE	MANUFACTURED FOOD	MANUFACTURED NON-FOOD				GRAMS /DAY	CALORIES /DAY	PROTEIN /DAY GRAMS	FAT /DAY GRAMS
MILK												651.8	40.9	31.1	102.8	67.0	4.2	3.2
WHOLE COW MILK			5.0	53.0		95.0	0.0	0.0	0.1	0.6	0.0	655.7	29.5	32.8	30.5	20.0	0.9	1.0
SKIM COW MILK			2.0			50.0	0.0	0.0	.0	0.0	0.0	327.9	32.8	0.0	24.4	8.0	0.8	
SHEEP MILK			1.0	10.0		12.0	0.0	0.0	0.1	0.8	0.0	1666.7	0.0	0.0	0.6	1.0		
CHEESE OF SHEEP MILK						1.0	0.0	0.0		0.0	0.0	4285.7	285.7	285.7	0.7	3.0	0.2	0.2
GOAT MILK			7.0	51.0		135.0	0.0	0.0	0.1	0.4	0.0	503.8	32.7	17.6	39.7	20.0	1.3	0.7
CHEESE OF GOAT MILK						6.0	0.0	0.0		0.0	0.0	3939.4	242.4	303.0	3.3	13.0	0.8	1.0
CAMEL MILK			1.0			8.0	0.0	0.0	0.1	0.0	0.0	555.6	27.8	27.8	3.6	2.0	0.1	0.1
OILS AND FAT												8461.5	0.0	953.8	13.0	110.0		12.4
VEGETABLE OILS AND FATS												8829.8	0.0	1000.0	9.4	83.0		9.4
SOYABEAN OIL												8571.4	0.0	1000.0	0.7	6.0		0.7
GROUNDNUT OIL					4.0	18.0	0.0	0.0	0.0	0.0	0.2	8840.6	0.0	1000.0	6.9	61.0		6.9
PALM OIL												8750.0	0.0	1000.0	1.6	14.0		1.6
ANIMAL OILS AND FATS												7500.0	0.0	833.3	3.6	27.0		3.0
CATTLE FAT						1.0	0.0	0.0	0.0	0.0	0.0	10000.0	0.0	1000.0	0.5	5.0		0.5
SHEEP FAT												10000.0	0.0	1000.0	0.1	1.0		0.1
GOAT FAT						1.0	0.0	0.0	0.0	0.0	0.0	7500.0	0.0	750.0	0.4	3.0		0.3
BUTTER OF COW MILK						3.0	0.0	0.0	0.0	0.0	0.0	7142.9	0.0	785.7	1.4	10.0		1.1
BUTTER OF GOAT MILK						2.0	0.0	0.0	0.0	0.0	0.0	7272.7	0.0	818.2	1.1	8.0		0.9
SPICES												3333.3	166.7	166.7	0.6	2.0	0.1	0.1
PIMENTO, ALLSPICE												5000.0	0.0	0.0	0.2	1.0		
SPICES NES						1.0	0.0	0.0	0.0	0.0	0.0	2500.0	0.0	250.0	0.4	1.0		0.1
TEA												0.0	200.0	0.0	0.5		0.1	
BEER OF BARLEY						9.0	0.0	0.0	0.0	0.0	0.0	384.6	0.0	0.0	5.2	2.0		

APPENDIX 2

From World Food Survey (the fourth)
Food and Agriculture Organization
Statistics Series No. 11
Food and Nutrition Series No. 10
Rome 1977

Includes:

Critical Limit for Per Capita Calorie Consumption, by country.

APPENDIX M

Per Caput Calorie Supply and Percentage and Number of Individuals Undernourished in Selected Countries, 1969/71 and 1972/74

Country	Calorie Supply per caput		Critical Limit	Population with Calorie Intake Below 1.2 BMR			
				Percentage		Number (1000	
	1979-71	1972-74	(1.2 BMR)	1969/71	1972/74	1969/71	1972/74
Afghanistan	1947	2000	??	43	37	7301	6774
Argentina	3342	3281	1631	2	2	475	494
Bangladesh	1945	1949	1512	38	38	25723	27026
Bolivia	1808	1860	1545	52	45	2846	2315
Botswana	2116	2025	1517	33	36	204	237
Brazil	2507	2538	1545	14	13	13329	13478
Burma	2184	2131	1487	19	22	5272	6555
Cameroon	2407	2383	1526	14	16	817	990
Chad	2088	1765	1526	34	54	1238	2063
Chile	2802	2736	1554	11	15	1031	1484
Colombia	2152	2164	1487	29	28	6402	6806
Dominican Rep.	2023	2158	1517	38	33	1650	1581
Ecuador	2062	2087	1507	30	30	1809	1995
Egypt	2676	2632	1557	7	8	2333	2866
Ethiopia	2168	2051	1512	26	38	6462	10174
Ghana	2273	2302	1498	22	20	1898	1866
Guatemala	2015	1987	1493	38	38	2013	2197
Guinea	2071	1994	1517	38	41	1490	1725
Haiti	1964	2029	1523	43	38	1821	1678
Honduras	2178	2052	1517	32	38	817	1075
India	2034	1970	1486	26	30	141214	175162
Indonesia	1965	2033	1507	34	30	40619	38742
Iran	2162	2326	1508	23	15	6523	4647
Iraq	2300	2392	1528	17	14	1591	1447
Ivory Coast	2608	2626	1517	9	8	388	371
Kenya	2241	2137	1517	24	30	2699	3722
Korea Rep.	2707	2749	1531	4	4	1255	1332
Liberia	1943	1976	1517	42	37	640	603
Libya	2553	2698	1526	13	7	252	149
Madagascar	2463	2360	1517	14	17	970	1285
Malawi	2340	2414	1517	19	14	828	655
Mali	2056	1759	1526	38	49	1918	2656
Mauritania	1993	1867	1517	36	48	418	591
Mexico	2661	2693	1512	9	8	4528	4435
Morocco	2480	2593	1528	14	10	2118	1650
Mozambique	2019	1989	1536	34	36	2800	3173
Nepal	2041	2015	1486	27	29	3033	3499
Nicaragua	2417	2384	1523	17	18	335	39[illegible]
Niger	1989	1857	1526	36	47	1446	2048
Pakistan	2148	2132	1512	24	26	14508	17223
Paraguay	2781	2723	1487	6	8	138	200
Peru	2312	2328	1526	23	23	3047	3326
Phillippines	1945	1953	1517	35	35	13161	14550
Saudi Arabia	2361	2411	1534	14	12	1084	1014
Senegal	2229	2181	1526	25	25	981	1053
Sierra Leone	2311	2254	1498	20	21	529	596
Somalia	1874	1916	1492	42	40	41171	1202
Sudan	2096	2067	1526	30	30	4709	5153
Swaziland	2072	2118	1536	35	33	143	147
Syria	2462	2525	1536	22	10	750	653
Tanzania	1964	1958	1498	35	35	4646	5076
Thailand	2295	2315	1511	18	18	6434	7095
Togo	2164	2167	1498	24	24	470	510
Tunisia	2213	2378	1514	24	16	1233	877
Turkey	2833	2830	1577	7	7	2466	2655
Venezuela	2405	2399	1536	7	7	739	806
Zaire	2022	1848	1504	34	44	7357	10244
Zambia	1980	2016	1517	35	34	1503	1600

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APPENDIX 3

From Calorie Requirements
Food and Agriculture Organization
Nutritional Studies No. 15
Rome 1968

Includes:

Calorie Requirements for Adults

Table 2 - CALORIE REQUIREMENTS OF ADULTS ACCORDING TO AGE AT REFERENCE TEMPERATURE AND BODY WEIGHT

Age	Percentage of Reference	Men	Women
Years		--- Calories per day ---	
20 to 30	100.0	3,200	2,300
30 to 40	97.0	3,104	2,231
40 to 50	94.0	3,008	2,162
50 to 60	86.5	2,768	1,990
60 to 70	79.0	2,528	1,817
70	69.0	2,208	1,587

Table 3. - CALORIE REQUIREMENTS OF ADULTS ACCORDING TO MEAN ANNUAL EXTERNAL TEMPERATURE AT REFERENCE AGE AND BODY WEIGHT

Mean Annual External Temperature	Percentage of Reference	Men	Women
Centigrade		--- Calories per day ---	
- 5°	104.5	3,344	2,404
0°	103.0	3,296	2,369
5°	101.5	3,248	2,335
10°	100.0	3,200	2,300
15°	97.5	3,120	2,243
20°	95.0	3,040	2,185
25°	92.5	2,960	2,128
30°	90.0	2,880	2,070

APPENDIX 4
From Agricultural Commodities
Projections for 1975 and 1985 Vol. 1
Methodological Notes
Statistical Appendix
Food and Agriculture Organization
Rome 1967

Includes:

Technical Conversion Factors Used in the Preparation of Standardized Food Balance Sheets

APPENDIX 4

Agricultural Commodities - Projections for 1975 and 1985 Vol. II
Methodological Notes, Statistical Appendix FAO 1967

Table I.27 Technical Conversion Factors Used in the Preparation of Standardized Food Balance Sheeds[1]

Basic commodity	Derived commodity	Conversion factor (percent)
Wheat	wheat flour	72-80
Rice, Paddy	rice, milled	60-70
Rice,	rice, milled	80
Barley	flour	60-80
Oats	flour	50-80
Maise	flour	80-95
Millet and sorghum	flour	80-95
Rye	flour	70-80
Cassava, fresh	cassava flour	25-33
Cassava, fresh	tapioca	15-30
Sugar cane	raw centrifugal sugar	10-12
Sugar beet	raw centrifugal sugar	14-17
Non-centrifugal sugar	raw centrifugal sugar	60
Raw centrifugal sugar	refined sugar	92
Groundnuts, in shell	groundnuts, shelled	70
Coconuts, in husk	copra	15-24
Fruit, Fresh	Fruit, dried	
Apples	dried apples	10-20
Pears	dried pears	17
Figs	dried figs	33
Peaches	dried peaches	18
Plums	dried plums	23
Citrus Fruit, Fresh	citrus juice, natural	30-40
Citrus Fruit, Fresh	citrus juice, concentrated	8
Meat, carcass weight	canned mean	60-80
Meat, carcass weight	smoked meat	75
Meat, carcass weight	salted meat	89
Eggs, in shell	liquid or frozen eggs	18
Eggs, in shell	dried eggs	24
Fish, round weight	fish, landed weight	67
Fish, Round weight	fish, fillet weight	50
Milk, whole	powered whole milk	12
Milk, whole	condensed or evaporated milk	38
Milk, whole	cheese	11
Milk, whole	butter	5
Milk, whole	cream	16
Milk, skimmed	powdered skim milk	9
Cotton seed	cottonseed oil	16
Sesame seed	sesame seed oil	47
Rapeseed	rapeseed oil	35
Linseed	linseed oil	34
Sunflower seed	sunflowerseed oil	30
Castor seed	castor seed oil	45
Groundnuts, shelled	groundnut oil	43
Soybeans	soybean oil	16
Melon seed	melonseed oil	30
Hempseed	hempseed oil	30
Palm Kernels	palm oil	46
Copra	coconut oil	64
Tungnuts	tung oil	17
Sheanuts	shea nut oil	46
Safflower seeds	safflower oil	30
Other seeds N.E.S.	oil	30

[1]Where conversion factor is applicable to many countries, it is shown as a dingle figure, while for those products for which conversion rates vary substantially from country to country the conversion factors are shown as a range. For further references regarding the specific factors applicable to particular countries see the FAO publication: Technical Conversion Factors for Agricultural Commodities", Rome 1960.

APPENDIX 5

Data Checklist for Deficit Assessment

DATA REQUIREMENTS FOR FOOD DEFICIT ASSESSMENTS

VARIABLE TO BE ESTIMATED	ALTERNATIVE METHODS OF ESTIMATION	ESSENTIAL DATA	USEFUL DATA (OR INFORMATION)
INDICATORS	1. prices	- monthly data series on food prices, by crop, by region, for a period of years; including current year - inflation rates for same years	- historical data series on: food import prices government procurement prices
	2. distress sales of livestock	- historical data on volumes of livestock sales -- or -- - livestock prices	
	3. remote sensing in images		- satellite images of the country by month over several years
TOTAL FOOD NEEDS	1. per capita consumption (multiplied by) population	- survey data on average consumption per person - population	- subsistence standards - historical data series on: food prices consumer incomes - consumer prices and income elasticities - total discretionary (above subsistence) food consumption in the economy - consumption behavior in previous droughts
	2. average total consumption from previous years adjusted for the current population	- historical data series (for at least 5 years) on: net domestic production net changes in stocks net food imports total food aid total population (or population growth rates) - current population	

DATA REQUIREMENTS FOR FOOD DEFICIT ASSESSMENTS (con't)

NET DOMESTIC PRODUCTION	1. The Area/Yield Method	- area data, by crop, by region - yield forecasts, by crop, by region	- historical data series on: commodity prices prices of non-agricultural products - available land - available inputs - NASA or NOAA assessments - historical data series on: rainfall (monthly, by region) inputs (fertilizer, improved seed, pesticides, tractor services, etc.) - coefficients for the affect of all of the above on yield
	2. The Post-Harvest Method	- sales to government marketing boards - percent of total production sold through government channels -- or -- - on-farm retention (stocks and consumption) - local sales	
NET CHANGE IN STOCKS	closing balances (minus) carry in stocks	- carry in stocks for government and on-farm inventories - coefficient for stock losses	- past storage behavior for government and farm stocks in periods of drought
NET FOOD IMPORTS	foreign exchange availability (divided by) 1 + (reserve/import ratio)	- international reserves - projected manufactured export earnings - production forecasts for cash crops - expected world prices for cash crops - projected debt service payments - world prices for food imports - historical data on: total food imports grain imports reserves	- food strategy - available international credit for import finance - illegal smuggling (import or export) - breakdown of imports by category

Data Checklist

HISTORICAL DATA SERIES

Production (by region)
Total grain production, by commodity
Total production of other food crops, by commodity
Area estimates, by variety and technique (e.g., irrigated vs. rainfed)
Area under fallows or potentially arable land
Yield estimates, by variety and technique
Fertilizer use (by crop)
Pesticide use (by crop)
Other input use (e.g., credit, tractor services)
Rainfall (weekly, from agriculturally representative regions)
Rural labor force

Prices
Commodity prices to consumers (by region, bi-weekly basis)
Commodity prices to farmers
Commidity prices in neighboring countries
Input prices
Consumer Price Index for non-farm goods
Urban/rural wage rates

Trade
Total merchandise exports (value $US)
Total food imports (quantity, tons)
Total grain imports - including smuggling (quantity, tons)
Total grain exports _ including smuggling (quantity, tons)
Total food aid

International Finance
International Reserves

Stocks
Net change in grain stocks
Yearly closing balances - Carry in stocks
    Public (official)
    Private (traders and on-farm)

Other
Marketed production

COEFFICIENTS

% of production used for seed, by crop
% of production used for feed, by crop
% of production wasted, by crop
Stock losses as % of total holdings
Price and income elasticities, particularly for grain consumption
Yield responses to fertilizer doses, by crop (for different levels of application)

Data Checklist continued

FACTORS OF CONVERSION

Kilograms of grain to calories, by commodity
Kilograms of other commodities to calories
Milling extraction rates

OTHER

Recommended per capita caloric intake
Population (by region)
Population growth rates
Size of livestock herds
Crop calendars, by commodity
Crop coefficients, by commodity
Stock inventory behavior
Food strategy

CURRENT YEAR DATA

Production (by region, by crop)

From farm surveys:
Area estimates, by variety and technique
Yield estimates, by variety and technique
Fertilizer use per hectare (by crop)
Pesticide use per hectare (by crop)
Seed use per hectare (high yielding varieties vs. standard)
Use of other inputs (e.g., credit, tractor services)

From national data:
Total fertilizer offtakes
Total seed (especially improved seed) offtakes
Offtakes of other inputs

Other:
Rainfall (weekly, from agriculturally representative regions)
Labor force and migration

Prices
Commodity prices to consumers (by region, bi-weekly basis)
Commodtiy prices to farmers
Commodity prices in neighboring countries
Input prices
Consumer Price Index for non-farm goods

International Finance
Merchandise export earnings
Projected debt service payments
Value of potential international import credits

Other
Changes in soil quality (desertification, salination, waterlogging, etc.)
Episodic information (plant disease, pest attacks, war, weather-related disasters and their impact on production)

APPENDIX 6

From User's Guide
Development of Agroclimatic/Crop Index
Assessment Models
NOAA/NESDIS/AISC

in cooperation with University of Missouri
by C. Sakamoto, R. Achutuni and L. Steyaert
September, 1984

Includes:

Equations for Percent of Normal Rainfall Calculations

IV. INDICES

A. Percent of Normal Rainfall

In climatology normal rainfall is determined by dividing the total amount of rainfall for the record period (example: 20 years of June rainfall) by the number of years. Clearly, this is the average or mean.

$$\text{Average} = [\ \Sigma X_i\ /\ n\ ]$$

where X = June rainfall

i = year, 1 to n.

Percent of normal (PN) is defined as:

$$PN = (X_i - \Sigma X_{i/n}\ )\ (100)$$

Even this simple percent of normal index can lead to confusion. For example, if average rainfall for a month is 50 mm and only 25 mm was reported, this represents 50 percent of normal (average). This amount could also represent 50 percent below normal. Similarly, if 150 mm was observed for the current month, this is 300 percent of normal or 200 percent above normal. Needless to say, these statements can only lead to confusion for the non-technical reader; therefore, it is suggested that when percent normal average is used, the values be consistently states as percent of normal (average).

One advantage of this index is its simplicity and ease of understanding by the non-technician. In addition normal rainfall, particularly monthly values, can be easily secured through many sources or estimated by various methods. It is well known that normal rainfall may be associated with deficient or excessive water for crops. Therefore, the use of percent normal has to be carefully interpreted in terms of the rainfall amounts, plant water requirements and time of rain relative to the growing season.

APPENDIX 7

From Crop and Food Aid Calendars for Africa
United States Department of Agriculture
Economic Research Service
International Economics Division
by Kevin Lanagan
August, 1983

Includes:

Crop calendars, by country, by commodity

Crop and Food Aid Calendars for Africa

The five calendars presented here show planting and harvesting dates for major food crops in 36 low-income countries in Africa. In addition, these calendars show when food supplies are critically short and when food aid must be shipped from the United States in order to reach its destination when it is most needed. These calendars differ, therefore, from earlier crop calendars that provided only planting and harvesting dates for key crops in the developing world.[1] Those calendars, although still valuable general reference works for world agricultural production, consumption, and trade, provided little help to policy makers and analysts on the issue of food aid needs in developing countries.

Interest in food aid policy has intensified over the last decade, due in part to the worldwide attention accorded Sahelian droughts and refugee problems in Cambodia and East Africa. In administering food assistance programs, the concern has been not only the volume of food aid available for and required by needy countries, but also the timing of its delivery. Recipient and donor countries alike have lamented those occasions where, despite early and accurate determination of food needs, delivery of food aid supplies did not occur at the time of most critical need. Food aid operations officials in USDA and AID speculate that food aid bundles have on several occasions reached targeted populations too early or too late to achieve optimal benefit. Documenting such occurrences has been difficult due to variability in on-site verification and opinion regarding the timeliness and adequacy of food aid distribution. A staff report to the Senate Foreign Relations Committee in the autumn of 1976 described how food relief had been shipped to Bangladesh earlier that year, despite ample grain supplies already in storage there. Grain spoilage and infestation resulted.

From the perspective of food aid, then, what has been missing among previous collections of crop calendars is an elucidation of how crop planting and harvesting seasons affect the timing for the delivery of food aid shipments. Analysts charged with appropriating food aid budgets should know not only in which month(s) a recipient country's harvest occurs but also when food shortages are most acute, how much lead time is required to transport food from donor to recipient countries, and what is the normal cycle of rainy seasons which could complicate inland food transportation efforts.

This document provides such enhancements to the traditional crop calendar, specifically for countries in Africa.[2] Table 1 contains basic crop calendars for major staple crops in low-income

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[1]Representing collections are Planning and Harvesting Seasons for Africa and West Asia, USDA/FAS-M-90, July 1960; and Crop Calendars, FAO/Rome Planting Production and Protection Paper No. 12, 1978.

[2]ERS/IED plans publication of comparable crop and food aid calendars for other regions.

developing African countries.[1] Tables 2-5 present supplementary information of use in food aid analysis and policymaking: rainfall seasons; periods when food shortages are most likely to be acute; shipping time from the United States to each country, and critical months for timely shipment of food aid from the United States. This last table takes into account all the factors included in the preceding tables--along with other information concerning port and transportation facilities--to provide an estimate of optimal months for delivering food aid. (Critical months for shipment from origins other than the United States can be estimated by factoring into estimates in Table 5 any differences in shipping times relative to time requirements indicated in Table 4.)

For the crop calendars (Table 1), countries are arranged alphabetically; for the food aid calendars (Tables 2-5) countries are arranged in blocks corresponding to an indicated period of the year, for purposes of easier chronological reference. Estimates of planting and harvesting times are based upon normal historical practice. In a given year, these times will vary somewhat with rainfall and available soil moisture. The crop calendars treat only key staple crops. Cassava is excluded because it is harvested year-round. Occasionally, crops are split into major and minor harvest, which indicates that more than one planting for that crop is normal. Major denotes the major planting in terms of volume.

One crucial step in the process of anticipating food aid needs is not dealt with in these tables--namely, the optimal timing of negotiations between donor (U.S.) and recipient countries in order to meet recommended shipping time frames in Table 5. Because of the numerous linkages within negotiations and processing cycles, firm estimates of when to start negotiations cannot be attempted here. Forging the agreement itself, initiating the purchase authorization, bidding on sale of the commodity, preparing documents, and loading the commodity for shipment all can vary in duration and therefore elude uniform time prescriptions. Instead, it is hoped that officers responsible for the operations of food aid assistance--who are more intimately acquainted with the timing of their own negotiating cycle--will find the food aid calendars a useful guide in determining optimal internal scheduling for food aid assistance activities.

[1]These calendars are geared to low-income countries which are most likely to experience food deficits and to request food aid assistance. Excluded are high-income and food surplus countries, as well as a few low-income countries for which the available information was inadequate.

Table 1--Low-income countries of Africa: Crop calendars for major food items[1]

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Angola	Corn					H						P	P
Benin	Corn (major)			P	P				H	H			
	Corn (minor)	H								P	P		H
	Yams			P	P	P		H	H				
Botswana	Corn				H	H	H				P	P	P
	Sorghum			H	H	H					P	P	P
Burundi[2]	Corn	H	H								P	P	
	Sweet Potatoes	P	P				H	H					
Cameroon[3]	Rice (major)	H							P				H
	Rice (minor)						P	P			H	H	H
	Corn (major)			P	P			H	H	H			
	Corn (minor)								P	P			H
	Millet					P	P			H	H		
Cape Verde	Corn							P				H	
	Beans							P				H	
Central Africa Republic	Corn				P	P			H	H			
Chad	Rice						P	P			H	H	H
	Millet						P			H	H	H	
Egypt	Wheat	P			H	H	H					P	P
	Rice	H		P	P	P					H	H	H
	Corn (major)				P	P	P	H	H	H	H		
	Corn (minor)	H	H				P	P	P			H	H
	Sorghum			P	P	P		H	H	H	H		
	Millet				P	P			H	H	H		
Ethiopia[4]	Wheat	H	H				P	P	P	P		H	H
	Corn				P	P	P			H	H	H	
	Barley					P	P	P			H	H	H
	Sorghum				P	P	P	P		H	H	H	H
	Teff	H	H	H	P	P	P	P	P	H	H	H	H
Gambia	Rice (major)					P	P			H	H		
	Rice (minor)	H							P	P			H
	Corn					P	P			H	H		
	Millet					P	P			H	H		

Note: P = Planting; H = Harvesting

[1]Cassava excluded. Harvested year-round.

[2]Imported food crops not listed include cassva, beans (harvested in February) and potatoes (harvested in July).

[3]Major corn crop grown in southern rainy region, millet and minor corn crop in northern dry area.

[4]Teff raised as a bread cereal almost exclusively in Ethiopia.

Table 1 - Low-income countries of Africa: Crop calendars for major food items -- continued

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ghana	Corn (major)			P	P			H	H				
	Corn (minor)	H	H							P			
	Cocoyams	H				P	P						H
Guinea	Rice (upland)				P	P				H	H		
	Rice (swamp)	H				P	P	P	P		H	H	H
	Corn					P	P			H			
Guinea-Bassau	Rice (major)				P	P				H	H		
	Rice (minor)	H				P	P	P	P		H	H	H
Kenya	Corn (major)	H	H		P	P					H	H	H
	Corn (minor)						H				P	P	
Lesotho[1]	Corn (major)				H	H	H	H			P	P	P
Liberia	Rice (upland)				P	P				H	H		
	Rice (swamp)	H				P	P	P			H	H	H
	Cocoyams	H				P	P						H
Madagascar	Rice				H	H	H			P	P	P	
Malawi[2]	Corn	P	P			H	H	H	H			P	P
Mali[3]	Rice (major)						P	P				H	H
	Rice (minor)					P	P						H
	Corn					P	P			H	H		
	Millet (major)					P	P	P			H	H	
	Millet (minor)			P	P						H	H	
Mauritania[4]	Rice						P				H	H	
	Millet						P				H	H	
Morocco	Wheat	P				H	H	H			P	P	P
	Barley				H	H	H	H			P	P	P
Mozambique	Corn					H	H	H				P	P
Niger[5]	Millet						P	P		H	H		
	Sorghum							P				H	H

[1]Sorghum harvested sooner than corn. Wheat -- with an April-November season -- less important than corn; large proportion of wheat needs imported from South Africa.

[2]Sorghum and rice have crop season similar to corn. Country is vulnerable to seasonal food shortages due dry season averaging 5 months.

[3]Minor millet crop is raised in Mopti-Gao region when rainfall provides adequate soil moisture for planti

[4]Rice grown on recession plains along Senegal River.

[5]Quick-maturing millet grown to provide food before the longer maturing sorghum crop is harvested.

Table 1 - Low-income countries of Africa: Crop calendars for major food items -- continued

Country	Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rwanda[1]	Sorghum		P	P			H	H					
	Sweet Potatoes		P	P			H	H					
Senegal	Rice						P				H	H	
	Millet						P				H	H	
Sierra Leone[2]	Rice (swamp)					P	P				H	H	H
	Rice (upland)						P				H	H	H
	Rice (moistland)				P	P		H	H				
Somalia	Corn (major)			P	P	P		H	H	H			
	Corn (minor)		H	H							P	P	
	Sorghum (major)				P	P			H	H	H		
	Sorghum (minor)		H								P	P	
Sudan[3]	Wheat			H	H							P	P
	Corn				P	P	P		H	H	H		
	Sorghum							P	P		H	H	
	Millet						P	P	P		H	H	H
Swaziland	Corn					H	H	H			P	P	P
Tanzania	Corn			P	P	P	P	H	H	H			
Togo	Corn				P	P			H	H			
	Millet					P	P			H	H		
Tunisia	Wheat					H	H	H			P	P	P
	Barley					H	H	H			P	P	P
Uganda[4]	Corn (major)				P	P			H	H	H		
	Corn (minor)	H	H							P	P		
Upper Volta[5]	Sorghum					P	P		H	H	H		
	Millet					P	P			H	H		
Zaire (Northern)	Rice							P	P			H	
	Corn (major)		P				H						
	Corn (minor)						P					H	
(Southern)	Rice	P				H							P
	Corn (major)	H									P		
	Corn (minor)	P					H						
Zambia[6]	Corn				H	H	H	H				P	P

[1]Sorghum and sweet potatoes interplanted during February-June rainy season; beans and corn during September-December rainy season.

[2]Tidal and inland swamp rice plants grown in nurseries during April-June, then transplanated in July.

[3]Wheat is primarily irrigated.

[4]No prolonged dry season normally, but rainfall is particular subject to variation in the northeast. All major grains have similar crop seasons.

[5]Sorghum is major staple; smaller millet crop harvested in August-September provides food until October sorghum harvest.

[6]Millet and sorghum crop seasons similar to corn. Zambia heavily dependent upon corn; long dry season for the crop -- 6 months -- makes country particularly vulnerable to shortfalls.

Table 2 - Low-income countries of Africa: Major rainfall seasons

Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Starting:																	
Jan-March																	
Benin			X	X	X	X	X	X									
Ghana			X	X	X	X	X	X	X								
Tanzania		X	X	X	X												
Starting:																	
April-May																	
Cameroon				X	X	X	X	X									
Ethiopia					X	X	X	X	X								
Gambia					X	X	X										
Guinea					X	X	X	X									
Guinea-Bissau				X	X	X	X	X	X								
Kenya				X	X	X	X										
Liberia					X	X	X										
Somalia				X	X	X											
Togo				X	X	X	X	X	X								
Uganda				X	X	X											
Starting:																	
June-Aug																	
Cape Verde							X	X	X								
Chad						X	X	X									
Mali						X	X	X									
Mauritania						X	X	X	X	X							
Niger						X	X	X									
Senegal						X	X	X	X								
Sierra Leone						X	X	X	X								
Sudan						X	X	X	X								
Upper Volta						X	X	X									
Zaire (Northern)								X	X	X							
Starting:																	
Sept-Dec																	
Angola										X	X	X	X	X	X	X	
Botswana											X	X	X				
Burundi											X	X	X	X	X	X	
Congo									X	X	X	X	X	X	X	X	X
Lesotho										X	X	X	X				
Madagascar												X	X	X	X	X	X
Malawi												X	X	X	X		
Morocco										X	X	X	X				
Mozambique											X	X	X	X	X	X	
Rwanda												X	X	X	X	X	X
Swaziland										X	X	X	X	X			
Tunisia										X	X	X	X	X			
Zaire (Southern)											X	X					
Zambia											X	X	X	X			

APPENDIX 8

From User's Guide
Development of Agroclimatic/Crop Index
Assessment Models

in cooperation with University of Missouri
by C. Sakamoto, R. Achutuni and L. Steyaert
September, 1984

Includes:

Crop Coefficients, by commodity

Exhibit _____

Table 4. Crop Coefficients (kc) (Adapted from Doorenbos and Pruitt, 1977)

CROP	Crop Development Stages				
	Planting or Transplanting	Vegetative	Flowering and Reproduction	Maturity	Harvest
Banana					
Tropical	0.40 - 0.50	0.70 - 0.85	1.00 - 1.10	0.90 - 1.00	0.75 - 0.85
Subtropical	0.51 - 0.65	0.80 - 0.90	1.00 - 1.20	1.00 - 1.15	1.00 - 1.15
Green Beans	0.30 - 0.40	0.65 - 0.75	0.95 - 1.05	0.90 - 0.95	0.85 - 0.95
Groundnut	0.40 - 0.50	0.70 - 0.80	0.95 - 1.10	0.75 - 0.85	0.55 - 0.60
Maize					
Sweet	0.30 - 0.50	0.70 - 0.90	1.05 - 1.20	1.00 - 1.15	0.95 - 1.10
Grain	0.30 - 0.50	0.70 - 0.85	1.05 - 1.20	0.80 - 0.95	0.55 - 0.60
Peas	0.40 - 0.50	0.70 - 0.85	1.05 - 1.20	1.00 - 1.15	0.95 - 1.10
Potato	0.40 - 0.50	0.70 - 0.80	1.05 - 1.20	0.85 - 0.95	0.70 - 0.75
Rice	1.10 - 1.15	1.10 - 1.50	1.10 - 1.30	0.95 - 1.05	0.95 - 1.05
Sorghum	0.30 - 0.40	0.70 - 0.75	1.00 - 1.15	0.75 - 0.80	0.50 - 0.55
Soybeans	0.30 - 0.40	0.70 - 0.80	1.00 - 1.15	0.70 - 0.80	0.40 - 0.50
Sugarcane	0.40 - 0.45	0.70 - 1.00	1.00 - 1.30	0.75 - 0.80	0.50 - 0.60
Wheat	0.30 - 0.40	0.70 - 0.80	1.05 - 1.20	0.65 - 0.75	0.20 - 0.25

APPENDIX 9

From User's Guide
Development of Agroclimatic/Crop Index
Assessment Models
NOAA/NESDIS/AISC

in cooperation with University of Missouri
by C. Sakamoto, R. Achutuni and L. Steyaert
September, 1984

Includes:

Equations, applications, and interpretations of Yield Moisture Index

Application of Yield Moisture Index: Examples

The Yield Moisture Index (YMI) is a very simple and useful tool for assessing crop conditions at any given location. The examples in this section are designed to illustrate the capabilities and limitations under three different rainfall regimes: a) adequate, b) wet and c) dry.

The station Nakhon Sawan (Thailand) was selected to represent a location that has adequate rainfall to grow crops during the rainy season without irrigation.

Chittagong (Bangladesh) was chosen to represent a location that is climatically wet. Flooding rather than drought is the major deterrent to crop production.

Lahore (Pakistan) was chosen to represent a location that is very dry where crops have to be irrigated from the rivers.

1. YMI Analysis: Main Maize Crop in Nakhon Sawan (Thailand)

Data: The historical monthly rainfall data for Nakhon Sawan is shown in Table 8. The crop calendar for main maize and the corresponding crop coefficients (kc) are as follows:

Planting: May (kc_5 = 0.35)
Vegetative Stage: June (kc_6 = 0.75)
Flowering/Reproductive Stage: July (kc_7 = 1.05)
Harvest: August (The index is run only up to the flowering/reproductive stage)

Procedure

The YMI analysis for main maize in Nakhon Sawan is shown in Table 9. The index values are given as both weighted (by crop coefficients) observed values (on left side of table) and percentile ranks (on right side of table). Sample calculations for 1982 are shown below.

1. Planting Stage (May 1982)

The YMI for May is given by:

$$YMI_{May} = P_5 \times kc_5 = 89 \times 0.35 = 31$$

P_5 is the May rainfall (mm) and kc_5 the corresponding crop coefficient.

2. Vegetative Stage (June 1982)

The YMI at the end of June is given by:

$$YMI_{May-Jun} = (P_5 \times kc_5) + (P_6 \times kc_6) = 31 + (58 \times .75) = 75$$

P_6 is the June rainfall (mm) and kc_6 the corresponding crop coefficient.

TABLE 8
+++ LIST RAINFALL FILE +++
THAILAND NAKHON SAWAN
WHOLE MILLIMETERS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DE
1951	9	9	28	63	261	60	212	134	271	319	72	1
1952	0	0	86	20	218	182	90	114	246	376	16	[illegible]
1953	38	244	0	68	82	66	186	184	362	160	72	[illegible]
1954	4	0	15	7	209	112	52	190	332	30	3	
1955	0	0	88	52	284	144	244	180	264	29	29	[illegible]
1956	0	6	34	222	173	179	195	129	250	169	2	[illegible]
1957	29	26	99	77	69	139	73	209	276	135	0	[illegible]
1958	21	10	58	86	47	91	95	146	294	43	0	[illegible]
1959	0	71	100	65	110	52	217	184	300	20	0	
1960	1	0	0	45	64	146	179	106	174	122	21	[illegible]
1961	0	31	7	56	195	139	163	83	159	190	0	1
1962	0	0	4	76	68	97	100	216	354	87	2	[illegible]
1963	0	0	3	27	13	159	150	208	251	297	115	[illegible]
1964	3	4	26	136	163	94	249	184	437	158	6	[illegible]
1965	0	27	107	55	117	154	40	250	222	122	15	[illegible]
1966	51	22	18	51	136	122	104	226	181	335	132	6
1967	0	2	4	110	103	72	79	157	346	114	91	[illegible]
1968	26	13	37	51	114	118	201	157	95	74	1	[illegible]
1969	54	0	35	91	104	230	116	74	298	98	3	[illegible]
1970	0	21	111	81	297	289	128	301	163	160	11	2
1971	5	109	64	13	163	43	43	411	81	52	3	[illegible]
1972	0	3	14	117	35	109	44	238	246	189	63	4
1973	0	0	109	27	148	131	189	219	193	60	9	[illegible]
1974	0	0	13	22	139	120	178	122	218	270	34	[illegible]
1975	103	27	37	15	118	46	140	232	262	192	55	[illegible]
1976	0	1	38	90	315	43	111	224	176	111	5	[illegible]
1977	0	0	17	39	219	33	56	176	84	41	0	3
1978	1	56	11	22	86	163	254	143	332	140	3	[illegible]
1979	0	3	0	56	80	250	69	140	279	0	0	[illegible]
1980	0	22	14	23	154	129	181	123	305	221	50	[illegible]
1981	0	8	37	131	142	331	207	210	187	85	114	[illegible]
1982	0	0	2	91	89	58	98	226	248	97	48	1
1983	49	0	0	0	107	75	233	245	220	201	61	1

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TABLE 9

+++ LISTING YIELD MOISTURE INDEX DATA +++

THAILAND NAKHON SAWAN

MAIZE(MAIN)

	YMI WHOLE MILLIMETERS			YMI PERCENTILE RANKS WHOLE PERCENTS		
YEAR	MAY	JUN	JUL	MAY	JUN	JUL
1951/51	91	136	359	88	50	79
1952/52	76	213	307	82	88	52
1953/53	29	79	274	23	11	41
1954/54	73	157	212	79	72	29
1955/55	99	207	463	91	82	94
1956/56	61	195	400	73	79	85
1957/57	24	123	205	16	39	26
1958/58	16	84	184	8	14	17
1959/59	38	77	305	41	8	50
1960/60	22	132	320	11	47	55
1961/61	68	172	343	76	76	73
1962/62	24	97	202	16	29	23
1963/63	5	124	281	2	35	44
1964/64	57	128	389	69	39	82
1965/65	41	157	199	48	72	20
1966/66	48	140	249	52	55	35
1967/67	36	90	173	33	20	11
1968/68	40	129	340	44	44	67
1969/69	36	209	331	33	85	61
1970/70	104	321	455	94	97	91
1971/71	57	89	134	69	17	2
1972/72	12	94	140	5	26	5
1973/73	52	150	348	61	61	76
1974/74	49	139	326	55	52	58
1975/75	41	76	223	48	5	32
1976/76	110	142	259	97	58	38
1977/77	77	102	161	85	32	8
1978/78	30	152	419	26	67	88
1979/79	28	216	288	20	91	47
1980/80	54	151	341	64	64	70
1981/81	50	298	515	58	94	97
1982/82	31	75	173	29	2	14
1983/83	37	93	338	38	23	64

3. Flowering/Reproductive Stage (July 1982)

The YMI at the end of July is given by:

$$YMI_{May-Jul} = (P_5 \times kc_5) + (P_6 \times kc_6) + (P_7 \times kc_7)$$
$$= 75 + (98 \times 1.05)$$
$$= 178$$

Similarly, P_7 is the July rainfall (mm) and kc_7 the corresponding crop coefficient. The procedure for computing the percentile ranks has been discussed previously.

Interpretation of Yield Moisture Index

The percentile rankings of the YMI for maize in Nakhon Sawan are shown in Table 9 and plotted as a time series in Figure 7. The index has to be calibrated using episodic event data information such as that shown in Table 6. The calibration process can be partially achieved by identifying the following:

- o Possible severe drought years (1958, 1965, 1967, 1971, 1972, 1977 and 1982). Index values are in the 0-20th percentile range. Index values in the 0-10th percentile range are generally associated with crop failures. However, as noted previously, index values early in the crop season should be viewed cautiously. These data years need to be corroborated with the episodic event data base.

For example, in 1982 the index value was in the 29th percentile for May (Table 9), suggesting marginal moisture and possible drought impact. By June the index dropped to the 2nd percentile rank indicating severe drought impact. And by the flowering stage (July) the index value reached the 14 percentile range. Since all these growth stages were relatively low, the index alerted the assessor to a severe drought impact on the maize crop in Nakhon Sawan.

- o Possible drought years (1954, 1962, 1966, 1975 and 1976). Index values in the 20-35th percentile range could be associated with drought impact. Again, information from selected published sources should be used to calibrate the qualitative term with the percentile values.

- o Favorable crop conditions are usually associated with index values in the 45-80th percentile range.

- o Possible flood years (1955, 1956, 1964, 1970, 1978 and 1981). Large index values in the range 80-100 can be associated with flooding in Nakhon Sawan.

2. YMI Analysis: Transplanted Aman Paddy Crop in Chittagong (Bangladesh)

Data: The historical monthly rainfall data for Chittagong in Bangladesh is shown in Table 10. The crop calendar for the transplanted aman paddy crop and the corresponding crop coefficients are as follows:

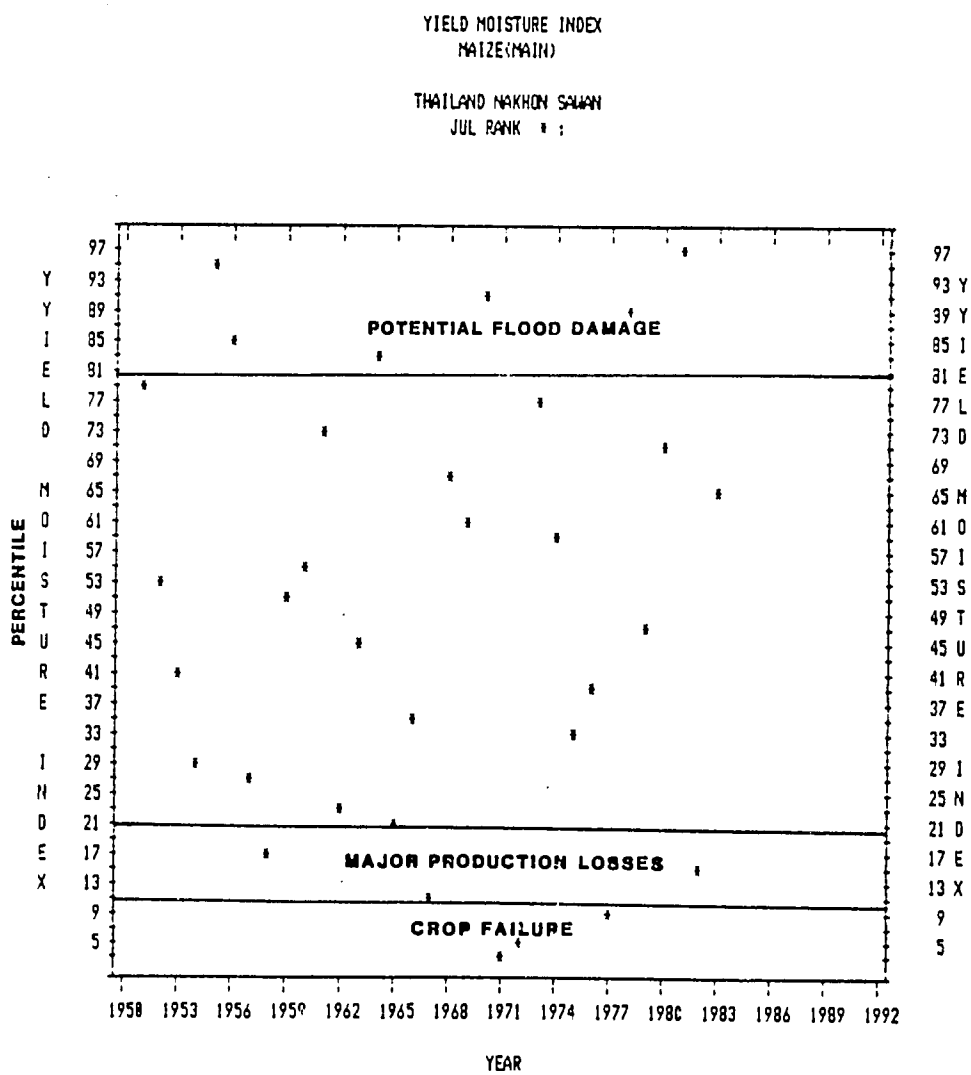

Figure 7: July YMI Ranks for Main Maize in Nakhon Sawan (Thailand).

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TABLE 10
+++ LIST RAINFALL FILE +++
BANGLADESH CHITTAGONG
WHOLE MILLIMETERS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	0	0	46	248	129	441	579	769	338	538	0	7
1952	0	6	102	342	109	-999	435	338	197	377	120	0
1953	0	0	13	53	635	548	745	680	421	272	12	0
1954	12	26	10	0	270	950	616	359	208	322	0	4
1955	0	0	254	34	324	426	1303	314	256	579	267	0
1956	3	0	35	48	434	655	211	647	413	159	112	0
1957	65	2	0	1	36	357	664	367	191	224	0	0
1958	0	5	56	91	287	248	284	377	359	142	0	2
1959	15	126	376	5	246	628	521	323	329	417	0	35
1960	0	0	36	0	117	410	750	326	297	154	70	3
1961	0	9	17	114	144	969	1038	892	164	235	1	0
1962	6	32	4	49	288	733	598	385	229	244	0	0
1963	0	0	31	126	222	947	975	297	243	298	0	0
1964	3	3	2	199	185	428	1085	622	265	270	18	0
1965	2	71	31	11	174	647	970	709	179	139	5	61
1966	26	0	71	53	197	650	349	605	388	233	4	100
1967	16	0	33	127	89	221	673	551	332	223	0	0
1968	7	11	59	48	307	590	1080	-999	69	93	6	0
1969	0	0	119	251	30	673	679	712	254	232	31	0
1970	1	10	2	130	156	296	1107	402	317	380	150	0
1971	10	0	-999	-999	74	1125	949	935	214	59	111	-999
1972	0	19	0	169	93	501	382	629	108	81	3	0
1973	5	3	4	91	521	408	508	250	285	211	259	39
1974	0	0	158	34	341	1214	937	614	272	317	98	0
1975	0	5	0	68	312	352	904	302	309	238	143	0
1976	0	6	22	60	141	1128	1266	467	97	210	252	20
1977	4	0	0	502	344	432	717	378	91	75	35	3
1978	0	0	2	42	375	807	275	430	438	193	0	0
1979	0	8	1	43	85	712	497	911	394	59	47	36
1980	0	28	56	46	479	518	587	702	229	275	0	0
1981	26	2	129	277	417	394	825	343	151	23	1	5
1982	44	8	29	140	44	746	475	785	387	6	43	[illegible]

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Transplanting:	July	(kc_7 = 1.0)
Vegetative :	August	(kc_8 = 1.0)
Flowering :	September	(kc_9 = 1.0)
Maturity :	October	(kc_{10} = 1.0).

Normally, about 250 millimeters of rainfall per month is considered adequate for growing paddy. The monthly rainfall in Chittagong during the critical period July-September generally far exceeds crop requirements for paddy.

Procedure

The YMI for transplanted aman paddy in Chittagong is shown in Table 11. A sample computation for 1981 is given below:

Transplanting Stage (July 1981)

The YMI for July is given by

$$YMI_{Jul} = P_7 \times kc_7 = 825 \times 1.0 = 825.$$

P_7 is the July rainfall and kc_7 is the corresponding crop coefficient for paddy.

Vegetative Stage (August 1981)

The YMI at the end of August is given by

$$YMI_{Jul-Aug} = (P_7 \times kc_7) + (P_8 \times kc_8) = 825 + (343 \times 1.0) = 1168.$$

P_8 is the August rainfall and kc_8 the corresponding crop coefficient for paddy.

Flowering Stage (September 1981)

The YMI at the end of September is given by

$$YMI_{Jul-Sep} = (P_7 \times kc_7) + P_8 \times kc_8) + (P_9 \times kc_9) = 1168 + (151 \times 1.0) = 1319.$$

P_9 is the September rainfall and kc_9 the corresponding crop coefficient for paddy.

Maturity Stage (October 1981)

$$\text{The } YMI_{Jul-Oct} = (O_7 \times kc_7) + (P_8 \times kc_8) + (P_9 \times kc_9) + (P_{10} \times kc_{10}) = 1319 + (23 \times 1.0) = 1342.$$

P_{10} is the October rainfall and kc_{10} the corresponding crop coefficient for October. The procedure for obtaining percentile rankings has been discussed previously.

TABLE 11

+++ LISTING YIELD MOISTURE INDEX DATA +++

BANGLADESH CHITTAGONG

RICE(MAIN)

	YMI WHOLE MILLIMETERS				YMI PERCENTILE RANKS WHOLE PERCENTS			
YEAR	JUL	AUG	SEP	OCT	JUL	AUG	SEP	OCT
1951/51	579	1348	1686	2224	34	59	65	84
1952/52	435	773	970	1347	18	9	3	21
1953/53	745	1425	1846	2118	59	68	78	75
1954/54	616	1475	1683	2005	43	71	62	65
1955/55	1303	1617	1873	2452	96	81	84	96
1956/56	211	858	1276	1435	3	15	28	25
1957/57	664	1031	1222	1446	46	28	25	28
1958/58	284	661	1020	1162	9	3	6	3
1959/59	521	1344	673	2090	31	56	59	71
1960/60	750	1076	1373	1527	62	31	37	34
1961/61	1038	1930	2094	2329	84	96	93	93
1962/62	593	983	1212	1456	40	21	21	31
1963/63	975	1262	1505	1793	81	50	40	51
1964/64	1085	1707	1972	2242	87	87	90	90
1965/65	970	1679	1858	1997	78	84	81	62
1966/66	349	954	1342	1575	12	18	34	37
1967/67	678	1229	1561	1784	51	43	50	46
1969/69	678	1390	1644	1876	51	62	53	59
1970/70	1107	1509	1826	2206	90	75	71	81
1971/71	949	1884	2098	2157	75	93	96	78
1972/72	382	1011	1119	1200	15	25	12	6
1973/73	508	788	1073	1284	28	12	9	12
1974/74	937	1551	1923	2240	71	78	87	87
1975/75	904	1206	1515	1753	68	40	43	43
1976/76	1266	1733	1830	2040	93	90	75	68
1977/77	717	1095	1186	1261	56	34	18	9
1978/78	275	705	1143	1336	6	6	15	15
1979/79	497	1408	1802	1861	25	65	68	56
1980/80	587	1289	1518	1793	37	53	46	51
1981/81	825	1168	1319	1342	65	37	31	18
1982/82	475	1260	1647	1653	21	46	56	40

Interpretation

A plot of the YMI percentile rankings for aman paddy over the period 1951-1982 is shown in Figure 8. At first glance, the YMI percentile rank for the 1981 aman paddy crop in October is at the 18th percentile rank indicating possible drought impact. However, as the summary Table 12 shows, in 1981 the cumulative YMI index rainfall for July to October was 1342 multimeters, the normal index value being 1774 millimeters. As discussed earlier, only about 1000 millimeters (250 mm per month) of rainfall is needed to meet the total crop water requirements for the aman paddy crop. Therefore, the low index value rankings in Chittagong are merely indicative of below normal rainfall conditions, and not necessarily indicative of impact on the paddy crop. Obviously, drought is not a major problem in a wet station such as Chittagong and the use of percentile ranking could be misleading.

3. YMI Analysis in dry area: Paddy Crop in Lahore (Pakistan)

Data:

The historical monthly rainfall data for Lahore, Pakistan is shown in Table 13. The crop calendar for the transplanted wet season paddy crop and the corresponding crop coefficients are as follows:

Transplanting	:	June	(kc_6 = 1.0)
Vegetative Stage	:	July	(kc_7 = 1.0)
Flowering Stage	:	August	(kc_8 = 1.0)
Maturity Stage	:	September	(kc_9 - 1.0).

Procedure:

The YMI analysis for the wet season paddy crop in Lahore (Pakistan) is shown in Table 14. A sample computation for 1983 is given below.

Transplanting Stage (June 1983)

The YMI at the end of June is given by

$$YMI_{Jun} = P_6 \times kc_6$$
$$= 16 \times 1.0$$
$$= 16.$$

P_6 is the June rainfall (mm) and kc_6 the corresponding crop coefficient.

Vegetative Stage (July 1983)

The YMI at the end of July is given by

$$YMI_{Jun-Jul} = (P_6 \times kc_6) + (P_7 \times kc_7)$$
$$= 16 + (152 \times 1.0)$$
$$= 168.$$

P_7 is the July rainfall (mm) and kc_7 the corresponding crop coefficient.

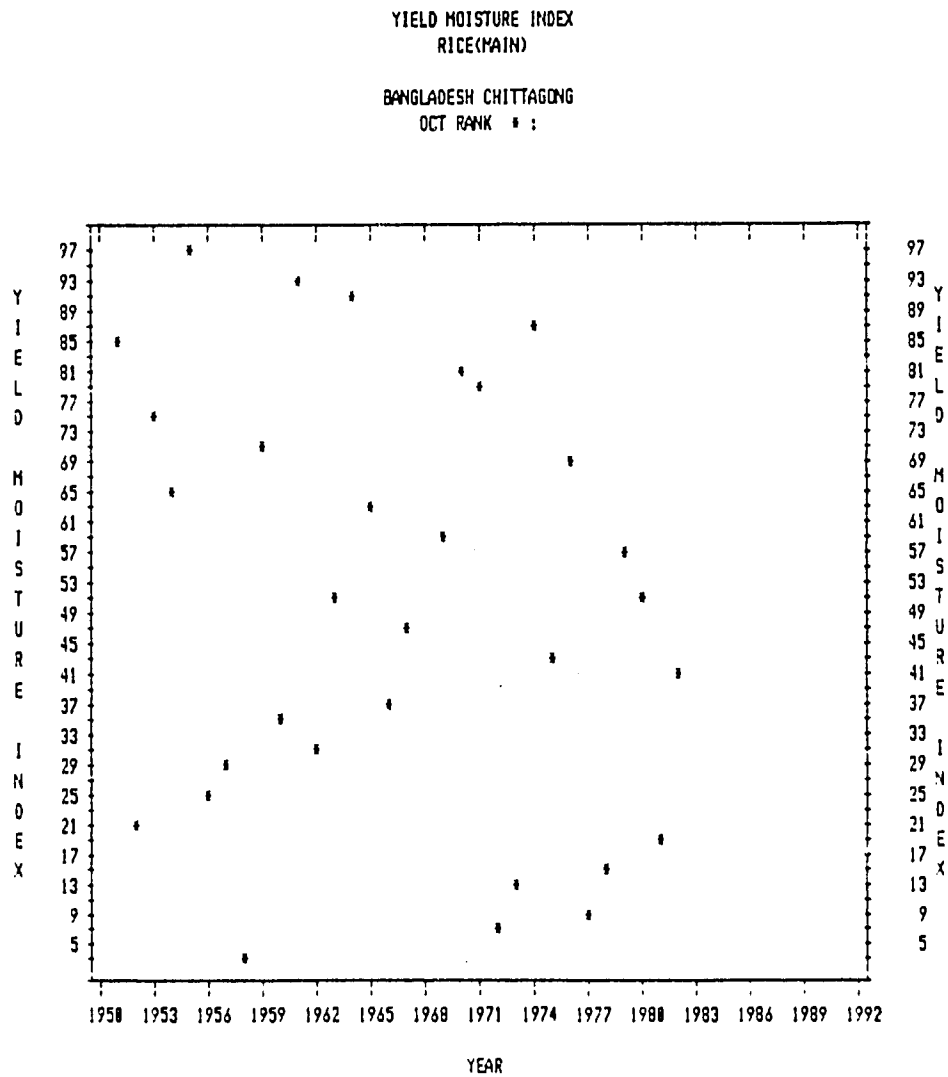

Figure 8: YMI for Transplanted Aman Paddy in Chittagong (Bangladesh).

Table 12. Summary YMI Analysis for the
1981 Aman Paddy Crop in Chittagong, Bangladesh

	Month			
	Jul	Aug	Sep	Oct
Normal Cumulative Precip	707	1269	1542	1774
Observed Cumulative Precip	825	1168	1319	1342
Crop Coefficient	1.0	1.0	1.0	1.0
Observed YMI	825	1168	1319	1342
Normal YMI*	707	1269	1542	1774
Percent of Normal YMI	117	92	86	76
Percentile Rank	65	37	31	18

*Identical to normal precipitation because the crop coefficient is 1.00 for Jul thru Oct.

TABLE 13
+++ LIST RAINFALL FILE +++
PAKISTAN LAHORE
WHOLE MILLIMETERS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	27	2	16	31	22	11	168	85	0	0	33	0
1952	10	5	41	1	3	34	145	33	2	3	1	0
1953	33	3	0	7	7	15	191	212	85	0	1	11
1954	19	52	1	0	1	23	42	30	526	15	0	0
1955	15	2	44	13	12	20	33	83	218	80	0	6
1956	37	3	36	9	0	109	209	206	1	50	0	0
1957	95	6	61	40	16	10	115	275	11	5	9	37
1958	9	0	8	4	2	54	151	63	493	11	4	71
1959	55	16	14	0	13	6	207	292	44	11	26	0
1960	27	0	46	16	0	20	68	60	54	0	0	10
1961	100	30	10	25	20	10	210	130	70	20	1	10
1962	32	40	44	0	15	0	164	117	169	0	14	73
1963	0	3	13	23	36	11	100	56	40	1	0	12
1964	36	7	9	17	20	43	247	351	61	0	3	6
1965	15	26	22	54	26	1	172	94	13	10	-999	-999
1966	0	3	21	11	35	42	145	95	96	21	0	0
1967	0	24	76	8	3	3	91	128	32	7	3	112
1968	28	21	17	2	11	41	108	198	0	21	0	11
1969	4	0	58	28	28	11	237	55	23	2	0	0
1970	20	23	24	0	4	35	42	167	29	1	0	0
1971	0	18	0	21	29	36	149	77	0	0	0	0
1972	0	14	0	2	0	8	89	115	33	15	10	7
1973	17	14	37	2	22	12	339	218	66	0	0	50
1974	0	3	3	1	12	83	205	71	10	0	0	13
1975	29	20	39	6	0	100	218	125	125	0	0	0
1976	23	28	31	12	12	82	270	512	131	10	0	0
1977	11	6	2	29	41	69	186	57	35	1	0	7
1978	3	11	167	19	0	22	290	96	101	0	4	0
1979	14	51	69	5	38	34	145	91	0	12	5	0
1980	20	6	29	13	2	91	471	300	52	11	9	11
1981	121	27	67	0	3	0	478	103	1	14	25	0
1982	21	33	111	18	56	44	59	206	0	0	24	24
1983	58	37	67	141	109	16	152	271	23	38	0	0

Flowering Stage (August 1983)

The YMI at the end of August is given by

$$YMI_{Jun-Aug} = (P_6 \times kc_6) + (P_7 \times kc_7) + (P_8 \times kc_8)$$
$$= 168 + (217 \times 1.0)$$
$$= 439.$$

P_8 is the August rainfall (mm) and kc_8 the corresponding crop coefficient.

Maturity Stage (September 1983)

The YMI at the end of September is given by

$$YMI_{Jun-Sep} = (P_6 \times kc_6) + (P_7 \times kc_7) + (P_8 \times kc_8) + (P_9 \times kc_9$$
$$= 439 + (28 \times 1.0)$$
$$= 467.$$

P_9 is the September rainfall (mm) and kc_9 the corresponding crop coefficient.

Interpretation

The percentile ranks of the YMI for paddy in Lahore shown plotted in Figure 9, reveal a low of 35 percent for July, rising to 73 in August.

The paddy crop in Pakistan is cultivated under irrigated conditions as seasonal rainfall is inadequate to meet crop water requirements. For example, the normal rainfall at Lahore for the period June to September is only 444 millimeters when the crop water requirements are 1000 millimeters. Crops such as the paddy crop in Lahore that do not depend upon the seasonal rainfall cannot be assessed using the YMI. Cumulative precipitation in the catchment areas of the major rivers may be a good indicator of irrigation supplies.

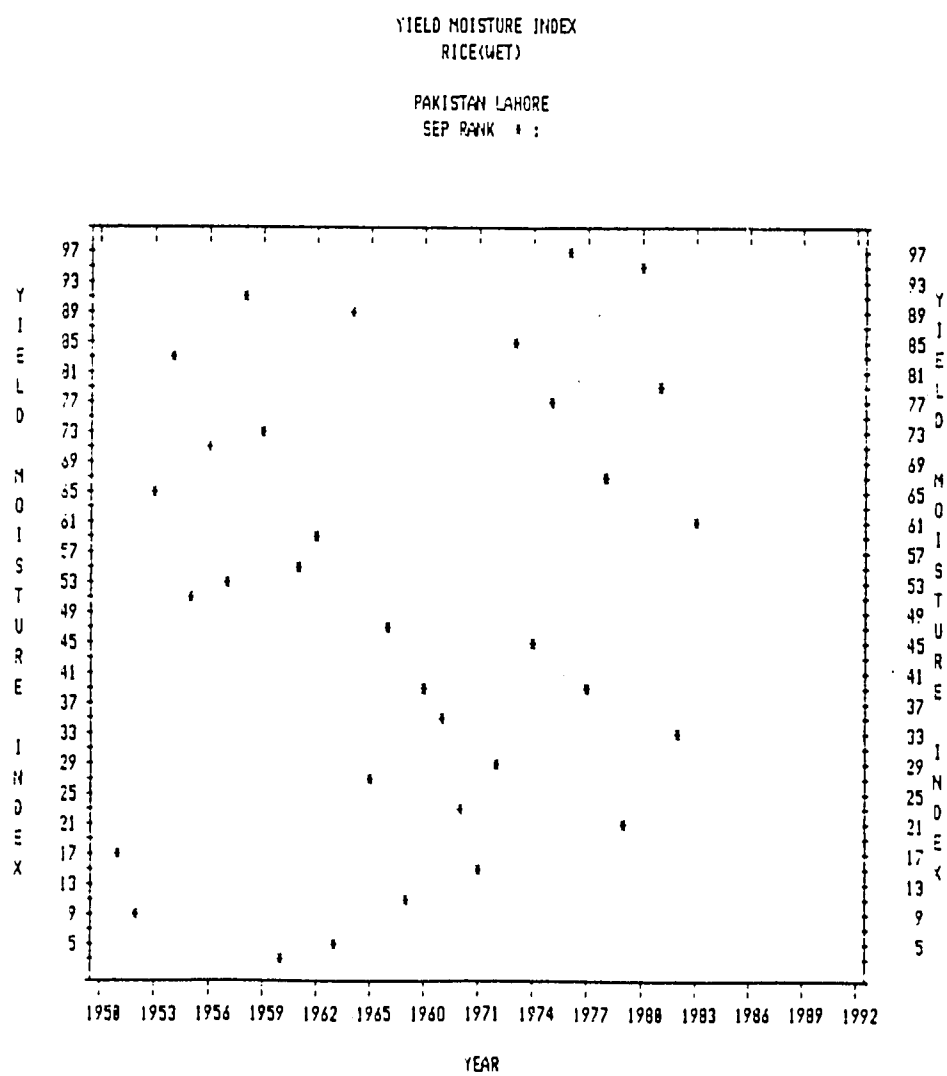

Figure 9: YMI for Wet Season Paddy in Lahore (Pakistan).

TABLE 14

+++ LISTING YIELD MOISTURE INDEX DATA +++

PAKISTAN LAHORE

RICE(WET)

	YMI WHOLE MILLIMETERS				YMI PERCENTILE RANKS WHOLE PERCENTS			
YEAR	JUN	JUL	AUG	SEP	JUN	JUL	AUG	SEP
1951/51	11	179	264	264	29	44	29	17
1952/52	34	179	212	214	57	44	16	8
1953/53	15	206	418	503	38	58	70	64
1954/54	23	65	95	621	52	2	2	82
1955/55	20	103	186	404	45	19	11	50
1956/56	109	318	524	525	97	83	82	70
1957/57	10	125	400	411	22	26	64	52
1958/58	54	205	268	761	79	55	35	91
1959/59	6	213	505	549	14	61	79	73
1960/60	20	88	148	202	45	8	5	2
1961/61	10	220	350	420	22	64	58	55
1962/62	0	164	281	450	4	32	41	58
1963/63	11	111	167	207	29	23	8	5
1964/64	43	290	641	702	73	76	91	88
1965/65	1	173	267	280	8	38	32	26
1966/66	42	187	282	370	70	52	44	47
1967/67	3	94	222	254	11	11	20	11
1968/68	41	149	347	347	67	29	55	39
1969/69	11	248	303	326	29	67	47	35
1970/70	35	77	244	273	61	5	23	23
1971/71	36	185	262	262	64	50	26	14
1972/72	8	97	212	295	17	14	16	29
1973/73	12	401	619	685	35	91	88	85
1974/74	83	288	359	369	88	73	61	44
1975/75	100	318	443	568	94	83	76	76
1976/76	82	352	364	995	85	88	97	97
1977/77	69	255	312	347	82	70	52	39
1978/78	22	312	408	509	56	79	67	67
1979/79	34	179	270	270	57	44	38	20
1980/80	91	562	862	914	91	97	94	94
1981/81	0	478	581	582	4	94	85	79
1982/82	44	103	309	309	76	19	50	32
1983/83	16	168	439	467	41	35	73	61

APPENDIX 10

Converting Actual Consumption to Calories and Cereal Equivalents

APPENDIX 10

What follows is a step by step approach to covert kilograms of different food items to their caloric value and then back to a cereal grain equivalent.

- multiply kilograms consumed per person, per year by the number of calories per kilogram for each commodity;
- sum the total number of calories consumed per person per year for all commodities;
- divide the total calories consumed per person, per year by the number of calories per kilogram of the most basic cereal staple consumed in the country.

This calculaton will result in an estimate of the number of kilograms of cereal equivalent consumed per person per year.

Example

Commodity	Number of Kilograms Consumed	Calories Per Kilogram	Calories Consumed
Millet	97	3,150	305,550
Paddy Rice	32	2,422	77,504
Maize	3	3,175	9,525
Chicken	3	1,190	3,570
Beef	5	1,610	8,050
Milk	10	660	6,600
Groundnuts (in shell)	15	3,857	57,855
Fresh fruit	4	600	2,400
Fresh vegetables	6	200	1,200
Cassava	10	1,077	10,770
Peanut oil	2	8,714	17,428
Total Calories			500,452
Millet Equivalent (in kilograms)			159

APPENDIX 11

Equations for Emergency Food Deficit Assessment

Food Deficit Equations

Food Deficit =
Total Food Needs
- Net Domestic Production
- Net Change in Stocks
- Net Imports

1. Total Food Needs =
Per Capita Foods Needs x Population

a. Per Capita Food Needs =
Average Total Food Consumption for Past Five Years/Population

b. Population =
Population estimate from last census x
1 + Population growth for each year

2. Net Domestic Production =
Total Domestic Production
- Seed
- Feed
- Waste
x Milling Extraction Rate

a. Total Domestic Production =

Pre-Harvest x Area Yield

or

Post Harvest
On-farm Retention
(stocks + consumption)
+ Local sales
+ Sales to government marketing boards

3. Net Change in Stocks =
Closing Balance
- Carry in Stocks

4. Net Imports =
Foreign Exchange Availability
Reserve/Import Ratio

a. Foreign Exchange Availability =
International Reserves
+ Export Earnings
+ Commercial Credits
- Debt Service Payments

b. Reserve/Import ratio =
Average of Reserves/Imports for base period
(4 or 5 years)

APPENDIX 12

Removing the Effect of Inflation from Price Series

APPENDIX 12

To determine if an observed crop price is "high" relative to previous years or rising faster than it did in previous years, the affect of general economy-wide inflation must be removed. This is really quite easy, even though it sounds complicated. The first section that follows is a step-by-step procedure to determine if a price is "high;" the second section presents the procedure for determining if the price is rising faster than it did in previous years.

1. Is the crop price "high" relative to previous years?

a. A price series should be collected, for each crop, for each region for several previous years (about five), as well as for the current year.

b. These price series should include a price observation for each month of each year. If monthly data are not available, it might be necessary to use quarterly data.

c. The price from the most recent month of the current year (for a single crop in a single region) should be obtained. This will be called the current price. The object is to determine whether the current price is "high" relative to previous years.

d. From each of the previous years, the price observation for the same month as the current price should be selected for the comparison. For example, if the most recent price for the current year is from the month of April, the price in April for each of the past five years should be chosen.

e. This yields a set of five prices, P1, P2, P3, P4, P5 (with P5 being the year just before the current one) plus the current price Pk.

f. Next, the inflation rate for the general economy should be obtained for each of the five years I1, I2, I3, I4, I5. If possible, these inflation rates should not include food prices. These rates should be expressed as a decimal (e.g., an inflation rate of 8% would be .08; a rate of 15% would be .15).

g. Then each price must be adjusted for general inflation rates so they can be compared. This is done with the following equations.

To adjust P1:

P1 x (1 + I1)	P2 x (1 + I2)	P3 x (1 + I3)	P4 x (1 + I4)
x (1 + I2)	x (1 + I3)	x (1 + I4)	x (1 + I5)
x (1 + I4)	x (1 + I4)	x (1 + I5)	
x (1 + I5)			

and P5 x (1 + I5)

The April price from five years ago is multipled by one plus the inflation rate from five years ago. This whole quantity is multiplied by one plus the inflation rate from four years ago. This whole quantity is multiplied by one plus the inflation rate from three years ago, etc.

i. After each price has been inflated for each year since it was observed, the prices can be compared to see if the current price is significantly higher than the prices from the five earlier years.

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2. <u>Is the crop price rising faster than previous years</u>?

Determining if a price is rising faster than it did during previous years is actually easier than determining if it is "high," although it may require more detailed non-food price series. Monthly data on these non-food prices would be ideal.

a. Select a period for analysis, e.g., December and January.

b. Calculate the percentage change in the crop price for those months in the current year.

c. Calculate the percentage change in non-food prices for the same months.

d. Subtract the percentage change of non-food prices from the percentage change in the price of the crop. This results in the real price change for the crop (deflated).

e. Calculate the percentage change in the crop price for the same months during each of the last five years.

f. Calculate the percentage change in non-food prices for the same months during each of the last five years.

g. Subtract the percentage change in non-food prices from the percentage chnage in the crop price for each of the five years. This results in the <u>real</u> price change for each crop for each year.

h. Take an average of the real price changes for the last five years (add them up and divide by five).

i. Compare the real change in the crop price for the current year with the average real change in the crop price from the past five years. If it is larger, then prices are rising faster.

j. This analysis can be repeated for any time period (e.g., December and Janauary; or December through March; or July through September; etc.).

APPENDIX 13

Using Survey Data

APPENDIX 13

USING SURVEY DATA

Information from field surveys can be extremely useful in making food aid needs assessments. Survey data can either be obtained from other institutions or other analysts; or it can be collected as part of this assessment. In either case, the analyst should have a feel for the basic elements of sound sampling techniques. Use of survey data that are unrepresentative or incomplete may yield worse needs assessments than would be the case if aggregated national data were used instead.

A. Survey Data from Other Sources

If the analyst can obtain survey data from another source (e.g., the government), an effort should be made to ascertain the quality of the estimates. The following questions raise some of the relevant issues to consider in making this determination.

Is there reason to believe that certain farms are systematically unobserved (e.g., remote areas or land used only for subsistence farming)? Is there reason to believe that the stratification of selected sample areas is unrepresentative? Is there reason to believe that there is significant non-sampling error in the government estiamtes? Non-sampling error might occur, for example, if the areas selected for sampling are different from the ones that actually report, or if the data collected are not tabulated correctly. A common cause of non-sampling error arises when farmers pay a tax on cultivated land and consequently have an incentive to understate their crop acreage.

If there is reason to believe that the government area estimates are fairly good (or contain an acceptable level of sampling and non-sampling error), then these data should be obtained for use from the appropriate Ministry. If, however, the data are deemed to be of unacceptable (or perhaps unknown) quality, consideration might be given to improving the data collection process.

B. Area Sample Frames

In general, the greater the accuracy desired from the survey data, the more resources required. In all cases, even for the most simple and most basic data collection process, a sample frame must be designed to collect the information on a statistically sound basis. One of the most practical methods for Africa is to construct an area sample frame. To do this, the country must be divided into strata on the basis of agro-climatic

differences. This can be done with satellite images (e.g., Landsat), soil and weather maps or standard road maps if the analyst knows the country well. These strata must then be divided into segments of size that can be sampled by enumerators in a reasonable amount of time (usually one day each). Random samples of these segments must then be selected. Area data (as well as other data) can then be collected from the chosen segments. (A complete list of useful data for food needs assessments that could be collected in field surveys is included in Appendix 5.)

C. Area Data

There are a variety of methods for collecting area data. What follows is not meant to be a complete discussion about survey techniques. For that the reader is referred to other documents (in particular, see Estimation of Crop Areas and Yields in Agricultural Statistics, FAO Economic and Social Development Paper, No. 22, Rome, 1982). The point here is to stress the importance of sound techniques, even if the data collection process is informal. Otherwise the results may be unrepresentative and potentially biased.

1. Aerial Photography

One of the more accurate methods of collecting area data is with aerial photography. Acreage by crop can be estimated fairly precisely from high resolution photographs. The biggest problems stemming from the use of this technique are separating different varieties of the same crop, and confusion over intercropped land. This method can also be somewhat costly.

2. Land Measurement

Another method of area estimation is actually to measure the land under cultivation in the selected segments. This procedure requires walking each field with chains or special survey equipment and performing sophisticated area calculations for odd-shaped parcels. This is time consuming, but, if undertaken properly, can yield fairly accurate and detailed results.

3. Interviews and Simple Questioning

A less resource-intensive method than actual measurement is simply to ask farmers or extension agents operating within the sample segment how much land is being cultivated under each crop, under each variety and under significantly different techniques (e.g., irrigated vs. rainfed). Depending on the country, these answers may be reasonably accurate. This technique can be most useful if cultivated area was measured reliably in some previous year, and the questions can be posed in relative terms (e.g., do you have more

or less land under millet this year than last year? How much more -- or less?). It should be emphasized that an analyst can often obtain a reasonably good assessment of a situation by simple questioning techniques, but the sample for the questioning must be statistically sound or the results may be unrepresentative.

4. Special Considerations

a. Doublecropping

One consideration that must be taken into account in making area estimates is that some land may be used for double cropping. When this is the case, repeat visits for measuring may need to be made for the same parcels of land during the next growing season. For many countries of Africa, this may only be an important concern in irrigated areas. Frequently, parcels that have already been measured may be used again for the second crop, reducing the resources required for the estimation procedures.

b. Intercropping

For land that is intercropped, the entire parcel can be measured and then an estimated share of the area is allocated to each crop as though the crop were being grown alone (even though yields may actually be higher). One method of allocating these shares is on the basis of seed used for each crop.

D. Yield Data

Yield assessments can be made using the same area sample frame methodology developed for estimating acreage, and the data can be collected at the same time. Yield data, however, may need to be gathered at several different points during the growing season. One field review might be scheduled soon after planting and one near harvest.

Estimates of yield can be made by selecting a random sample of the fields of the crop under investigation. The sample is harvested, threshed, dried, and otherwise processed. The produce is then weighted and yield computed by dividing the production by the net area of the sample field.

It should be emphasized that plots for cuttings must be selected randomly. Examining only stands near roads may yield biased results, as they may be the fields that get the most attention.

Simple questioning techniques may also yield biased results. Extension agents may have an incentive to overestimate yield, since it is their job to assure high productivity. Farmers usually tend to underestimate production in the hopes of

putting pressure on the government for more favorable prices or other forms of assistance. If questioning techniques are used for yield estimates, they should be carried out on multiple sources.

Another issue that might be important is how to estimate yields for crops that are "incompletely harvested" like cassava. Cassava is grown in some situations as a cash crop and the ground is completely cleared when it reaches maturity, which may be sometime after six months. Cassava, however, may also be planted as a reserve crop. (With shifting cultivation it is often the last crop in a cycle before the land is left fallow.) In this situation, the usual practice is to harvest the quantity needed. There are two different definitions of yield under such circumstances. One is actual yield, as represented by the amount harvested per hectare. The second is "potential" yield as represented by the total crop per hectare, whether harvested or not. One problem with the second definition is that the weight of the tuber potentially available for consumption will vary depending on when the assessment is made. Moreover, beyond a certain point, the cassava becomes inedible, even in severe famine situations. It is also difficult, however, to estimate actual harvest yield since farmers tend to cut a little at a time, as needed. The best method to obtain information on cassava yields is indirectly, e.g., through consumption surveys (FAO).

APPENDIX 14

Sample USDA Data Series

SAU Format 3 Niger - Wheat

DEC 13 1984

Milled Rate:(enter as decimal in location H3)

Year	Area 1000 ha	FAO Prod. 000 MT (T-1)	ERS Prod. 000 MT (T-1)	ERS Milled 000 MT (T-1)	Calc. field ton/ha	Beg. Stocks	End Stocks	Aid Imports	Total Imports	Exports	Total Avail. 1000 MT	Feed Use	Seed Use	Waste	Non-Food	Consumption	Prod. Price (govt)	Indices Population 1,000	Growth Rate (%)	Per cap. Consump. kg
1966	0	0	0	0.00	0.00	0	0	0.0	5.7	0.0	5.7	0.00	0.00	0.57	0.57	5.1		3662	---	1.4
1967	0	0	0	0.00	0.00	0	0	0.0	5.1	0.0	5.1	0.00	0.00	0.51	0.51	4.6		3766	2.80	1.2
1968	0	0	0	0.00	0.00	0	0	0.0	4.3	0.0	4.3	0.00	0.00	0.43	0.43	3.9		3873	2.80	1.0
1969	0	0	0	0.00	0.00	0	0	10.7	5.5	0.0	5.5	0.00	0.00	0.55	0.55	4.9		3985	2.85	1.2
1970	0	0	0	0.00	0.00	0	0	15.0	16.3	0.0	16.3	0.00	0.00	1.63	1.63	14.6		4100	2.84	3.6
1971	0	0	0	0.00	0.00	0	0	0.0	4.7	0.0	4.7	0.00	0.00	0.47	0.47	4.2		4215	2.86	1.0
1972	0	0	0	0.00	0.00	0	0	7.2	5.6	0.0	5.6	0.00	0.00	0.56	0.56	5.0		4332	2.87	1.2
1973	0	0	0	0.00	0.00	0	0	14.9	8.6	0.0	8.6	0.00	0.00	0.86	0.86	7.7		4470	2.91	1.7
1974	0	0	0	0.00	0.00	0	0	32.1	15.8	0.0	15.8	0.00	0.00	1.58	1.58	14.2		4603	2.93	3.1
1975	0	2	0	0.00	0.00	0	0	26.5	6.6	0.0	6.6	0.00	0.00	0.66	0.66	6.0		4741	2.95	1.3
1976	0	2	0	0.00	0.00	0	0	32.7	10.9	0.0	10.9	0.00	0.00	1.09	1.09	9.8		4886	3.01	2.0
1977	0	0	0	0.00	0.00	0	0	3.3	21.5	0.0	21.5	0.00	0.00	2.15	2.15	19.4		5037	3.04	3.8
1978	0	2	0	0.00	0.00	0	0	7.0	21.3	0.0	21.3	0.00	0.00	2.13	2.13	19.2		5194	3.07	3.7
1979	0	2	0	0.00	0.00	0	0	7.0	15.5	0.0	15.5	0.00	0.00	1.55	1.55	14.0		5357	3.09	2.6
1980	0	2	0	0.00	0.00	0	0	1.8	26.3	0.0	26.3	0.00	0.00	2.63	2.63	23.7		5528	3.14	4.3
1981	0	2	0	0.00	0.00	0	0	5.3	54.8	0.0	54.8	0.00	0.00	5.48	5.48	49.3		5705	3.15	8.6
1982	0	2	0	0.00	0.00	0	0	17.9	39.6	0.0	39.6	0.00	0.00	3.96	3.96	35.6		5890	3.19	6.0
1983	0	0	0	0.00	0.00	0	0	0.0	36.0	0.0	36.0	0.00	0.00	3.60	3.60	32.4		6083	3.22	5.3
1984	0		0	0.00	0.00	0	0		35.0		35.0	0.00	0.00	3.50	3.50	31.5			ERR	0.0
1985				0.00	0.00	0	0				0.0	0.00	0.00	0.00	0.00	0.0			0.00	0.0

FAO
Suppliers

S&U Format 3 Niger - Rice

Milled Rate:(enter as decimal in location H3) 0.66 Seed Rate: (enter in location M3) Waste Rate: (enter in location R3)

Year	Area 1000 ha	FAO Prod. 000 MT	ERS Prod. 000 MT	ERS Milled 000 MT	Calc. Yield ton/ha	Beg. Stocks	End Stocks	Aid Imports	Total Imports	Exports	Total Avail. 1000 MT	Feed Use	Seed Use	Waste	Non-Food	Consumption	Prod. Price (govt)	Indices Population 1,000	Growth Rate (%)	Per cap. Consump. kg
1966	9	20	20	13.20	2.22	0	0	0.0	1.0	0.0	1.0	0.60	0.00	0.00	0.60	0.4	17000	3662	---	0.1
1967	12	33	33	21.78	2.75	0	0	0.0	1.0	0.0	14.2	0.99	0.00	0.00	0.99	13.2	17000	3766	2.80	3.5
1968	15	39	39	25.74	2.60	0	0	0.0	1.0	0.0	22.8	1.17	0.00	0.00	1.17	21.6	17000	3873	2.80	5.6
1969	16	36	40	26.40	2.50	0	0	0.0	0.0	0.0	25.7	1.20	0.00	0.00	1.20	24.5	16500	3985	2.85	6.2
1970	16	37	37	24.42	2.31	0	0	0.0	0.0	0.0	26.4	1.11	0.00	0.00	1.11	25.3	16500	4100	2.84	6.2
1971	17	27	27	17.82	1.59	0	0	0.0	0.0	0.0	24.4	0.81	0.00	0.00	0.81	23.6	21500	4219	2.86	5.6
1972	17	32	32	21.12	1.88	0	0	0.0	0.0	0.0	17.8	0.96	0.00	0.00	0.96	16.9	21500	4342	2.87	3.9
1973	18	46	46	30.36	2.56	0	0	0.5	1.0	0.0	22.1	1.38	0.00	0.00	1.38	20.7	21500	4470	2.91	4.6
1974	15	30	30	19.80	2.00	0	0	0.0	1.0	0.0	31.4	0.90	0.00	0.00	0.90	30.5	30000	4603	2.93	6.6
1975	17	29	29	19.14	1.71	0	0	0.0	0.0	0.0	19.8	0.87	0.00	0.00	0.87	18.9	35000	4741	2.95	4.0
1976	22	29	29	19.14	1.32	0	0	3.8	1.0	0.0	20.1	0.87	0.00	0.00	0.87	19.3	35000	4886	3.01	3.9
1977	23	27	27	17.82	1.17	0	0	0.0	3.0	0.0	22.1	0.81	0.00	0.00	0.81	21.3	39000	5037	3.04	4.2
1978	25	32	32	21.12	1.28	0	0	4.0	16.2	0.0	34.0	0.96	0.00	0.00	0.96	33.1	39000	5194	3.07	6.4
1979	25	24	24	15.84	0.96	0	0	6.6	18.7	0.0	39.8	0.72	0.00	0.00	0.72	39.1	45000	5357	3.09	7.3
1980	21	31	31	20.46	1.48	0	0	0.0	35.6	0.0	51.4	0.93	0.00	0.00	0.93	50.5	45000	5528	3.14	9.1
1981	22	38	40	26.40	1.82	0	0	0.0	60.7	0.0	81.2	1.20	0.00	0.00	1.20	80.0	45000	5705	3.15	14.0
1982	24	52	41	27.06	1.71	0	0	2.4	68.0	0.0	95.4	1.23	0.00	0.00	1.23	93.2	55000	5890	3.19	15.8
1983	25	38	45	29.70	1.80	0	0	0.0	45.0	0.0	72.1	1.35	0.00	0.00	1.35	70.7	55000	6083	3.22	11.6
1984	20		30	19.80	1.50	0	0				29.7	0.90	0.00	0.00	0.90	28.8		6284	3.25	4.5
1985				0.00	0.00	0	0				19.8	0.00	0.00	0.00	0.00	19.8		6495	3.30	3.0

GDN
Berg
INF

FAO
Suppliers
78-81

Niger - Corn

DEC 13 1984

filled Rate(enter as decimal in location H3)

FAO Prod. 000 MT (T-1)	ERS Prod. 000 MT (T-1)	EFS Milled 000 MT (T-1)	Calc. Yield ton/ha	Beg. Stocks	End Stocks	Aid Imports	Total Imports	Exports	Total Avail. 1000 MT	Feed Use	Seed Use	Waste	Non-Food	Consump-tion	Prod. Price (govt)	Indices Popula-tion 1,000	Growth Rate (%)	Per cap. Consump. kg
2	2	0.00	0.67	0	0		0.0		2.0	0.06	0.10	0.20	0.36	1.6		3662	---	0.4
3	3	0.00	0.60	0	0		0.0		3.0	0.09	0.08	0.30	0.47	2.5		3766	2.80	0.7
2	2	0.00	0.50	0	0		0.0		2.0	0.06	0.06	0.20	0.32	1.7	13000	3873	2.80	0.4
2	2	0.00	0.67	0	0		0.0		2.0	0.06	0.06	0.20	0.32	1.7	14000	3985	2.85	0.4
2	2	0.00	0.67	0	0		0.0		2.0	0.06	0.06	0.20	0.32	1.7	17000	4100	2.84	0.4
2	2	0.00	0.67	0	0		0.0		2.0	0.06	0.06	0.20	0.32	1.7	20000	4219	2.86	0.4
2	2	0.00	0.67	0	0		0.0		2.0	0.06	0.10	0.20	0.36	1.6	20000	4342	2.87	0.4
3	3	0.00	0.60	0	0		12.0		15.0	0.09	0.12	1.50	1.71	13.3	25000	4470	2.91	3.0
4	4	0.00	0.67	0	0		22.0		26.0	0.12	0.14	2.60	2.86	23.1	35000	4603	2.93	5.0
4	5	0.00	0.71	0	0		3.0		8.0	0.15	0.14	0.80	1.09	6.9	35000	4741	2.95	1.5
12	12	0.00	1.71	0	0		6.0		18.0	0.36	0.14	1.80	2.30	15.7	39000	4886	3.01	3.2
6	6	0.00	0.86	0	0		0.0		6.0	0.18	0.24	0.60	1.02	5.0	39000	5037	3.04	1.0
9	9	0.00	0.75	0	0		10.0		19.0	0.27	0.14	1.90	2.31	16.7	45000	5194	3.07	3.2
9	8	0.00	1.14	0	0		0.0		8.0	0.24	0.14	0.80	1.18	6.8	45000	5357	3.09	1.3
10	8	0.00	1.14	0	0		7.0		15.0	0.24	0.14	1.50	1.88	13.1	55000	5528	3.14	2.4
9	7	0.00	1.00	0	0		7.6		14.6	0.21	0.16	1.46	1.83	12.8	70000	5705	3.15	2.2
10	8	0.00	1.00	0	0		9.0		17.0	0.24	0.16	1.70	2.10	14.9	70000	5890	3.19	2.5
	8	0.00	1.00	0	0				8.0	0.24	0.12	0.80	1.16	6.8		6083	3.22	1.1
	5	0.00	0.83	0	0				5.0	0.15	0.00	0.50	0.65	4.4			ERR	0.0
		0.00	0.00	0	0				0.0	0.00	0.00	0.00	0.00	0.0			0.00	0.0

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SAU Format 3 Niger - Millet

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Milled Rate: (enter as decimal in location H3) Seed Rate: (enter in location M3) Waste Rate: (enter in location R3)

Year	Area 1000 ha	FAO Prod. 000 MT	ERS Prod. 000 MT	ERS Milled 000 MT	Calc. Yield ton/ha	Beg. Stocks	End Stocks	Aid Imports	Total Imports	Exports	Total Avail. 1000 MT	Feed Use	Seed Use	Waste	Non-Food	Consumption	Prod. Price (govt)	Indices Population 1,000	Growth Rate (%)	Per cap. Consump. kg
1966	1743	842	842	0.00	0.48	0	0	0.0	0.0	0.0	0.0	25.26	0.00	0.00	25.26	-25.3	10000	3662	---	-6.9
1967	1865	1000	1002	0.00	0.54	0	0	0.0	0.0	0.0	842.0	30.06	0.00	0.00	30.06	811.9	10000	3766	2.80	215.6
1968	1895	733	733	0.00	0.39	0	0	0.0	0.0	0.0	1002.0	21.99	0.00	0.00	21.99	980.0	11000	3873	2.80	253.0
1969	2272	1091	1095	0.00	0.48	0	0	0.0	0.0	0.0	733.0	32.85	0.00	0.00	32.85	700.2	12000	3985	2.85	175.7
1970	2310	871	871	0.00	0.38	0	0	0.0	0.0	0.0	1095.0	26.13	0.00	0.00	26.13	1068.9	12000	4100	2.84	260.7
1971	2356	959	959	0.00	0.41	0	0	0.0	0.0	0.0	871.0	28.77	0.00	0.00	28.77	842.2	12000	4219	2.86	199.6
1972	2194	919	919	0.00	0.42	0	0	0.0	0.0	0.0	959.0	27.57	0.00	0.00	27.57	931.4	12500	4342	2.87	214.5
1973	2007	627	627	0.00	0.31	0	0	0.0	0.0	0.0	919.0	18.81	0.00	0.00	18.81	900.2	12500	4470	2.91	201.4
1974	2230	883	883	0.00	0.40	0	0	0.0	0.0	0.0	627.0	26.49	0.00	0.00	26.49	600.5	25000	4603	2.93	130.5
1975	1692	581	581	0.00	0.34	0	0	0.0	0.0	0.0	883.0	17.43	0.00	0.00	17.43	865.6	25000	4741	2.95	182.6
1976	2527	1019	1019	0.00	0.40	0	0	0.0	0.0	0.0	581.0	30.57	0.00	0.00	30.57	550.4	25000	4886	3.01	112.7
1977	2729	1130	1130	0.00	0.41	0	0	0.0	0.0	0.0	1019.0	33.90	0.00	0.00	33.90	985.1	25000	5037	3.04	195.6
1978	2747	1123	1123	0.00	0.41	0	0	0.0	0.0	0.0	1130.0	33.69	0.00	0.00	33.69	1096.3	40000	5194	3.07	211.1
1979	2922	1246	1255	0.00	0.43	0	0	0.0	0.0	0.0	1123.0	37.65	0.00	0.00	37.65	1085.4	40000	5357	3.09	202.6
1980	3072	1364	1364	0.00	0.44	0	0	0.0	0.0	0.0	1255.0	40.92	0.00	0.00	40.92	1214.1	50000	5528	3.14	219.6
1981	3037	1305	1314	0.00	0.43	0	0	0.0	0.0	0.0	1364.0	39.42	0.00	0.00	39.42	1324.6	70000	5705	3.15	232.2
1982	3066	1295	1297	0.00	0.42	0	0	0.0	0.0	0.0	1314.0	38.91	0.00	0.00	38.91	1275.1	80000	5890	3.19	216.5
1983	3135	1250	1326	0.00	0.42	0	0	0.0	0.0	0.0	1297.0	39.78	0.00	0.00	39.78	1257.2	80000	6083	3.22	206.7
1984	3000		1000	0.00	0.33	0	0	0.0			1326.0	30.00	0.00	0.00	30.00	1296.0		6284	3.25	206.2
1985				0.00	0.00	0	0				1000.0	0.00	0.00	0.00	0.00	1000.0		6495	3.30	154.0

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APPENDIX 15

Considerations for Logistical Analysis

APPENDIX 15

Logistical capacity is obviously a critical factor in determining the volume of food aid a country should receive. Food aid programs are very logistics-intensive; that is, the food must pass physically through hundreds of steps en route from the country of origin to the populations in need. Logistical capacity in most countries that need food aid is frequently limited, and the necessary supporting inputs that do exist are often subject to unexpected problems and may suddenly become unavailable. Thus, it is absolutely crucial that a logistics analysis be performed before food aid is requested.

First, the path that the food will follow to each of the recipient regions should be traced out. For example, food aid may pass on a container ship into a coastal port. From there it must be offloaded into bulk receiving stations, and then transferred into storage facilities at the port. Next, it will be cleared from the port, loaded onto trucks or railroad cars and transited across roads, rails, bridges, ferries. On the way, it may cross international boundaries or insecure regions.

Second, the logistics support available for each stage of the food's passage should be assessed. This support should be estimated, in capacity per unit of time (e.g., tons per month). For example, it is important to know the following:

At the port:

- What is the tonnage capacity of vessels that can be handled (draft/length limitations)?
- What is the number of vessels of this size that can be offloaded in a month?
- What is the capacity of bulk grain receiving stations?
- What is the capacity of food grain storage facilities in the port?
- What is the capcity for port clearance each month?

For transport:

- How many trucks of what capacity are available each month, taking into account the number that will be out of service for repairs and routine maintenance?
- What is the availability of mechanics and spare parts?
- What is the availability of diesel fuel?

Other constraints:

- Are there bridges or ferries with limited daily or monthly capacity that must be crossed?
- Is there a limit to the number of trucks that can cross the international border in a day/week/month?

-- Are there seasonal roads or waterways that will limit access during certain periods?

Any other potential constraints should be identified. Realistic assessments should be given to the frequency of necessary repairs for the truck and rail fleet, and the speed at which these repairs can be accomplished.

The stage of the distribution chain that can handle the least amount of food during each month will determine the total quantity that can be handled that month. It must also be remembered that food aid is not the only commodity that will be making demands on logistical support services. Other commodities will be imported commercially, and many goods produced in major cities will require transiting to rural areas. Moreover, many different donors will be shipping food aid at the same time.