

CASSAVA ASSESSING HANDBOOK
for
Improved Integration of Cassava
in the FAO/WFP Joint Crop and Food Supply
Assessment Mission (CFSAM)



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Preface

Root and tuber crops (cassava, yam and sweet potato) play an important role in household food security in Sub-Saharan Africa. Yet, compared to cereals, their importance is not duly recognized and, as a consequence, there is little reliable information and statistics on the extent of their cultivation, yield, production, marketing, storage, as well as utilization methods. For this reason, it has always been difficult for FAO's Global Information and Early Warning System (GIEWS) to incorporate these crops, effectively and adequately, into the country balance sheets prepared by Crop and Food Supply Assessment Missions (CFSAMs) when these commodities constitute an important part of the diet.

Estimation of cassava yield and production in mixed smallholder cropping systems is notoriously difficult. Cultivars of different maturity lengths may be grown mixed together; planting may be carried out over several months, resulting in different maturity periods; the crop may be planted on mounds and intercropped with a wide range of other crops (at least during the first year), making the actual cropped area difficult to estimate. Harvesting may be done piecemeal according to household requirements, with mature roots of unknown size and condition left in the ground for many months.

Consequently, a consultancy, including field work in Mozambique, was undertaken to develop a practical methodology to estimate the potential contribution of the main tuber crop (cassava) to the national food balance sheet, normally expressed in terms of cereal and cereal equivalent. The practical guidelines, resulting from the Mission have been used to produce this handbook.

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Introduction

This book is called the **CASSAVA ASSESSING HANDBOOK**.

It shows you how to *estimate*² the cassava crop in fields and backyard plots at harvest time. The book contains a series of **STEPS** for assessing area and yield which you should follow to reach your conclusion. The final section includes **PHOTOGRAPHS** of crops with different yields. By comparing the photos with the **CASSAVA** plants and tubers you see in the field, you will be able to decide if your yield estimate is realistic.

When you estimate the amount of crop in the field at harvest time the action is called a **crop assessment**. This handbook will help you to complete a rapid crop assessment on farms and relate the returns to production for a village, for a county and for a region.

Whatever the situation, whether you are considering a farm, a locality, a district, a province or a region, you will need to know two things:

1. **Area** of cassava to be harvested and,
2. **Yield** of tubers from a known area of land.

Area

When considering area at farm level the farm size may be measured or told to you by the farmer. The size of the farm describes all crops and fallow areas farmed by that household, which may include fields both far-away and close to the home. In both types of fields you will find cassava growing sometimes by itself (**monoculture/sole crop**) and sometimes in association with other crops (**intercropped**).

For the assessment, you must find out the total area of cassava that will be harvested during the coming marketing year.

As cassava may be grown as either a **perennial** or an **annual** crop, the proportion of the planted area harvested will be different from place to place according to the type of system the farmer uses. The **CASSAVA ASSESSING HANDBOOK** will help you decide what that will be.

Yield

Considering the yield of tubers at farm level, you could either dig all the area to be harvested and weigh the crop or, you could harvest and weigh the crop from a small area and multiply the result proportionally to match the size of the area to be harvested. **The CASSAVA ASSESSING HANDBOOK** will help you to do this.

Production

Considering production at district level and above; **MADER** departments are responsible for the accumulation of data from farms either assessed by the Early Warning Department or estimated during the Annual Sample Survey undertaken by the Statistics Department. The role of the **CFSAMs** is to authenticate that data provided by such departments by cross-checking them at farm level. **The CASSAVA ASSESSING HANDBOOK** will help you to do this.

² For an explanation of this word and all words in italics, see the Question and Answer section in Annex 3.

STEP 1 - What is the System?

CFSAMs point to the importance of three systems of CASSAVA production using:

- a) seasonally planted, early-maturing varieties which are ready for harvest at 8-12 months and are usually harvested in blocks at the end of one year;**
- b) seasonally planted, late-maturing varieties which mature at 18-24 months and are usually harvested in blocks during that period,³; and**
- c) late-maturing varieties seen in multi-tiered, multi-age, back-yard subsistence plots, planted and harvested plant-by-plant and all-year-round.**

The first two systems connect to a known optimum age for tuber harvest for either sale or for flour/*rale* production⁴ and the last case connects to the role of cassava as a food security safety net, particularly in peri-urban areas.

Plates 1, 2 and 3 are photos taken of each cassava system noted above to indicate how the three production systems may be identified. This is an important consideration in any rapid assessment protocol. The implications regarding area to be harvested and, therefore, the assessment of production are explained in the text next to the photographs.

PLATE 1 (Shown on the cover page)

Plate 1 shows a 1 year system:

- The cuttings were planted at the same time.
- The plants will be harvested together in a block, in the same season, the whole process being completed in one year.
- The plants are comparatively uniform, short and fairly closely spaced.
- The cassava should be treated as an annual crop.
- Area planted will be the same as the area harvested in most cases.

Plate 2 shows a two-year system:

- The bigger plants to the left have been planted a year before the plants to the right of the photograph.
- Plot ages are one year apart, so exhibit two distinct canopies or tiers. Plate 2 shows the boundary of two such plots.
- The plants to the left will be harvested before the end of the second year, which is during the coming marketing year and as such is the area to be measured.
- As planting is an annual process, in such systems there are always two plots of plants.
- The plots are often, but not always, next to each other.

³ Although these may also be kept as growing stocks for a further 12 months to be harvested at 30-36 months, there is a concomitant loss of flouring capability as the tubers become more fibrous and a real danger of rotting in the generally high annual rainfall experienced in cassava growing areas. These factors cause most farmers to clear the crop within 24 months.

⁴ These decisions to harvest are also fine-tuned by the prevailing market prices and weather conditions influencing not only the growth of the cassava plants but also the performance and the saleability of other crops on the farm.



PLATE 2

Plate 3 shows a backyard system with plants harvested when two years old:

- The area is small, close to the house and no complete canopy is apparent.
- Cuttings have been planted at various times during the past two years.
- The plot exhibits a full range of ages from 0 to 24 months as a series of scattered plants.
- No set area is obviously harvestable.
- The mature plants (two years old) will be harvested one-by-one as needed which will form the subsistence ration for the coming year.



PLATE 3

- In the back yard system for 2⁵ year varieties, the area to be harvested in a normal year, i.e. once the field has reached a *stable state* of plant use-replacement (when each plant

⁵ In a back-yard system made up of 1 year, early maturing sweet cassava varieties, all plants are likely to be harvested within that year so annual harvested area is the same as the planted area.

taken is immediately replaced by a cutting), is related to the average age of harvesting and so is 50% of the total cassava area.

Under any of the three systems described above, intercropping, use of mounds or ridges makes no difference to the basic approach. In the intercrops, each crop is treated independently, plant density per ha of the crop of interest is determined and yield per plant ascertained. Where land-forming alters the conditions and the density of cassava plants, the effects will be noted in the yield estimated under those conditions.

STEP 2 - What is Production?

Whatever the system, cassava production is considered as the weight of TUBERS obtained from the area concerned.

The fresh-weight⁶ produced may be estimated by multiplying the area harvested by the average weight of tubers per unit area. (NB. not area of mound or ridge but area of the plot harvested).

Area harvested in any year depends on the system, yield per unit area depends on the weight of tubers per plant and the average number of plants in the unit area as shown in Table 1.

Table 1. Summary of Annual Production Calculations by System

Annual Production (AP) = Area Harvested x Yield per Unit Area

AP 1 yr system = Total Cassava Area x Plant Density x Yield per Plant

AP 2 yr system = Area of Plants in their 2nd Year x Plant Density x Yield per Plant

AP All-yr-round system = Total Cassava Area x Plant Density x 12/H x Yield per Harvested Plant.

(where H is the average age of the harvested plants in months)

NB Land forming *viz* mounds or banks or intercropping doesn't affect the form of the calculation.

STEP 3 - What Areas do I Measure?

During rapid assessments, the farmers, who allow the fields to be used to *cross-check* data provided from the MADER Early Warning Department or the Statistics Department, agree to grant access to their fields and plants to the field team.

The field team **MUST** take full advantage of these opportunities and **MEASURE** the basic components of production at each site. This means:

- Calculating the areas to be harvested from the measured dimensions of the field or plot.
- Calculating plant density from measured distances between plants.

Calculating area

⁶ Because of variations between types of crops DRY MATTER (DM) is a much better way of describing production. Cassava DM is around 38%-42% of the fresh weight

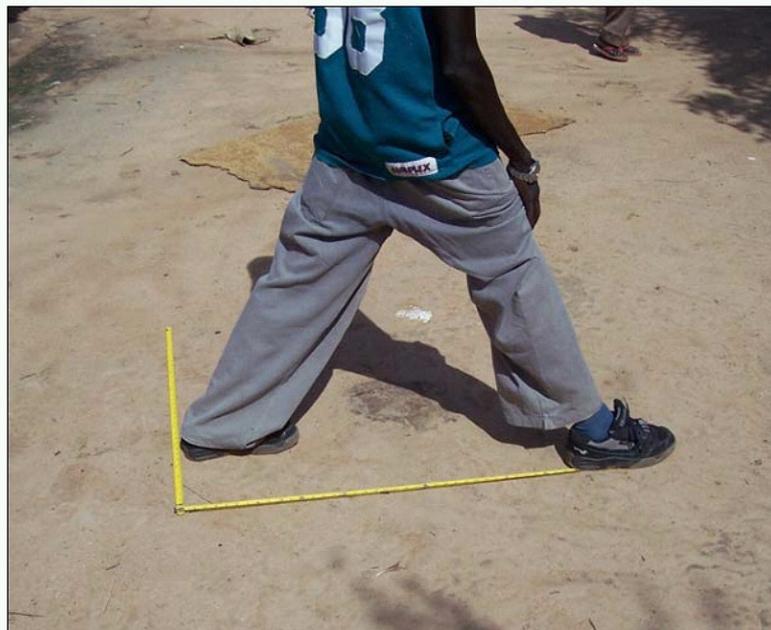
Once the production system being used has been agreed with the farmer, the areas to be harvested are known. These are:

- In 1 year systems, **the total planted area.**
- In the 2 year systems, **the area of the first generation plants** (that is, plants in their second year; probably covering 50% of the total area).
- In all-year-round backyard systems in a *stable state*, the **total area multiplied by a factor which will vary but will always be 12/H**, where H is the age of plants in months when harvested (2 yr system=12/24= 50% of area).

The assessors should measure the dimensions required to calculate the area to be harvested. This may be most rapidly executed by pacing the dimensions, needed using a stride of known length as shown in Figure 1. As a general guide, one stride of a person of medium height is equal to one meter, measuring from the heel of the back foot to the heel of the front foot.

By using a measuring tape or ruler, you can measure your own stride and adjust it so that it is as close to 1 m in length as possible, as shown in PLATE 4. As one stride should measure about one meter in length, the number of steps taken is equal to the number of meters of that dimension of the area.⁷

PLATE 4. - Taking a step of one meter



Calculating Plant Density

The assessors must walk through the plots of cassava, whether intercropped or not, measuring, at regular intervals, the distance between rows of cassava plants and the distances between plants within rows. Where rows do not exist, regular planting allows approximate lines, sought by eye, to be marked at the edges of the fields, which may be substituted for more formal rows and similar measurements made.

Average area per plant is calculated as follows, by:

⁷ Useful formulae to remember: area of a rectangle or square is length x width; area of a triangle is height x base/2; area of a circle is πr^2

- i. Estimating average distance in meters (a) between rows and (b) between plants within rows;
- ii. Multiplying (a) by (b) to obtain the average area commanded by a single plant in m^2 . This is denoted as 'C' in this handbook.

iii. Plant density as plants per ha is then calculated as follows:

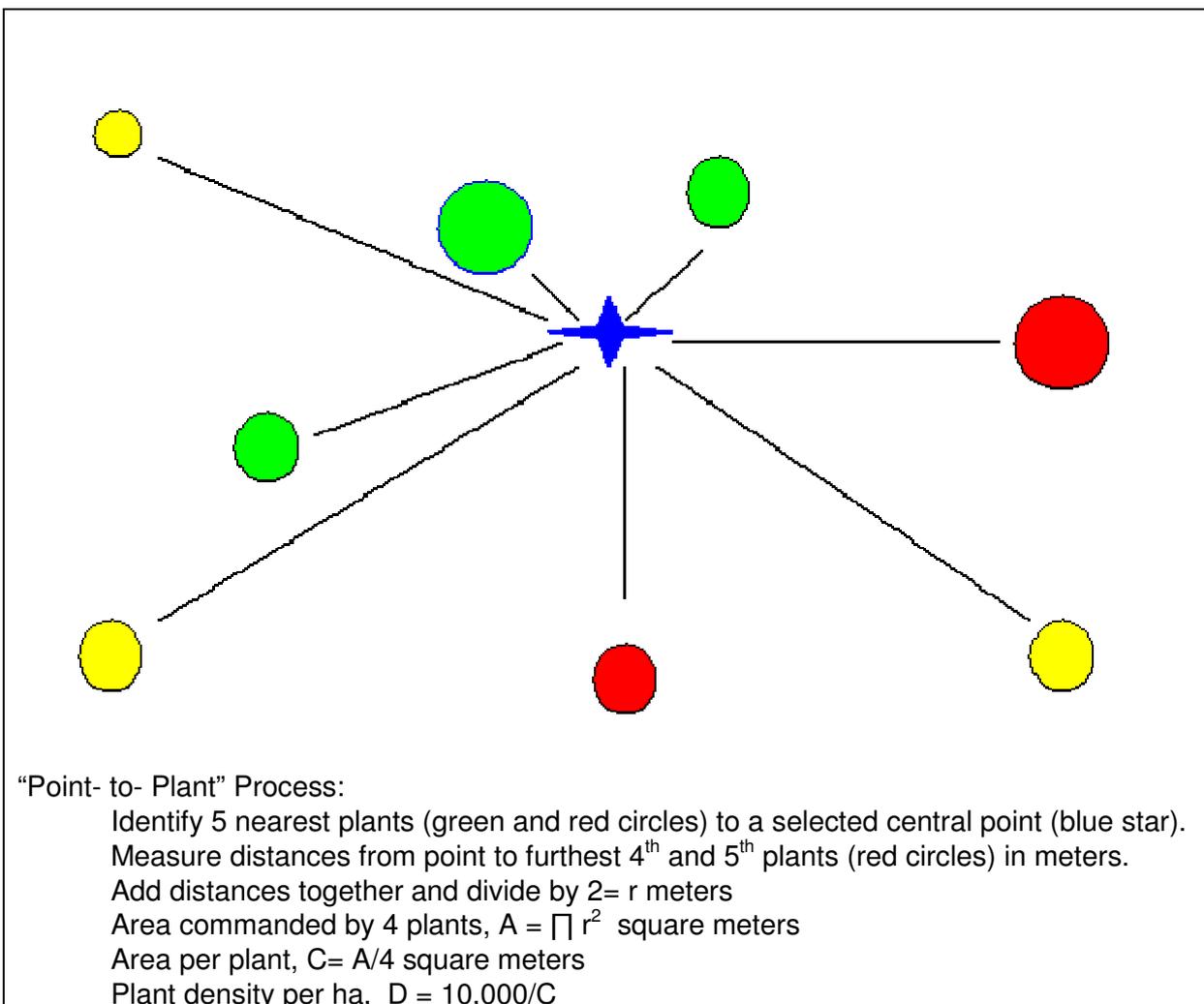
Number of plants per ha, $D = 10\,000/\text{area per plant} = 10\,000/C$.

- number of plants per ha, $D = 10,000/\text{area per plant}$.

In some circumstances, because of heavy weed growth or very thick canopies of the cassava plants, identifying planted rows or approximate lines may not be possible. In such cases the “point-to-plant” system, shown in Figure 2, is proposed.

To use the point-to-plant approach, you must select a point in the plot or field which you feel represents the way in which all the cassava plants are growing, especially regarding how close they are to each other. In cases where you feel the density of plants differs from place to place, you may have to select more than one point and repeat the process described in Figure 2.

Figure 1 “Point – To - Plant” Plant Density Estimate



Our experience is that the plots are small and planting is regular, so one estimate per field is probably enough.

STEP 4 - What do I Weigh?

Cassava is harvested as *tubers*; these are underground parts of the roots found in clusters at the base of the stem. Considering the yield of tubers at farm level, you could either dig all the area to be harvested and weigh the crop, or, you could harvest and weigh the crop from a small area and multiply the result proportionally to match the size of the area to be harvested. During rapid assessments there is no time to dig whole fields to obtain an estimate, therefore samples should be taken, weighed and the weight multiplied by the number of plants per ha to give an estimate of production of tubers in kg per ha.

Sampling; estimating yield by weighing tubers from selected plants:

A recent study conducted by the author shows that a) weighing the tubers harvested from one plant selected by the farmer as being normal (average) for the year⁸ and b) weighing the tubers from 10 plants selected by the farm family using a lottery system based on rows and plants within rows, gave very similar estimates of yields in tonnes per ha.

Therefore, we suggest that assessors pick a SINGLE plant which the FARMER (man or woman), who is digging the tubers, thinks is representative of the average plant. In our experience, the selection is usually done better by women.

Our experience also suggests that for this approach to be successful, there are important conditions that should be met:

- Harvesting should have started or be about to start⁹.
- The plant should be of a similar age to those to be harvested.
- Choose a plant of the main variety present.¹⁰
- Where two varieties are equally important, take a sample from each.
- Take more than one sample if the plant performance is not uniform due to disease or other factors.

Most importantly:

- The Farmer/Selector should be very familiar with the cassava plots.
- The judgement of the selector should not be influenced by well-meaning outsiders or other persons outside the family, who may have vested interests.

Weighing

The following procedure should be used at each weighing:

- i. The area around the selected plant should be cleared of weeds.
- ii. The stems cut off and the tops of the roots/tubers exposed.
- iii. The tubers should be dug with care to make sure that all tubers are lifted.
- iv. All loose or clinging earth should be removed and the tubers placed in a clean bag for immediate weighing.

⁸ Given even-aged, homogenous fields, a normal distribution of weight of tubers per plant is to be expected, so the average and median are considered to be synonymous.

⁹ The correct time for harvesting is when the tubers need reasonable force to be broken in two and the two surfaces at the break are dry.

¹⁰ If a single variety dominates the crop, the effect of other minor varieties may be insignificant enough to ignore, given the approximations involved. Alternatively, if others are present, their comparative performance may also be known, which may enable assessors to make slight adjustments to the yields without further sampling.



Before each weighing, the **spring balance scale** of an appropriate size (2 kg-5 kg), such as the one in Plate 5 should be set to zero using an empty plastic bag. Weigh the tubers in a sheltered position away from wind. The cleaned or threshed harvested parts should then be placed in the clean bag and the weight recorded.

PLATE 5

If the tubers from the single plant harvested are large, then cut them into smaller sections and weigh individually. Add up all the weights of the individual sections and record the total tuber weight in a field book.

STEP 5 - Calculate the Yield

The yield we wish to estimate is tuber production in tonnes per ha. In STEPS 3 and 4, we measured the dimensions, calculated area to be harvested, determined the plant density and weighed the yield of tubers of a plant representing the crop to be harvested. Here are ways of using that information to get the data you need.

1. To find the average yield (**Y**) in **tonnes per ha** divide the plant tuber weight (**W**) in kilograms (kg) by area per plant (**C**) in m², and multiply by 10.¹¹

Calculation explained:

- To find the average square meter yield (**M**), divide **W** by **C**.
- To scale up from one square meter to one hectare, multiple **M** by 10 000.
- To convert your result from kg to tonnes (t) divide by 1 000.

$$Y = M \times 10\,000 / 1\,000$$

¹¹ Equally, $Y = W \times \text{plant density} / 1000$ or $Y = W \times D / 1000$

$$Y = M \times 10$$
$$Y = W/C \times 10$$

2. To find the farm field estimate (T) in tonnes multiply **Y** by field area in ha (**F**).

Calculation explained:

- Field or plot area, **F** in ha is determined by multiplying the two dimensions length x width, measured in m² and dividing by 10 000.
- **Y** is the estimated yield in tones per ha calculated above.
- Production **T** = **F** x **Y**

STEP 6 - Check the Yield Estimate

In Annex 1 we have placed a series of photos, taken in fields under assessment in Mozambique, showing cassava plant samples from fields with yield estimates ranging from 8.9 tonnes per ha to 29.5 tonnes per ha.

The photos of each plant are arranged in sets of four:

- **The approach, a field from-a-distance.**
- **A field in close-up.**
- **The product at harvest time.**
- **The crop yield.**

Approach: the photographs on this page show the field from a distance, giving an idea of the health of the crop (**stand health**), how many plants are in the field and how uniformly they have grown.

Close-up: a close view of the crop showing area commanded by the plant, which determines the number of plants in a known area, such as 1 ha (10 000 m²) - called the plant density or crop density. The photos also show how strong the stems are and the quality of the canopy of branches and leaves. In each case plant density is noted in Annex 1, Table 1.

Product¹²: the tubers are shown, still attached to the plant, to indicate what to expect from such a crop when harvested at the right time. The actual weight of tubers per plant (kg) is shown in Annex 1, Table 1.

Yield: the photos on this page show the tubers to be weighed in the form in which they will be used or sold. Yields in t/ha are shown in Annex 1, Table 1.

STEP 7 - Including Cassava in the Balance

The FOOD BALANCES in CFSAMs comprise a reconciliation of annual cereal domestic requirement with annual cereal domestic availability. This is because the CFSAMs are conducted in marginal areas or in countries where the food supply is in jeopardy and FOOD AID is likely to be required and contemporary practice dictates that the food balances are constructed using cereals, as cereals are the currency of FOOD AID. Consequently, the expected total annual cereal use needs to be estimated and compared with estimated amount of cereals available in the country for the coming marketing year.

¹² In the 'Product' and the 'Yield' page, a digging hoe and notepad are placed on the ground next to the tubers to give you a better idea of the size and amount of yield.

To reach the domestic requirement, annual total per capita intake in the form of cereals (or cereal equivalent) is added to:

- i. Seed demand (to maintain production for the following year).
- ii. Cereals used in animal feed.
- iii. Cereals used for brewing and any non-food manufacturing.
- iv. Post harvest losses estimate.

To reach the domestic availability the following data must be added together:

- i. Estimated main season cereal harvest
- ii. Forecast minor season cereal harvest.
- iii. Forecast of any main crop cereals to be consumed green.
- iv. Cereal stocks carried over from previous year.
- v. Imports.

Regarding the use of roots and tubers as well as other important foods, mean annual per capita intake in fresh weight is usually converted to cereal equivalent by:

- Calculating the cereal equivalent factor for each food item (**CEF**), by dividing the calorie content of the selected food item such as cassava (average of several varieties) per 100 gm of fresh retail weight as purchased (**CCQ**) by calorie content of 100 gm of a typical cereal basket (**CCC**); i.e.

$$\text{CEF} = \text{CCQ}/\text{CCC} = 109/344 = 0.32 \text{ or } 32\%^{13}$$

- The cereal equivalent amount (**CEQ**) is calculated by multiplying **CEF** with the fresh weight (as ready for retail market state) production (**FWQ**).

$$\text{CEQ} = \text{CEF} \times \text{FWQ}.$$

Cereal requirement, in many cases, is only a partial estimate of the national energy requirement. Therefore, the food balance is really an incomplete view of the situation. With improved estimates of cassava areas and yields, annual fluctuations in cassava production and availability may be taken into account thereby improving the scope and accuracy of the analysis.

Inclusion of Cassava

To include cassava in the food balance, both sides of the equation need to be revised. Domestic requirement must be calculated using total per capita intake of energy components of the annual ration rather than partial energy intake.¹⁴ Similarly, cassava use for livestock must be estimated and included.

The domestic availability component of the balance must include a quantitative estimate of all cassava sources. This means converting the fresh weight of tubers dug into cereal equivalents to be consumed, which entails:

- Adding together the fresh weight tuber harvest from the different systems.
- Adjusting for a post harvest loss – this is reduction in quantity in the estimated harvest at the farm gate to the point of sale or home consumption. Typically it would include loss in storage, handling, grading and further trimming at the time of sale. Much evidence needs to be collected through practical experiments to establish this loss. Like other cereals it will vary from country to country depending on the storage and other conditions. In the

¹³ Source: FAO's Food Composition Tables for International Use. This factor may vary depending on the dominant varieties from country to country.

¹⁴ Unlike cereals there is no need to include next year's planting material, as propagation is by inedible stem cuttings.

absence of empirical data past CFSAMs have used 30% as post harvest loss in Mozambique and Malawi in recent years.

- Converting the adjusted fresh weight into cereal equivalent by multiplying by about 32%.
- Adding the cereal equivalent into the domestic availability balance calculation.

In addition, domestic availability must include an estimate of the cassava flour/*rale* carried forward from the harvest of the previous year as household or commercially held stocks.



Plate 6

Revised Balance

The components of a typical revised balance incorporating cassava are shown in Table 2.

Table 2: Staple food supply/demand balance

	Maize	Rice (milled)	Wheat	Sorghum/ Millet	Total cereals	Cassava In Cereal Equivalent	Total Cereal Equivalents
Domestic availability							
Opening stocks							
Production							
Domestic Requirement							
Food use							
Feed use							
Other uses/losses							
Exports							
Closing stocks							
Total imports requirements							
- Commercial							
- aid pledged/received							
Uncovered balance							

ANNEX 1: Photos of Plant Samples

The next 4 pages show a range of photos of Plant Samples connected to yields ranging from 29.5 to 8.9 tonnes per ha. These yields are derived from different plant densities and different weights of tubers per plant as shown in Annex 1 Table 1.

Yields will vary, even when tuber weights are similar, when plant densities differ and *vice-versa*.

Table 1 Plant Samples and Connected Yields (see next four pages)

PHOTO LAYOUT; plant density and yields							
Page I		Page II		Page III		Page IV	
Approach	Close-Up Pl/ha	Product kg/pl	Yield t/ha	Approach	Close-Up Pl/ha	Product kg/pl	Yield t/ha
A	2,632	11.2	29.5	D	3,596	4.7	10.0
B	2,604	8.9	23.0	E	11,091	1.1	10.0
C	3,333	6.0	20.0	F	2,777	3.2	8.9

A



B



C



A



B



C



D



E



F



D



E



F



ANNEX 2: Stable-States

In the 1-year system, planting takes place at a similar time each year. A block is planted and that block will be entirely harvested at around a similar time a year later. Therefore, on such farms the Mission will note one generation of plants, exhibiting a single canopy. The area to be harvested will be the area noted. For 1 year cassava varieties with the preferred harvesting age of 12 months, a *stable-state* may be reached after 18 months following block planting with harvesting beginning with plants at 6 months of age and ending with plants at 18 months of age in the first cycle. After 18 months, the area to be harvested during the coming year will be the whole area planted at the start of that year.

In the 2-year system, planting takes place at a similar time each year as above, but in any one year, in any one farm, there will be two generations of plants in two blocks planted at a similar time in two successive years, exhibiting two canopies. Only the first generation of plants will be harvested, which will usually correspond to c.50% of the area.¹⁵ For two year cassava varieties with the preferred harvesting age of 24 months, a *stable-state* may be reached after three years following block planting, with harvesting beginning with plants at 12 months of age and ending with plants at 36 months of age in the first cycle. After 3 years, the area to be harvested will be the elder of the two blocks of plants, 50% of the total area.

In the back-yard system, planting and harvesting takes place all the year round, plant-by-plant. Planting the new generation takes place immediately after digging-up the old generation, using a stem-cutting from the harvested plant, rather than block-by-block planting in established seasons as described in the other two systems. Therefore, plants of all ages, from a few days old to the age at harvesting, may be found all over the plot. The size of the area to be harvested is reached by adding together the domains of those individual plants that will be dug in the coming year. It is expected that the household will have determined, by trial and error, the area needed to meet annual requirements. Using forestry notations, the area will not be "clear-felled," it will be harvested as needed and will reach a sustainable *stable-state* after 1.5 x targeted harvesting age, provided harvesting begins at half the target age in the first cycle. Area to be harvested will be the combined areas of all plants reaching harvesting age equal to total area x 12/average age in months of harvested plant¹⁶.

Households staggering their first planting to match demand will achieve a *stable-state* when the first plants reach harvestable age.

¹⁵ The areas may not be next to each other.

¹⁶ In the dryer areas, backyard systems with two year varieties will incorporate annual dry seasons of c.3 month's duration, which will preclude planting but not harvesting. In such circumstances part of the backyard crop will probably be planted in a block, after the rains have begun, thereby skewing the plant population age towards less than 2 years.

ANNEX 3: Glossary

What does *estimate* mean?

An **estimate** is an approximate or rough calculation. Good estimates are based on some knowledge of a situation or some useful information to help you reach a decision. For example, if you are asked how much crop is harvested from a farmer's field, you could either measure the whole crop to get a true value of yield or you could **estimate** the yield with the help of this manual. In most situations, it is not practical to measure the harvested crop so a good **estimate** is important.

What is a *crop assessment*?

When you estimate (or measure) the amount of crop in a district, a county or a region at harvest time, you are doing what is called a **crop assessment**. Most of the time a **crop assessment** involves estimates and not measured values of crop yield, because measuring the production from every farmer's field is not practical. You get an accurate **crop assessment** by multiplying estimates of crop yield per unit area (hectare) by the number of units in your area of interest.

What is *crop yield* (or *yield per area*)?

The **yield** of a crop is the weight of that part of the crop that can be eaten and is harvested by the farmer (for example, maize cobs, groundnut pods and cassava tubers). The yield per unit area is the weight of the harvested parts produced from a known area of land (hectare). For example, 10,000 kilogram's per hectare or 10 tonnes per hectare (10 t/ha; 10 t ha⁻¹).

Commons units of yield: kilogram's per hectare (kg/ha, kg ha⁻¹); tonnes per hectare (t/ha; t ha⁻¹); kilograms or grams per square meter (kg/sq.m or kg m⁻² or g m⁻²).

If you are measuring the weight of your crop from one square meter (1 m²) you would weigh your crop in kg or g. So if you weigh your crop from one square meter, and it weighs 400 g, you can say your yield is 400 g per square meter (400 g/sq.m or 400 g m⁻²). If you are talking about the yield from a whole field you would use tonnes per hectare (t/ha or t ha⁻¹), in this case the yield is 4 t/ha. Remember: One tonne (t) is the same as 1 000 kilos (kg). One kilogram (kg) is the same as 1 000 grammes (g).

What is *stand health*?

By **stand health** we mean the health of the whole crop in the field. If you are looking at a **stand** of cassava and the plants look weak and are not strong, the **stand** would be in poor health. If the plants are strong and tall then you have healthy plants.

What is *plant density* (or *crop density*)?

By **plant** (or crop) **density** we mean the number of plants in a known area of land. If the plant density is high, you can also say it is a very dense crop. If you have few plants inside your designated area then the **plant density** is low. You can also say it is not a dense crop, or it is a thin crop. Some fields have mixed stands, some areas may have a high density and others may have a low density. You will have to estimate the proportions of each high area and each low area to arrive at the **average plant density** of the field. In the photos in Annex 1, **plant density** ranges from approximately 10 000 plants to 2 500 plants per ha.

What is a *square meter*?

A **square meter** is a measurement of area and is often used as a unit of area in which to count the number of plants or weigh the harvest. You may work with a square frame (a quadrat) and each of the four sides will be one meter. The area inside your square frame when you put it on the ground is one square meter (1m x 1m = 1 m²).

If you have a small plot of land, and you can cover it four times with the square frame, your land will measure four square meters (4 m²) this will be equivalent to a square with sides 2m long (2m x 2m).

If you have a bigger field and you can cover the field with your frame 100 times, then your field is 100 square meters ($100 \text{ m}^2 = 10\text{m} \times 10\text{m}$).

What is one hectare?

One hectare (ha) is another measurement of area 10 000 times larger than 1m^2 . It is equivalent to an area $100\text{m} \times 100\text{m}$ ($10\,000\text{m}^2$). It is the most used international measure of land area; and used most often for the value of crop yields (for example, tonnes per hectare, t/ha or t ha^{-1}).

What does cross-check mean?

When you **cross-check** your data it means that you compare your estimate of crop yield with a measured value of crop yield to make sure that your estimates are accurate.

What is a quadrat?

A **quadrat** is a square frame which can be made of most materials such as wood, plastic or wire. A **quadrat** is used to mark an area of land from where you will take your crop cuttings or counts. The **quadrat** you will use will usually measure one meter (1 m) each side, and therefore the size of the land inside the **quadrat** will measure one square meter (1 m^2).

What is a spring balance scale?

The **spring balance** is a simple weighing instrument which you can see in the photograph in the manual. It is used to measure the weight of small quantities of crop. You need to have something to hold the crop, in this case a clean plastic bag. The plastic bag has a weight, so in order to measure the weight of the crop you first need to set the **spring balance** to zero with the empty plastic bag attached. This is known as calibrating the spring balance or setting to zero or taring the balance.

What is a monoculture?

A **monoculture** is a large area of land covered by a single species.

What is intercropping?

Intercropping is when different crops are grown together in the same field at the same time.

What is a perennial?

A **perennial** is a plant that persists for many years.

What are CFSAMs?

CFSAMs are the UN FAO/WFP Crop and Food Supply Assessment Missions.

What is rale?

Rale is the Mozambique name for cassava processed in the form of dried granules.