

PET-Crops Somalia

A Pictorial Evaluation Tool for Crop Harvest Assessment in Somalia




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A Pictorial Evaluation Tool (PET) for Crop Harvest Assessment in Somalia

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INSTRUCTIONS FOR USE OF THIS MANUAL

This manual is made from polypropylene. If you use this PET manual in the rain, DRY THE WET PAGE with with a soft dry cloth before closing.

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What is PET-Crops Somalia?

This book is called PET-Crops Somalia; it shows you HOW TO USE PICTURES to estimate[1] the amount of crop in fields at harvest time. The book contains photographs of different crops. By comparing the pictures in PET-Crops Somalia with the crop in a field, you will be able to decide how much crop may be harvested from that field.

When you estimate the amount of crop in the field at harvest time it is called a **crop assessment**. PET-Crops Somalia will help you to complete a rapid crop assessment for a farm, for a village, for a district and for a region. Whatever the situation, you will need to know:

1. the size or **area** of the crop and,
2. **crop yield** from a known area of land.

Area: At the simplest level of assessment, field size and even farm size may be measured or told to you by the farmer; at the village or district level, crop areas can be estimated by collecting data from all the farmers in the district and adding them together, or, by taking samples and multiplying the sample averages by the number of families farming in the village or district.

Such exercises are usually done by the local authorities, ministries or commissions. In neighbouring countries such as North Sudan, the State Ministries of Agriculture use the first method, collecting information from farmers and combining them at district level, then adding up the total areas in each district for each crop, they arrive at an estimate of areas farmed for each crop at state level. Finally, the state data are combined at the national level- to provide the national crop estimates. Where such levels of organisation are not available, methods used to calculate crop area are different. In South Sudan,

[1] For an explanation of all words in grey see the Question and Answer section in Annex 4 at the back of this PET.

areas farmed are currently calculated by multiplying estimates of numbers of people farming by the areas they have farmed in the past, adjusted by observations obtained during the assessment for the year.

In Somalia, area and production estimates are presently compiled by FSNAU from data collected according to the means available. This means that cropped area information gathering varies considerably from place to place and includes:-

- data collected from statements by individual farmers;
- data collected by active administrations;
- data collected by projects and NGOs;
- data extrapolated from household surveys by other agencies;
- historical data.

Area estimates for each crop are then multiplied by estimates of crop yield per unit area to determine production. More information to help you estimate area is given in Annex 5.

Crop yield from a known area of land: To estimate crop yield from a known area, you could harvest the whole field and weigh the crop or, much easier, you could mark a small area of the field and harvest and weigh the crop within it. Usually an **area of one square metre** (**1 m^2**) is used for the smaller sample and the crop yield is then recorded as the weight of crop harvested per one square metre (sq m) or crop yield/m^2. This sum may then be multiplied by 10,000 to obtain the estimated yield per hectare. If a field is large and variable you may have to take more than one sample, add up the values and take the average to get a representative estimate of the production of the whole field.

Taking samples from each field is a time-consuming process. During rapid assessments there is usually NOT ENOUGH time to sample every field. Therefore, PET-Crops Somalia has been prepared to provide ALL ASSESSORS with a set of photographs that shows all common Somali crops at different levels of production. Comparing the fields in view with the annotated photographs enables assessors to choose the photograph that matches the field under observation and read off the probable yield from the table.

Using PET Crops Somalia **means:**

Look at the field- Look at the photos- Pick the photo that matches your field- Read off the yield in tonnes/ ha.

The crop yield at harvest will differ every year in the same fields. This means that in order to get a good idea of the crop yield at the field, farm, village and district level you will need to cover vast distances and visit many farms in order to **assess** yields in many different places at harvest time. PET-Crops Somalia will allow you to complete this **assessment** with confidence; and will allow you to decide for yourself how much crop will be harvested. You can then compare your estimates with information given to you by farmers, other agencies and the authorities.

BEFORE YOU START

It is important that you spend time reading this introduction. It explains not only how to use PET-Crops Somalia but also how to check your results to make sure you are using the book correctly.

In this book you will find photographs of each crop, showing you what a field looks like with a '**high**', a '**medium**' and a '**low**' crop. Photographs of '**high**' crop yields have **red** backgrounds. Photographs of '**medium**' crop yields have **yellow** backgrounds. Photographs of '**low**' crop yields have **blue** backgrounds.

In the photographic guide beginning on page 25 of PET-Crops Somalia, you will find photographs of the most common crops grown in Somalia: samples of sorghum, maize, and pearl millet. The photographs show *crops of known yield* placed in series for you to use as *photo-indicators*.

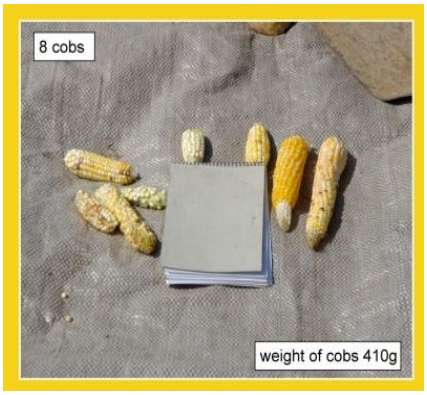
Each *photo-indicator crop* has double pages of rows of photographs showing fields **from-a-distance** (1) fields in **close-up** (2); the **harvest** from a representative 1 sq m (3) and the **grain** from that 1 sq m (4). A yield estimate in tonnes per hectare is attached at the end of row.

The photographs of the intermediate phases **harvest** and **grain** placed between the close-up and yield estimate are present to show you how the yield was derived. When you use the manual in the field you can, if you feel confident, move directly from the **close-up** (2) to the yield estimate.

In the 'Harvest' and the 'Crop yield' photographs**,** digging hoes or reporter's notepads (measuring about 21 cm x 12 cm) are placed on the ground next to the harvested parts and the grain yields for comparison purposes.

(1) From-a-distance: these photographs show you the field from a distance giving you an idea of the health of the crop, how many plants are in the field, how uniformly they have grown, how weed the field has become and how well the harvestable parts have developed.

(2) Close-up: the photographs of a close view of the crop show the number of plants in an area of **one square metre** - called the **plant density** or **crop density**. The photographs also show how strong the plants are and, for crops with above-ground edible parts, the size, number and quality of the harvestable parts of the crop, such as maize cobs and sorghum grain heads.



(3) The harvest: the photographs of the harvest show those parts of the crop that have been harvested from the typical area of 1 sq m shown in the close-up photographs **'high'**, **'medium'** and **'low'** fields.

(4) The Grain: the photographs show grain from **'high'**, **'medium'** and **'low'** fields, threshed/shelled from the harvest after threshing, and after drying to **constant weight.** The weight of the yield is shown in g/sq m and in the manual, extrapolated to **tonnes per hectare** (t/ha). Dry matter (DM) %, at harvest is included for information.

STEP 1

Is it an intercrop or a sole crop?

To begin the crop assessment you must first identify which cropping system the farmer is using. If the field has a mixture of plants, are they crops and weeds or are they a mixture of crops? Does the field have just one crop or are there two or more crops grown together?

Most crops in Somalia are sole crops or mono-crops of cereals, pulses or oilseeds, however, crops are sometimes grown together in a mixed stand, known as *intercrops*, such as combinations of maize and beans or maize and qat (qad).

Firstly, you need to confirm that your crop is a mono-crop, as is usually the case. The photographs below show a mono–crop of maize, an intercrop of maize and qat and a weedy crop of sorghum that may be confused with an intercrop.

- If the crop is a mono-crop, with or without weeds, continue to **Step 2**.
- If the crop is an intercrop, proceed to **Annex 1.**

Mono-crop of maize

Weedy crop of sorghum

Intercrop of maize and qat

STEP 2

Is it a 'high', 'medium' or 'low' crop?

In Step 2, you will decide if the general condition of the crop in the field is 'high', 'medium' or 'low'. To do this you should look at the *'From-a-distance'* photographs in the photographic guide and compare the views of *photo-indicator crops* with the farmer's field in which you have interest. Looking *from-a-distance* will give you an impression of the overall quality of the crop and tell you if the crop is variable.

Turn to the photographic guide beginning on page 25 and select the cereal you wish to assess. Look at the **'from-a-distance'** photographs for high (red band), medium (yellow band) and low (blue band) levels of production for that cereal.

For maize and sorghum[2] the **'from-a-distance'** photographs show three *photo-indicators* within each band or range of the three production levels.

The photographs have been taken from a distance of several metres. If you stand at the same distance from the field, you can compare your crop with the *photo-indicators*. By looking at the whole field you can decide which photograph is most similar to your crop.

There are notes next to the **'from-a-distance'** photographs; read these carefully because they will tell you what to look for when deciding if your field is **'high'**, **'medium'** or **'low'**.

The example on the next page shows how to assess a sorghum crop and decide whether it is a **'high' (red)**, **'medium' (yellow)** or **'low' (blue)** crop.

[2] Pearl (Bullrush) Millet has one page of examples only

Look at the farmer's field from a distance and compare it with the photographs.

Which photograph does it match?

Farmer's Field

***Photo-indicator* Crops**

'From-a-distance'

No

Yes!

No

In the above example, the crop is clearly not as good as the 'high' *photo-indicator* but is better than the 'low' *photo-indicator*. The Famer's crop of sorghum is best described by the 'medium' *photo-indicator* - yellow background with a possible yield of 1.5 to 3.0 t/ha.

To check that you are confident with your choice of **'medium'**, take a closer look at the crop by walking up to it and/or through it, taking care to keep damage to a minimum, following the instructions in **Step 3**.

STEP 3

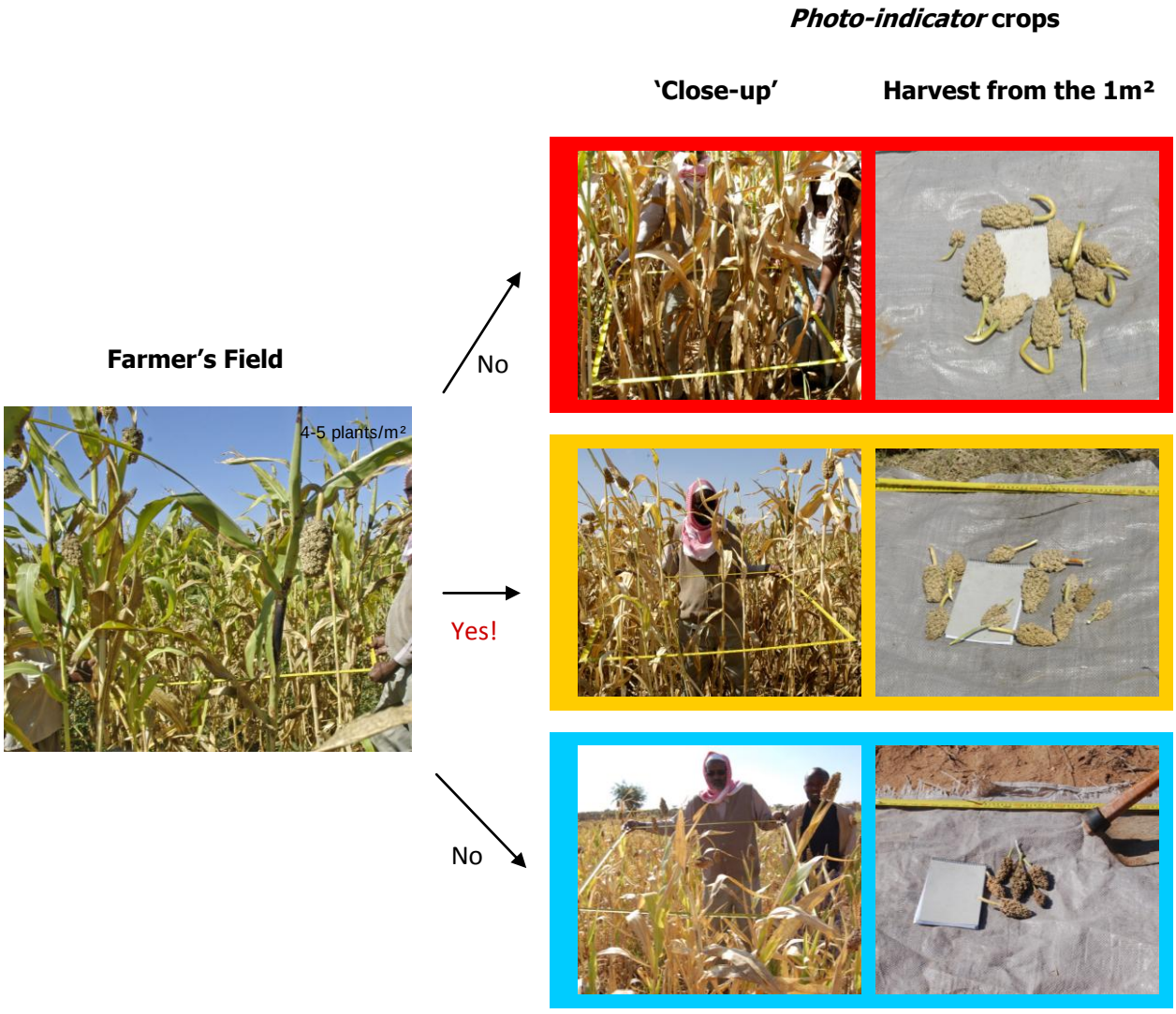
Confirming your choice

Confirm your choice in Step 2 by looking more closely at the field. If the field is small, walk up to the field and look closely at a small area which represents the field. For larger fields, you will need to take a close look at several places, either by a) walking around the edge or b) walking through the middle of the field. In some cases the *close-up* view may not be exactly the same as the photographs. The plant density may be higher or the harvested parts may be larger, smaller, greater or fewer in number.

Regarding the **close-ups** you should concentrate your gaze on one square metre of crop which you can judge by standing with your feet one metre apart and projecting your gaze forward to make a square or:- Use a 1 square metre ***quadrat*** to define your area by placing the quadrat at the best height to suit your purposes as shown in the next group of photographs.

When looking more closely you should see more detail than when looking from a distance. You may see more soil, more gaps, more weeds, the plants may look less strong and healthy than they looked from a distance, or, the opposite may be true. The plants may look stronger and the parts that will be harvested such as the maize cobs and grain heads, may look larger than when you looked at the crop from-a-distance. So do not be afraid to change your mind.

In the photographs below, the heads in the Farmer's Field seen on the plants within the quadrat are better formed than the '**low**' crop; and although there are fewer of them in 1 sq m, the Farmer's Field heads are also much larger than in the photo-indicator '**medium**' crop, so the level of production is correctly identified as being in the **'medium'** band.



In **Step 1** you decided that your crop was a mono-crop of sorghum.

In **STEP 2,** you observed **from-a -distance** that the crop was probably in the **'medium'** band of production.

In **STEP 3** you confirmed from the **close-up** that your crop is within the **'medium'** band **with a yield of around 2 tonnes/ ha.**

STEP 4

Estimating the value

In STEP 4 you place a value in tonnes per hectare on your crop using the second page of photographs, which show the 'harvest' and 'grain' from 1 sq m.

The photographs on the second page show how the yield for the *photo-indicator crops* were derived;

- The first photo shows the number and size of maize cobs and sorghum and pearl millet heads harvested from 1 sq m of the *photo-indicator* crop shown in close-up on the first page;
- The second photo shows the amount of grain threshed from heads or shelled from the cobs from the same 1 sq m.
- Next to each grain photograph, the crop yield for the *photo-indicator* crop is given in units of g/sq m and tonnes per hectare (t/ha).

- **RECORD THE YIELD from the *photo-indicator crop* CLOSE–UP THAT MATCHES YOUR FARMER'S FIELD CLOSE-UP - THEN MOVE ON TO THE NEXT FIELD**.
- ***ONLY HARVEST AND WEIGH YOUR SAMPLE of 1 sq m WHEN YOU WANT TO CROSS CHECK YOUR RESULTS (see STEP 6)***

Range of production: It is unlikely that your crop will look exactly like the one in the photograph. If you crop does not look exactly like the one in the photograph, pick the one that is closest to it or choose a yield in between the values of the two closest *photo-indicators.*

In the example below, the maize from a farmer's crop has produced the same number of cobs from one square metre as the 3.0 t/ha *photo-indicator* crop but the cobs the farmer's field are slightly bigger, therefore, the grain yield is higher than 3 t/ha but lower than the yield from 4 similar sized cobs in the 4.0 t/ha *photo-indicator* crop. The value of the farmer's crop is, therefore, estimated at 3.5 t/ha.

Farmer's Field

Number of maize cobs harvested from one square metre of the farmer's field.

***Photo-indicator* crop**
3.00 t/ha

***Photo-indicator* crop**
4.00 t/ha

The value of the yield is between 3 and 4 t/ha of grain and is estimated at 3.5 t/ha

Important Remember that the same amount of yield may be produced in different ways. For example, a farmer may harvest 2 heads from one square metre each producing 75 g of grain. This would give a yield of 1.5 tonnes per hectare. In another field, the same farmer may harvest 10 heads from one square metre each head giving 15g of grain which would also produce 1.5 tonnes per hectare.

***Photo-indicator* crop**
2 heads each producing 75g

***Photo-indicator* crop**
10 heads each producing 15g

The harvest in both the *photo-indicator* crops above is 150g or 1.5 t/ha

STEP 5

Accounting for field variability

Often you see parts of the field where the crop has been damaged by too much or too little water, poor soil, pests or diseases or too many weeds. When this happens, the crop will be different for different parts of the field and the field will be variable.

When the field is variable you will need to decide which parts of the field are **'high'**, **'medium'** or **'low'** and estimate the overall yield taking this variation into consideration. Look closely at the two photographs below. Decide how many samples you should take to place a value on the average level per hectare.

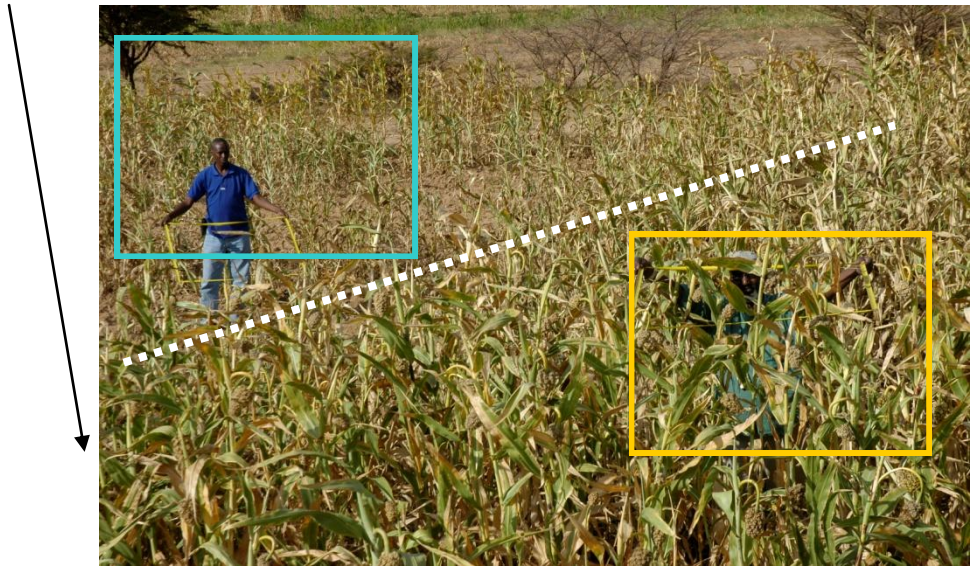
The field on the left is very even, so one PET estimate of yield will suffice.
The field on the right is variable, so more than one PET estimate is needed to take the variability into consideration.

A closer look at the field on the right shows that 2 estimates are required.

Estimating the yield of a variable field

1. Stand where you can see the whole field.

2. Divide the field into 2 (or 3) different parts. Within each part the crop should look similar. In this case, 2 estimates are required.



3. Determine whether each part is 'high', 'medium' or 'low' .

Half the field looks most like a 'low' crop. (PET Photograph with a blue background).

The other half of the field looks most like a 'medium' crop. (PET Photograph with a yellow background).

This part of the field is similar to the 1.10 t/ha *photo-indicator.*

4. Estimate crop yield for each part of the field by following the instructions for STEP 4 of PET-Crops Somalia

This part of the field is similar to the 2.70 t/ha *photo-indicator*.

1.10 t/ha **=Estimated yield=** **2.70 t/ha**

5. Calculate the total crop yield of the variable field.

The sorghum field is producing at two levels, one **'low'** and one **'medium'**. In this example, each part is about half of the field. The **'low'** half is estimated to have a yield of **1.10 t/ha**. The **'medium'** half was estimated to have a yield of **2.70 t/ha**.

For each part of the variable field:

Crop yield = Estimated crop yield (t/ha) x the size of the part of the field compared to the total field.

For the example shown on the previous page:

Crop yield from the **'low'** part = **1.10 t/ha** x 0.5 = **0.55 t**

Crop yield from the **'medium'** part = **2.70 t/ha** x 0.5 = **1.35 t**

To calculate the total crop yield for the field you simply add together the crop yield of each part of the field.

For the example shown on the previous page:

Crop yield = **0.55 t** + **1.35 t = 1.90 t/ha**

Harvest of field in tonnes = Yield t/ha x Field Area in hectares

STEP 6

Deciding when to cross-check your results

To make sure that your estimates of crop yield *based on the photographs* are accurate and that mistakes are not being made, it is important that you regularly cross-check your results by following the crop cutting procedure described in STEP 7.

Crop cutting is the method used to cross-check your photo-based estimates of crop yield with a physical sample. Harvesting small areas of the farmer's crop and measuring the weight of the harvested parts when they are dry, gives you a physical value to compare against your estimate based on the *photo-indicators*.

By doing this, you can find out if your estimates of crop yield using PET-Crops Somalia *photo-indicators* are too large or too small.

If you find that your estimates are often too large, you can make changes to improve the accuracy of your results. The same is true if you find that your estimates are often too small. It is very important that you regularly cross-check your results and it is recommended that you do this in the following situations:

- When using PET-Crops Somalia for the first time.
- When estimating yield for a new crop.
- When estimating crop yield in a new region.
- Finally, at regular intervals even if you are always working on the same crop in the same region because mistakes can be made through complacency.

STEP 7

How to cross-check your results

To cross-check your results you will need to take a crop cutting from a known area of a field and then measure the weight of the harvested parts. This will give you the value of crop yield per unit area. In each situation where cross-checking your data is recommended, crop cuttings must be taken from a minimum of three separate fields. The number of samples you take in each field will depend on how variable the crop is.

1. Choosing the field

Try to choose an area where the crop does not change too much. If this is not possible and the fields are very variable then divide a field into different parts - as explained in **STEP 5-** but choosing a variable field IS NOT RECOMMENDED[3].

2. Estimating crop yield

Estimate crop yield following the instructions given in **STEPS 1** to **4** of PET-Crops Somalia.

3. Select the areas of the field for crop cuttings

For all short stover/ straw crops, take a long stick, mark one end clearly and ask the farmer to turn their back to the field and throw the stick over their head into the crop. Where the stick lands in the crop is where you will position your square frame or **quadrat** for the crop cutting. Push the marked end of the stick upright into the ground. The quadrat should be placed around the stick with the stick marking the centre of the square frame.

4. Placing the quadrat in the crop

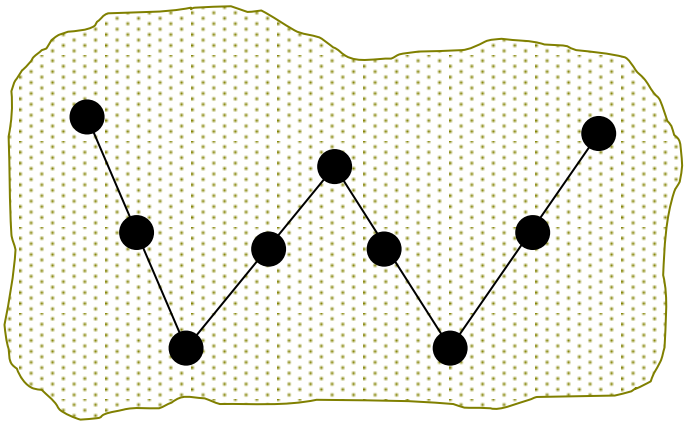
The quadrat is used to mark an area of crop from which plant and head counts, and crop cuttings can be taken. To do this accurately, it is important

[3] You are cross-checking your own judgement - so make it as easy as possible!

that only those plants whose stems emerge from the soil within the quadrat are included in the measurements.

For tall crops, hold the quadrat at waist height. By rotating 90^{o} clockwise 4 times, 4 square metres can be sampled from the same location, as shown below.

Moving in a **W** shape across the field (see example below) and sampling 4 times at 9 points spaced at regular intervals, will provide 36 sample counts of plant density per field in a very short time.



5. Counting the number of heads/plants inside the quadrat

For maize, sorghum and pearl millet you need to count both the number of plants and heads (or cobs) inside the quadrat. When you have finished counting, you should record on your recording sheet[4] the total count for each quadrat, then use the average value to adjust the weight of harvest obtained from the square metres that will be weighed and dried by multiplying the weight (W) by Average number of heads or cobs (A)/ Number of heads or cobs in sample weighed (N):- Final Weight[5]= FW= W x A/N

6. Harvesting

The number of quadrats harvested will depend on the variability of the field. With small peasant farms of less than 1 ha, if the field is very uniform, you may harvest just 1 square metre. If the field is variable refer to **STEP 5**. For very large fields, more samples are required and the number will depend on the time available. The amount of plant material that is removed from inside the quadrat will depend on how the crop is usually harvested. For example, for maize, sorghum and pearl millet it is only necessary to remove the harvested parts – the maize cob, sorghum and millet heads. Take extra care to remove only those plants or parts of plants whose stem emerges from the soil inside the quadrat.

7. Cleaning and threshing harvested parts

For maize, sorghum and pearl millet the grain should be removed from the cobs and heads. Try to minimise any loss of grain when you are threshing. If possible, ask the farmer to thresh and winnow the harvested parts in their usual manner.

[4] Annex 3
[5] When average number is the same as the number in 1 sq metre weighed FW= Wx1

8. Weighing

Before each weighing, the **spring balance scale** should be set to zero with a clean, empty plastic bag. Do this 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 (Annex 3).

9. Repeating the measurements

Unless the field is uniform, it is recommended that a minimum of **two quadrats** are taken for each field. If the field is variable, divide the field in your mind into 2 separate parts[6]. Take one quadrat from each part of the field and calculate the total crop yield for the field PROPORTIONALLY by following the instructions given in **STEP 5** to arrive at the *weighted average* for the harvest from the quadrats.

10. Large field adjustments

If the field is large, you will have already counted plant density at many places as described following paragraph **4 and 5.** In order to adjust the weights obtained multiply as before:

Weight x Average number of cobs or heads (all samples) / Number of cobs or heads (in weighed sample quadrats)

Remember: whenever using PET-Crops Somalia in a new situation, crop cuttings should be performed for a minimum of three fields.

11. Drying of grain

If the grain of maize, sorghum, pearl millet is not dry when harvested and threshed, it should be stored in a clearly marked **cotton** bag or a thick **paper** envelope, clearly labelled on the outside with information on the crop, field, quadrat number, date, village, district and the region where the crop was harvested. The grain should be stored in a safe place in the sun or on the roof rack of the vehicle if you are travelling. This allows the contents of the bag to be dried to a **constant weight** (you will know if the weight is constant because when you weigh it on two consecutive occasions – with a break of

[6] Stratified sampling

several hours between measurements - the measured weight remains the same).

NB heavy duty paper envelopes will suffice except for drying on roof racks where they are definitely not suitable.

12. NB. Recording the results

All weights for each quadrat should be clearly written on a results sheet. An example of the results sheet and the calculations to change your values of crop yield measured for the quadrat- to crop yield for a hectare of crop, are given in Annex 2 and 3 of PET-Crops Somalia.

PET-Crops Somalia

Photographic guide

Crops in order of appearance

Maize – Rainfed (3 double pages)

- High-yield range 3 tonnes/ha and above
- Medium-yield range 1.25-2.5 tonnes/ha
- Low-yield range 1.0 tonnes/ha and below

Maize – Irrigated (1 double page)

- High-yield 7.0 tonnes/ha
- Medium-yield 4.5 tonnes/ha
- Low-yield 1.6 tonnes/ha

Sorghum – Rainfed (3 double pages)

- High-yield range 4.5 tonnes/ha and above
- Medium-yield range 1.5-3.0 tonnes/ha
- Low-yield range 1.25 + tonnes/ha and below

Pearl Millet – Rainfed (1 double page)

- High-yield 2.4 tonnes/ha
- Medium-yield 1.8 tonnes/ha
- Low-yield 0.35 tonnes/ha

Maize - Rainfed - High

From-a-distance

Close-up

- Short maturing
- Even stand
- c 7 plants/m^2
- 1-2 cobs/plant
- Most cobs well formed

- Short maturing
- Even stand
- c 8 plants/m^2
- 1-2 cobs/plant
- Small cobs - most well formed

- Local maize - Short stover
- Even stand
- Dense c 5-6 plants/m^2
- Healthy
- 1-2 cobs/plant
- Cobs of variable size.

Maize - Rainfed - High

Harvest from 1m^2	Grain from 1m^2	Yield

Fresh weight 610g/m^2

DM 82%

Dry matter 500g/m^2

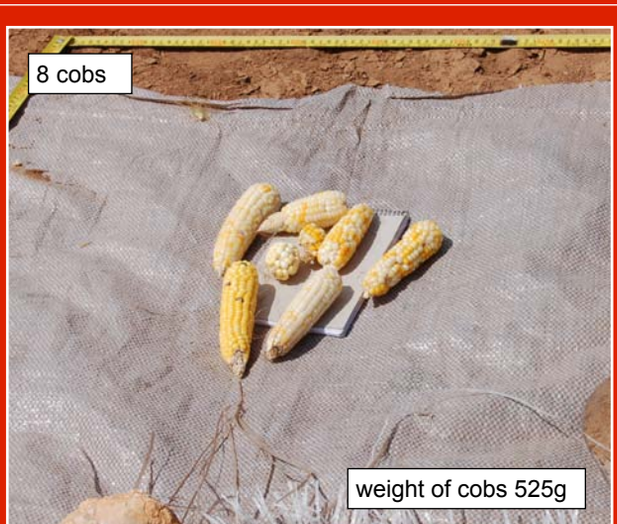
5.00 t/ha

Fresh weight 460g/m^2

DM 71%

Dry matter 325g/m^2

3.30 t/ha



Fresh weight 385g/m^2

DM 80%

Dry matter 307g/m^2

3.10 t/ha

Maize - Rainfed - Medium

From-a-distance

Close-up

- Local maize
- Variable stand. Obvious rows well spaced
- c 4 plants/m^2
- 1 cob/plant
- Regular sized cobs

- Local maize
- Even stand.
- c 9 plants/m^2
- Clumps of 3 plants
- 1 cob/plant
- Poorly formed cobs - poor seed set

- Very late maize crop
- Even establishment
- c 5-6 plants/m^2
- Thin stems. Weed free
- 4 cobs/plant
- Mostly small, poorly formed cobs - poor seed set

Maize - Rainfed - Medium

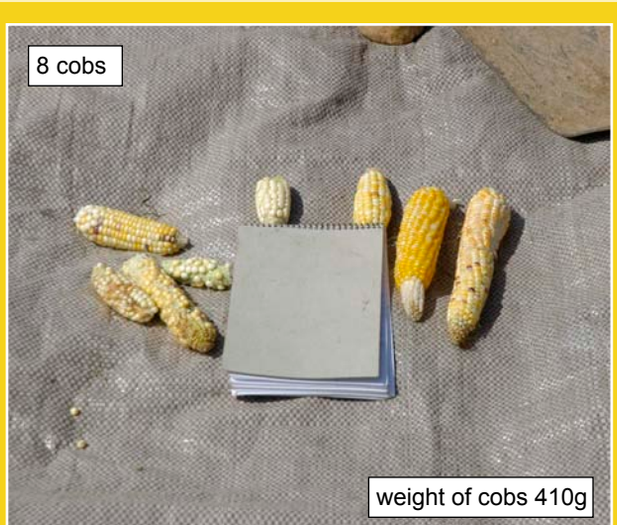
Harvest from 1m²	Grain from 1m²	Yield

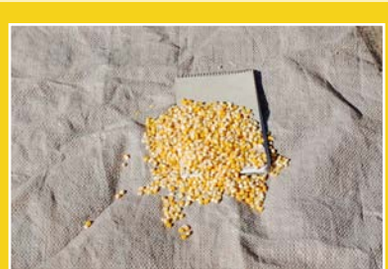
Fresh weight 325g/m²

DM 74%

Dry matter 240g/m²

2.40 t/ha



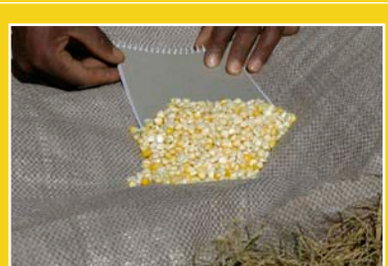


Fresh weight 250g/m²

DM 76%

Dry matter 190g/m²

1.90 t/ha



Fresh weight 150g/m²

DM 83%

Dry matter 125g/m²

1.25 t/ha

Maize - Rainfed - Low

From-a-distance

Close-up

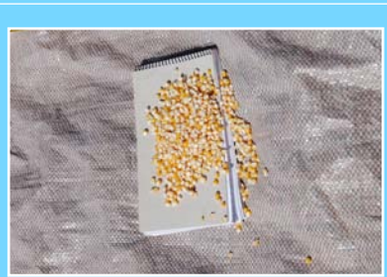
- Short stover crop
- Early establishment
- c 4 plants/m^2
- c 1 cob/plant
- Many poorly formed cobs
- Weedy. Lodging. Very dry

- Poor maize crop
- Early establishment
- c 4 plants/m^2
- c 2 cobs/plant
- Lodging

- Poor maize crop Very short stover
- Early establishment
- c 3 plants/m^2
- Gap filling with sorghum
- Ill formed, very small cobs - variable seed set and growth
- Lodging

Maize - Rainfed - Low

Harvest from 1m²	Grain from 1m²	Yield



Fresh weight 90g/m²

DM 100%

Dry matter 90g/m²

0.90 t/ha

Fresh weight 60g/m²

DM 100%

Dry matter 60g/m²

0.60 t/ha

Fresh weight 40g/m²

DM 88%

Dry matter 35g/m²

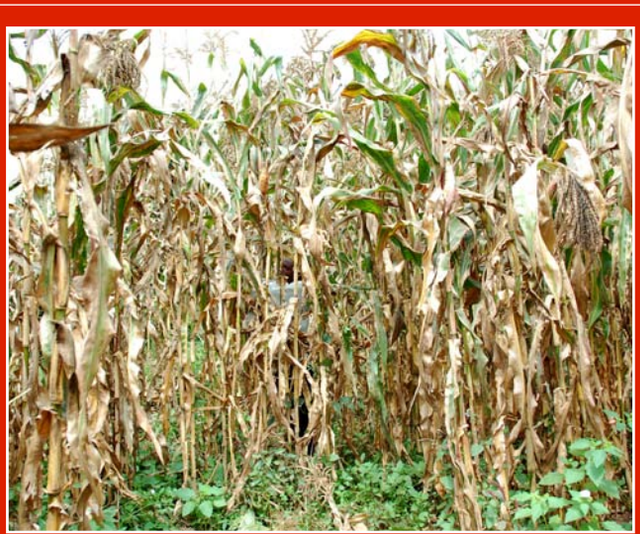
0.35 t/ha

Maize - Irrigated

From-a-distance

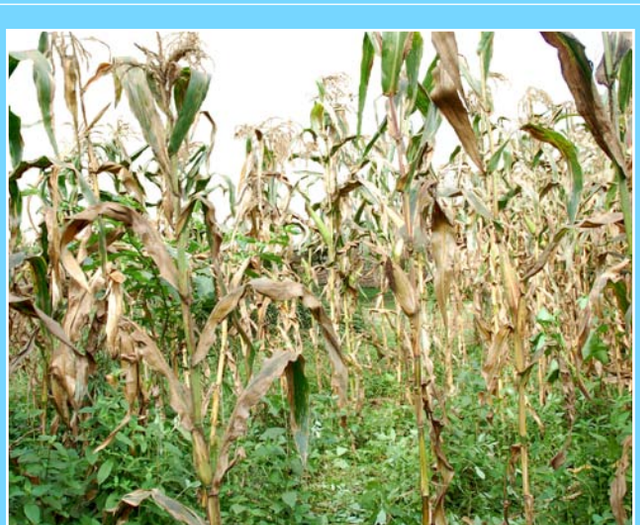
Close-up

- Hybrid maize Somtex
- Even stand
- 5-6 plants/m^2
- Healthy
- Well formed cobs. 1 + /plant



- Hybrid maize Somtex
- Even stand
- 6 plants/m^2
- Healthy plants
- 1 cob/plant. Variable size
- Some weeds

- Hybrid maize Somtex
- Variable stand
- 1 plant/m^2
- 1 cob/plant. Good size
- Weedy crop



Maize - Irrigated

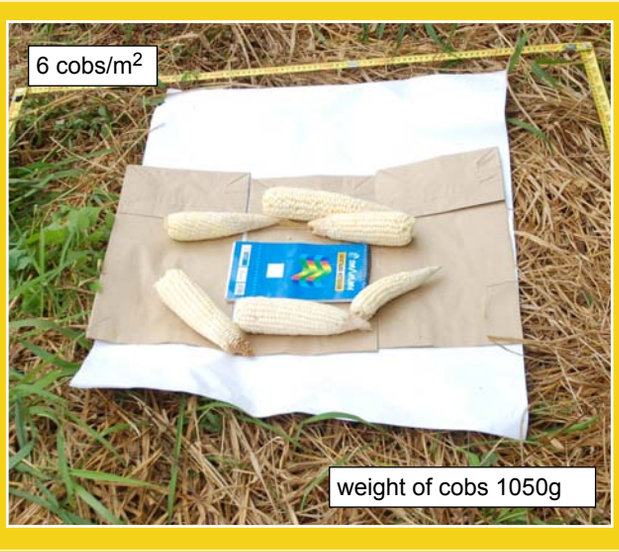
Harvest from 1m^2	Grain from 1m^2	Yield

Fresh weight 1050g/m^2

DM 67%

Dry matter 700g/m^2

7.00 t/ha

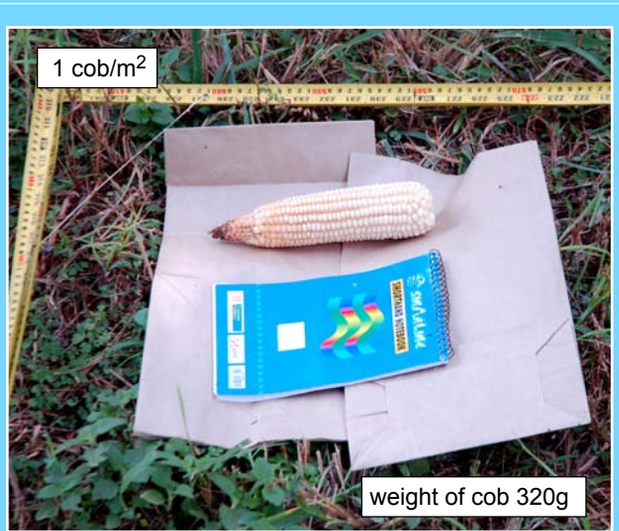


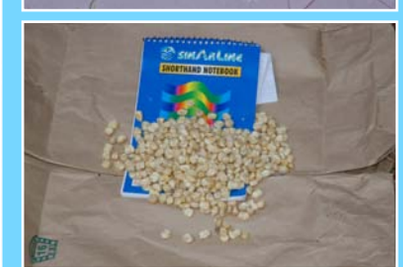
Fresh weight 650g/m^2

DM 69%

Dry matter 450g/m^2

4.50 t/ha





Fresh weight 225g/m^2

DM 70%

Dry matter 157g/m^2

1.57 t/ha

Sorghum - Rainfed - High

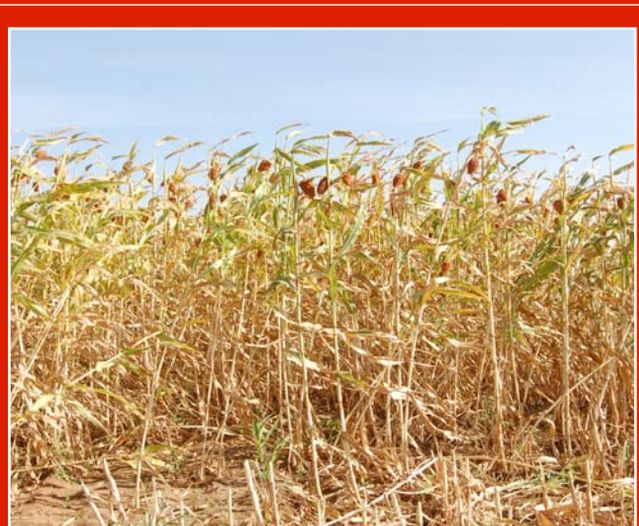
From-a-distance

Close-up

- Local goose neck sorghum *kuso* type
- Even stand
- Dense c 10 plants/m^2
- Healthy
- Well-formed heads varying in size
- No weeds

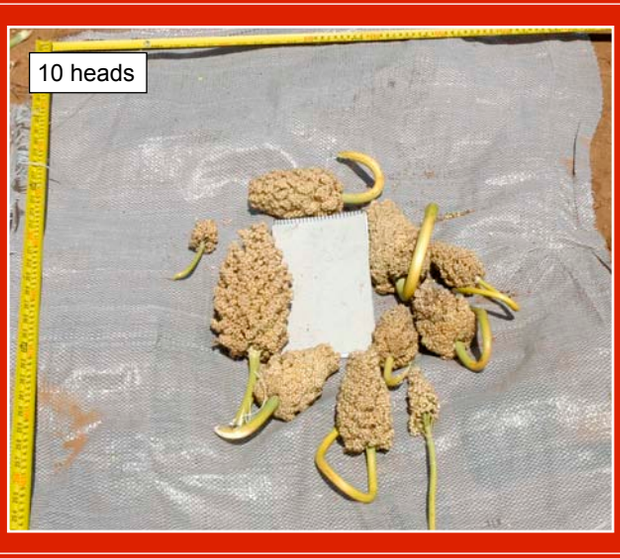
- Local goose neck sorghum *kuso* type
- Even stand
- Very dense c 22 plants/m^2
- Healthy, but some smut
- Small, well-formed heads
- No weeds

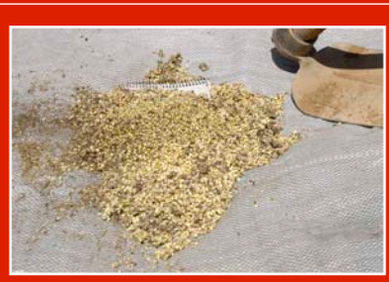
- Local goose neck sorghum *Abadiro* type
- Even stand
- Not dense c 5-6 plants/m^2
- Healthy
- Well-form heads, mostly regular in size
- No weeds



Sorghum - Rainfed - High

Harvest from 1m²	Grain from 1m²	Yield





Fresh weight 945g/m²

DM 77%

Dry matter 730g/m²

7.30 t/ha

Fresh weight 525g/m²

DM 100%

Dry matter 525g/m²

5.30 t/ha

Fresh weight 585g/m²

DM 79%

Dry matter 465g/m²

4.70 t/ha

Sorghum - Rainfed - Medium

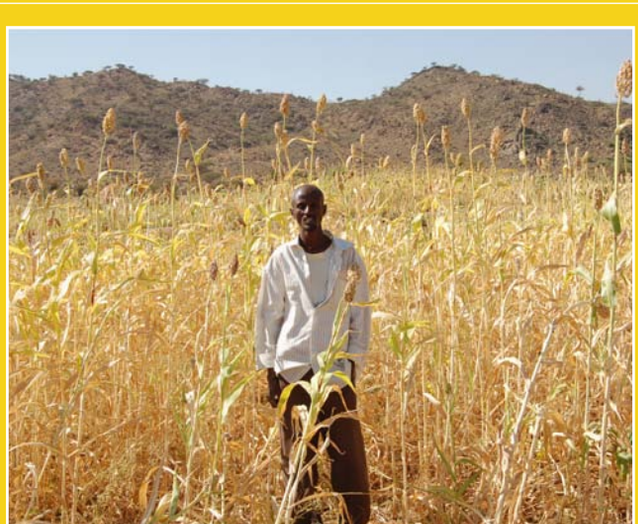
From-a-distance

Close-up

- Local goose neck sorghum *kuso* type
- Uneven stand Variable height
- Less dense c 4-5 plants/m^2
- Well-formed heads varying in size
- Some streak and smut. Some weeds

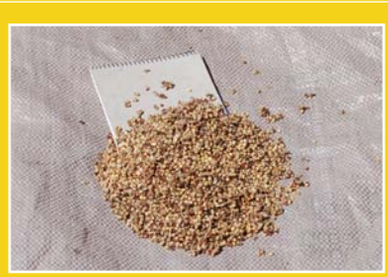
- Local sorghum *white*
- Uneven stand Variable height
- Dense c13-15 plants/m^2
- Healthy
- Well-formed heads varying in size
- Some weeds

- Local sorghum *white*
- Uneven stand
- Dense c10-12 plants/m^2
- Small heads very variable
- Some weeds



Sorghum - Rainfed - Medium

Harvest from 1m²	Grain from 1m²	Yield

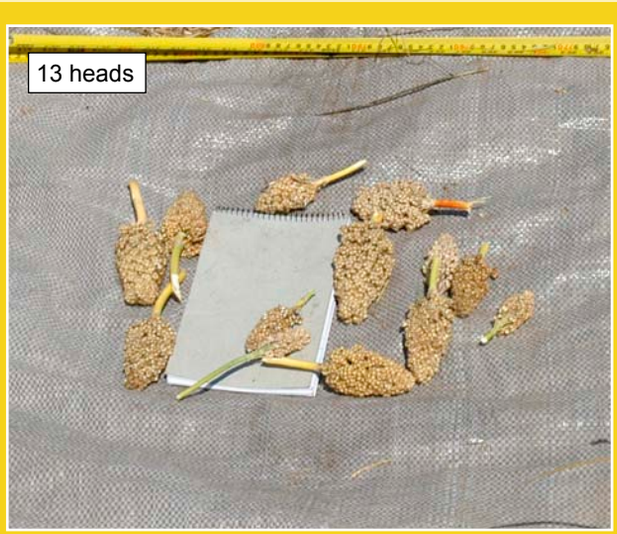


Fresh weight 340g/m²

DM 78%

Dry matter 265g/m²

2.70 t/ha

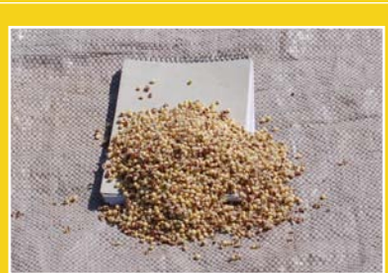


Fresh weight 225g/m²

DM 83%

Dry matter 187g/m²

1.87 t/ha



Fresh weight 205g/m²

DM 78%

Dry matter 160g/m²

1.60 t/ha

Sorghum - Rainfed - Low

From-a-distance

Close-up

- Local sorghum *Abadiro* type
- Intercrop-first crop taken
- Less dense c 5 plants/m^2
- Signs of chlorosis
- Small compact heads varying in size

- Local sorghum *kuso* type
- Goose necks not evident
- Poor stand
- Less dense c 6 plants/m^2
- Chlorotic. Weedy
- Poor plant and head development
- Ill formed heads varying in size

- Local sorghum *kuso* type
- Poor stand
- Low density < 3 plants/m^2
- Only 1 in 3 plants heading
- Low fruit set and seed formation
- Weedy

Sorghum - Rainfed - Low

Harvest from 1m²	Grain from 1m²		Yield
	 	Fresh weight 115g/m² **DM 96%** Dry matter 110g/m²	**1.10 t/ha**
	 	Fresh weight 85g/m² **DM 82%** Dry matter 70g/m²	**0.70 t/ha**
	 	Fresh weight 25g/m² **DM 92%** Dry matter 23g/m²	**0.23 t/ha**

Pearl Millet - Rainfed

From-a-distance

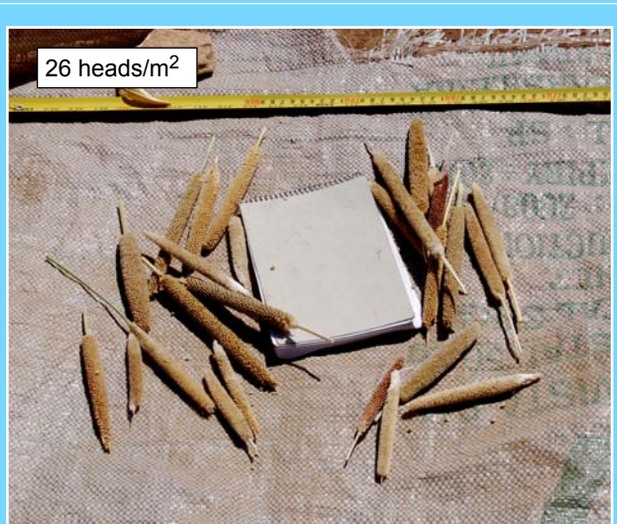
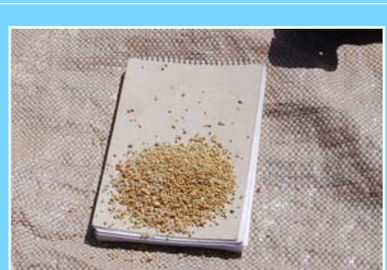
Close-up

- Local pearl millet
- Dispersed sowing rate
- Much tillering
- c 10 plants/m^2
- Healthy. Fairly evenly sized heads
- Good seed formation
- Some weeds

- Local pearl millet
- Sowing in clumps at c 1m centres
- 6 + heads/plant
- Medium sized heads
- Mixed seed set

- Local pearl millet
- Few tillers/plant
- Small head size
- Poor seed set
- Very weedy

Pearl Millet - Rainfed

Harvest from 1m^2	Grain from 1m^2		Yield
	 	Fresh weight 240g/m^2 **DM 100%** Dry matter 240g/m^2	**2.40 t/ha**
	 	Fresh weight 190g/m^2 **DM 100%** Dry matter 183g/m^2	**1.83 t/ha**
	 	Fresh weight 35g/m^2 **DM 100%** Dry matter 35g/m^2	**0.35 t/ha**

ANNEX 1

Estimating yield of each crop in an intercrop

To estimate the yield from an area of land in an intercrop you will need to consider each crop separately and estimate its density. This is because farmers plant their crops at different densities in intercrops compared to sole crops and this needs taking into consideration when estimating crop yield.

Remember, an intercrop is any field that has two or more crops grown together as a mixture on the same piece of land. If your crop is an intercrop, consider each crop separately and decide which one you will estimate.

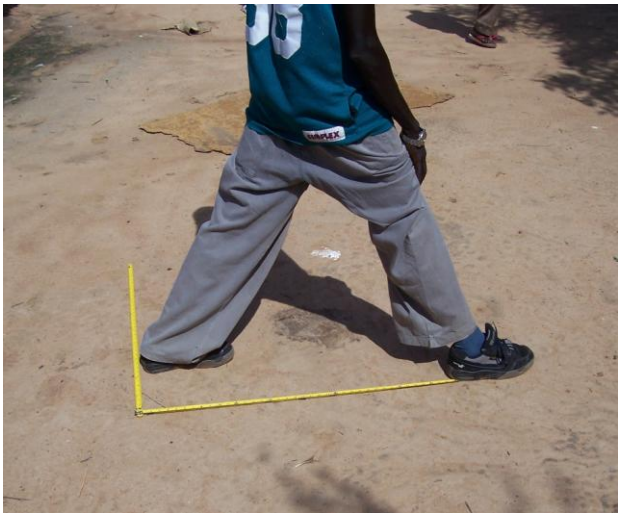
Locating the crops ready for harvest in an intercrop: Look at your intercrop, identify those plants that are crops and those that are weeds. Disregard the weeds. **Remembe**r, the farmer may have planted the crops at different times and so some of the crops may be immature and are not ready for harvest.

For these immature crops there are two options;

(i) you can make a note in your field book of the location of the field and which crops are immature so that the field can be revisited later or,

(ii) if the crops are close to maturity then you can continue with a crop assessment and estimate the yield the crop may give when it reaches maturity.

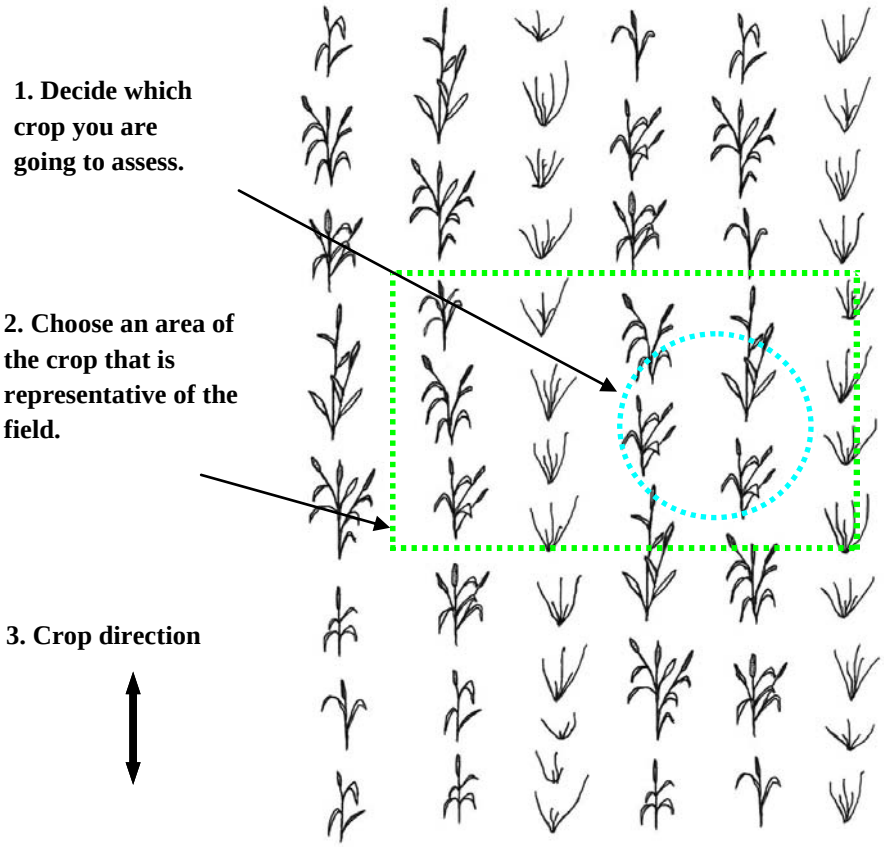
Estimating the density: To do this, count the number of plants of each chosen crop in a known area of the field. For well-spaced crops, use an area of **four** square metres (**4 m^2**) which means an area that is a square in shape with each side measuring **two** metres in length. As a general guide, one stride of a person of medium height is equal to one metre (measuring from the back of the foot to the back of the next 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, shown in the following photo.



One stride should measure about one metre in length. You can check your own stride and if necessary adjust it slightly so that it measures one metre in length.

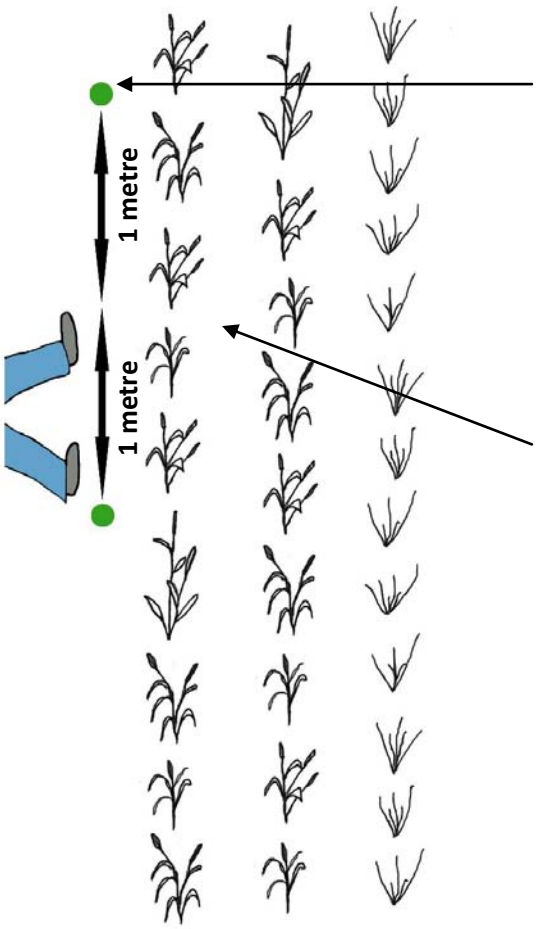
Procedure for measuring population density:

1. Decide which crop in the intercrop you are going to assess.
2. Choose an area of the field where the crop is neither very good nor very poor (i.e. it is representative of the field as a whole).
3. Look at the crop and decide which direction the rows are planted.



4. Use an object to mark the start of your **2 m** length and then take two good strides along the row and use another object to mark the end of the **2 m** length.

5. Count the number of plants along this **2 m** length (*Count 1*).



4. Use an object to mark a 2 metre length of the row (use one stride as a measure of 1 metre)

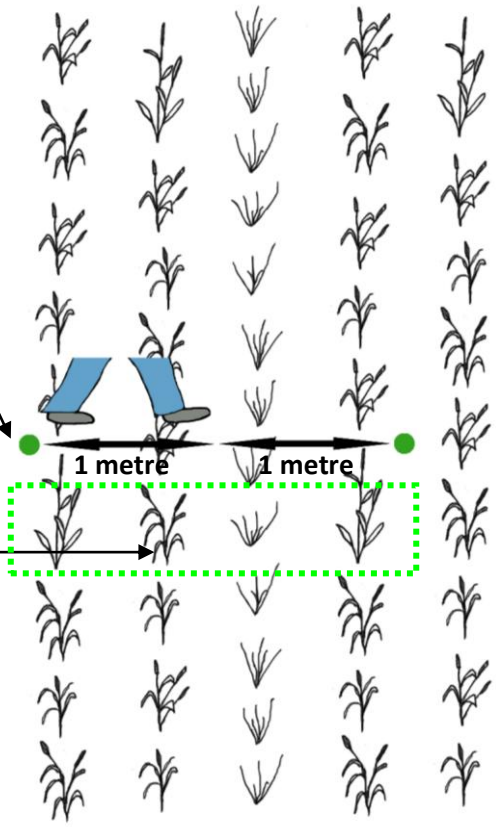
5. *Count 1:* Count the number of plants in a 2 metre length of row.

In this example *Count 1* =4

6. Repeat the process described in 4. but at a 90° angle to the row.

7. Count the number of plants along this **2 m** length (*Count 2*).

6. Repeat the process but at a 90° angle to the first count.



7. *Count 2*: Count the number of plants of one crop in a 2 metre cross-section of the intercrop.

***Count 2* = 3 in this example.**

8. Calculate the total plant population for a 4 m^2 area by multiplying *Count 1* by *Count 2*. In the example above:

Total population density of **ONE** crop in the intercrop

= *(Count 1)* x (*Count 2*)= 4 x 3 = 12 = **12** plants in **4** m^2

9. Calculate the total plant population for 1 m^2 by dividing the answer above by **4**. Plant density in **1** m^2 = **12/4** = **3** plants per sq m

10. Record the density of each crop in your notebook and then continue to **STEP 3**.

ANNEX 2

Convert grams to tonnes/ha

To convert the weight of your grain sample harvested from one square metre (m^2) to yield in tonnes per hectare (t/ha) divide the weight in grams by 100.

Calculation explained:

- To scale up from one square metre to one hectare multiple your sample weight by 10,000.
- To convert your sample weight from grams (g) to tonnes (t) divide by 1 000 000 :

$$1000\ g = 1\ kg$$

$$1000\ kg = 1\ t$$

- Example: if the grain harvested from one square metre weighs 250 g, then to convert to tonnes per hectare:

$$250\,g/m^2 \times \frac{10000\,(to\,convert\,to\,hectares)}{1000 \times 1000\,(to\ convert\,to\,tonnes)} = 2.5\,t/ha$$

Or quick calculation:

$$\frac{250\,g/m^2}{100} = 2.5\,t/ha$$

For quintals per hectare simply divide the sample weight (g) from one square metre by 10.

ANNEX 3

PET-Crops Somalia: Results Sheet

Region: **Assessors Name:** **Date:**

CROP	Yield estimate PET-Crops Somalia (t/ha) or (qt/ha)	Count Data (mean value from one square metre)		Measured Yield (grams per square metre)				Comments
		Heads/Cobs	Plant number	Quadrat 1	Quadrat 2	Quadrat 3	Mean Yield	

ANNEX 4
Questions and Answers

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 PET-Crops Somalia. In most situations, it is not practical to measure the harvested crop and so a good estimate is important.

What is a crop assessment?

When you estimate (or measure) the amount of crop in a village, a district 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 and grain). The yield per unit area is the weight of the harvested parts produced from a known area of land (usually a hectare). For example, you can say that the farmer's field produced 1000 kilograms per hectare (1000 kg/ha) or one tonne per hectare (1 t/ha).

If you are measuring the weight of your crop from one square metre (1 m^2) you would weigh your crop in grams (g). So if you weigh your crop from one square metre, and its weighs 400 grams (400 g), you can say your yield is 400 grams per square metre (400 g/sq m or g/m^2). If you are talking about the yield from a whole field you would use kilos, quintals or tonnes per hectare.

Remember: One tonne (t) is the same as 1000 kilos (kg).
One quintal (qt) is the same as 100 kilos (kg).
One kilogram (kg) is the same as 1000 grams (g).

What is plant density (or crop density)?

By plant (or crop) density we mean the number of plants in a known area of land. In PET-Crops Somalia, plant density often refers to the number of plants inside the square frame (or quadrat) whose sides measure one metre in length (that is, the number of plants per $1m^2$). If you have a crop with many plants inside the square metre then the plant density is high. You can also say it is a very dense crop. If you have few plants inside your square metre 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.

What is one square metre?

A square metre 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 will be working with a square frame (a quadrat) and each of the four sides will be one metre. The area inside your square frame when you put it on the ground is one square metre (1m x 1m = 1 m^2).

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 metres (4 m^2) this will be equivalent to a square with sides 2m long (2m x 2m= $4m^2$)

If you have a bigger field and you can cover the field with your frame 100 times, then your field is 100 square metres (100 m^2 =10m x 10m)

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 100m x100m ($10,000m^2$). It is the most used international measure of land area; and used most often for the value of crop yields.

What is a tonne per hectare?

A tonne per hectare is a measure of the weight of crop harvested (one tonne) from an area of one hectare (please read the explanations on yield and hectare).

If you have one tonne per hectare (1 t/ha) it means that a field which measures one hectare produced 1 tonne or 1000 kilos of crop.

If a field which measures one hectare produced 2000 kilos, you would say that the crop quantity was two tonnes per hectare (2 t/ha).

When you weigh your crop from one square metre, you will obtain the yield in grams per square metre (g/m^2). Normally you do not give the yield from a field in g/m^2, because the area is so small, instead you would convert your measures to tonnes per hectare (t/ha). Annex 2 will explain how to do this.

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 good and 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 metre (1 m) each side, and therefore the size of the land inside the quadrat will measure one square metre (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 PET 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 does drying to a constant weight mean?

When the sampled crop is not fully dry, you must dry it in the sun to obtain an estimate of the weight of the mature crop. It may take a long time to bring down the water content to the usual level at harvest time which is usually lower than 15%, dry matter (DM) being greater than 85%. After drying for several hours, weigh the crop on the spring balance and dry again. You will know when the harvested parts are fully dry when the measurement you take is the same as the one before. When two consecutive measurements are the same, the sample is said to be dried to a constant weight and is, for purposes of crop assessment, completely dry.

ANNEX 5
Estimating Area

1.0 Background.

1.1 The agricultural component of any crop assessment aims to produce a mosaic of figures describing the disaggregated harvest of the main staples for a particular season. Production estimates, in most cases, are derived by multiplying area harvested by an estimated yield per unit area, components that are both measurable at harvest time when the assessments usually occur. To be convincing, levels of production recorded must not only be possible but must also be plausible. Plausibility is a very important consideration in acceptability, without which crop assessments become worthless exercises. Therefore, data presented should be justifiable and defendable in debate; and should come from a source as close as possible to the farming community.

1.2 Where civil war inflicted disruption has led to a complete breakdown of the official gathering of agriculture statistics and access limitation precludes land surveys of any description, peasant sub-sector **area estimates** are compiled from derived population statistics using factors selected to determine;

- Number of households in each district- achieved by dividing the latest population estimate by average household size.
- Percentage of households in settled communities (including long-term IDPs) that area farming- as noted by and reported to the assessment mission teams.
- Area cropped by cereals per household during the year in question, including home-gardens and far-fields- as noted by and reported to the assessment mission teams.

1.3 In countries/ states where active administrations exits, the largest administrative units that a) are in day-to-day contact with their farming community, and b) may be visited within *the time and cash allocated* to assessments, constitute the probable *entry-points* for any crop assessment mission. These are usually district or regional level Ministry of Agriculture offices but may also be, depending on circumstances, irrigation schemes, area development projects, private estates or zones under

temporary administrations. During the course of an assessment mission, such *entry-points* will be visited in sequence to provide the background quantitative information required to create the area/ crop framework upon which the results are built. With these points in mind, the *golden* rules regarding quantitative data are;

- Assessment mission teams must never leave an *entry-point* without the area[7] data for the season's crops of interest.
- If time is short and data are not compiled, teams should concentrate on the compilation of the data for the main staples.
- Do not accept that data will be sent/faxed/e-mailed later. The road to incomplete files is paved with such broken promises.

1.4 The final data base will be achieved through combining information received and adjustments made following the teams' field audits, particularly with regard to yield. Remember, by virtue of the facilities placed at their disposal, assessment missions are invariably in a far better position to estimate actual yields than the local officers or any other assessing groups.

1.5 Regarding area *per se*, it is far less easy for visiting teams to estimate area than to estimate yield per unit area. Assessment missions may only ensure that the figures provided to them by the *entry- point* administrations are plausible and connect to the land available for cultivation within the *entry-point* . To achieve this assessment missions with access to *entry-point* data should:-

- Watch out for double counting due to administrative boundary changes which may change the status of villages or even whole districts.
- Be aware of changes in numbers of households farming due to mass migrations of families.
- Be sure to check the units used i) at the point of data collection from the farmers and ii) when transcribed into the records.
- If local units are used, check that the conversion factors are consistent and plausible.
- Remember that at most *entry-points*, most data are summated by hand and entered/ copied by hand. Mistakes invariably occur, so check the calculations, even if only *rough checking* in 1000s of hectares or tonnes, to be sure that all decimal places are correct.[8]

[7] Sometimes yield estimates will also be available but, usually, they have not been made.

[8] The above cautionary notes assume that the administration is trying to provide accurate data. Unfortunately, vested interest often causes key informants to try to deceive assessment teams with completely false data. Therefore teams must continuously cross –check/ audit all data received from all sources against historical data with a view to obtaining rationale explanations for any deviations.

- When sure of the overall accuracy, enter the data into a hierarchically linked excel spreadsheet using figures rounded-up to an appropriate level. This is necessary because most MoA offices work down to final ha or kg, or even fractions of kilograms in their tables, which bear little relation to the level of accuracy of the process.

2.0 General Approach to Adopt (active administrations)

2.1 On arrival at *entry-point* town inform local Ministry office of arrival immediately[9]. Present letters of introduction/authority and arrange to meet the full complement of subject matter specialist/s under Chair of Head of Office or delegated official at the first convenient moment. The expert areas should include - extension, crop production, crop protection, post-harvest, marketing, credit, input supply, livestock production, veterinary and the archivist.

2.2 Data requested[10] should include rainfall data in *decads* (or daily data, not just monthly totals) for as many rain-gauges as are in the *entry-point* area, crop area estimates, expected yields, seeds, fertilisers and other agro-chemicals distributed and used, farming practices and variations from the norm- all factors which have an impact on area farmed.

2.3 As well as the data listed above.

(a) Obtain final post-harvest assessments, area and yield for each crop, *from the previous year* for comparison with this year's and last year's mission estimates (if there was one).

(b) Obtain specialist reports regarding events in the *entry-point*.

(c) With the local experts, select districts to visit covering the variations in population (ethnic groups), topography, soils and rainfall zones. Identify any areas of special interest/concern.

(d) In the case of each new crop in each area, conduct spot-check (dip-stick) crop measurements by field cuts or counting of exact harvests from known areas, if harvesting is on-going or about to start, use PET manuals, if they exist, to standardize the approach.

(e) Combine drivers and threshing machine operations are the **best** sources of information and should be **targeted** in the fields where they are working. Against this, field samples based on accurate estimates of plant destiny and weighed, threshed grains will give yield.

[9] A team member, who knows the area, should do this BEFORE settling into the lodging, to ensure that the crucial officers needed do not "go on travel" while the Mission team is in the location.

[10] If in local languages, arrange for immediate translation and take away photocopy or carbon copy.

2.4 If the Mission is conducted at the correct time (i.e. harvest time) field measurements will give an accurate sample of what is available. Such samples are clearly not to be confused with statistically accurate sampling methods - but will allow the Mission to evaluate information received from other sources. Are they of the same order? If not, why not?

2.5 Commercial farms with their own recording systems should be visited at every opportunity and field conditions compared with parallel peasant systems. It is not necessarily true that large-scale farmers have better yields than the peasant farmers. Indeed, attention to detail is often much better on the peasant farms and this is often reflected in better yields.

3.0 Area specific.

3.1 The timing of assessment missions means that, in most cases, harvesting is underway. Therefore, harvested area data will always be incomplete. Final planted area data, therefore, provide the best crop area statistics with which to calculate production.

3.2 Mission teams should request final planted area data at each *entry-point* for each crop. This means that each crop has a separately recorded area. Complications arise when;

- Two crops are planted in series in the same season, i.e. the second one is planted after the harvest of first one. This doubles the occupancy of the area under production whether the two crops are the same or different.[11] **(Relay cropping)**

- Two or more crops are grown together in same field during the same season. When planted and harvested at different times, this doubles the occupancy of the field and, therefore, doubles the harvested area [12] **(Intercropping).**

3.3 The areas duplicated in both circumstances noted above means that the actual *production* area will be twice the *geographical* area. Where data allows, the extent of the increase, regarding the individual crop areas, should be noted in the text and identified in tables. The approach to adopt is different when;

[11] At least two crops of maize, from the same field, in the same season, are grown in West Equatoria, South Sudan. Pulses are grown following cereals, in the *meher* season, in some areas of Ethiopia

[12] Coconuts, cassava and cowpeas are all intercropped in coastal areas of Mozambique. Maize and beans are intercropped in South Sudan and in south Ethiopia.

- Two crops are sown together and the mixed products are harvested together. In such cases the area is not doubled and only the area of the dominant crop is recorded.[13] **(Mixed cropping)**

3.4 Total planted area data received should be:

- Collected at each *entry-point* in its original form. (Photocopy or carbon copy preferred; if not available then transcribed from original on to assessment mission sheets).
- Cross-checked for year-to-year and place-to-place for consistency in transformation from local measures to international units.(*eg* Sudanese *feddan* is always 0.42 ha)
- Compared with the known total agricultural/cultivated area of each *entry-point*.
- Cross-checked against any known changes to numbers of house-holds farming in each *entry-point*.
- Cross-checked against any known boundary changes to eliminate double counting.
- Compared with last year's main season harvested area in each *entry-point*.
- Cross-checked with any changes to the planted area of any preceding minor season in each *entry-point*.
- Compared with any known changes to area of industrial crops, tree crops, pasture land, forestry areas or fallowing practices.

3.5 Individual staple–food crop planted areas should be:

- Compared with last 5 years' annual national, regional and *entry-point* estimates.
- Intercropped areas noted in each *entry-point*.
- Main crops expressed as ratios between one another and with the total area in each *entry-point*, for comparison with actual ratios noted in transects driven by assessment mission.

3.6 Local areas should be audited by:

- Frequently:- pacing-out field dimensions and calculating crop areas to cross –check information received.(NB calculating in circles is often quicker than in squares or rectangles or triangles when dealing with hand-dug fields surrounding huts)

[13] Wheat and barley seeds are mixed, sown together and harvested together in northern Ethiopia in a mixture known as *hamfes* (Tigray) or *wazera* (Amhara). The area and production are noted separately in Tigray and allocated to barley data in Amhara. Mixed sorghum seeds are sown in South Sudan, although harvested at very different times, the area and production are simply allocated to sorghum.

- Making rough calculations of areas visited/ driven-through by noting kilometre readings on vehicle gauges.
- Making observations from higher ground and estimating, by eye, proportions farmed to different crops-(rules of thumb; and looking at areas through a transparent sheet grid may help in this regard).
- Estimating distances/ areas by comparing the areas in view with areas you know well (eg football pitch).
- When you know the distances between them, calculate distances viewed by counting telegraph poles/ electricity pylons.

4.0 Factors affecting area.

4.1 Area planted is influenced by natural and man-made factors. **Changes** are usually more dramatic among market-orientated farmers who are cultivating land in favourable areas where several crop options, including set-aside or fallowing, are possible. Subsistence farmers, with only small plots to cultivate, rarely have a wide choice of crops and can never opt not to plant staple crops at all. However, the **consequences** of change are usually more dramatic for the subsistence farmers whose marginal existence is finely balanced.

4.2 Natural factors affecting area comprise rainfall and extreme events.

- Rainfall at the beginning and end of the season influences area planted and harvested respectively. Positive and negative effects are summarized in Table A3 1. Data from official government weather stations should be provided/accessed and disaggregated into *decads* and compared with recent years and long term averages to determine changes. The data should be triangulated against all possible sources available, which include:
    i. Remote sensed data, based on cold cloud cover, provided by agencies including FEWS-NET and FAO.
    ii. Rainfall data collected by local MoA offices, NGOs, projects and provided to teams during field visits.
    iii. Qualitative statements about *the rains* from sample farmers interviewed by assessment mission teams.

Extreme events will cause localised planted areas to be lost through flooding or landslides. The former losses may well be recovered later as

- ex-flooded areas provide high levels of residual moisture for draw-down farming.[14]

4.3 Man-made factors affecting changes to area planted are mostly linked to government policies and include farm-gate market prices of crop products; input (fertilizer and improved seed) availability and price; labour movement/profiles and wages, power sources available and farmer confidence plus, in all areas states/ stages of conflict.

4.4 The factors noted above should be investigated in depth using the tools specified earlier namely;

- Secondary data collected pre-mission from various government agencies responsible for meteorological data, input supply, seed development, pest control, price and market presentation monitoring.(time-series and current data).
- Key informant interviews with national and sub-national offices of the above, traders and contractors.
- Key informant interviews with MoA staff at every *entry-point***.**
- Semi-structured interviews with farmers in every *entry-point***.**
- Transect driving/ flying/ walking. Market surveys.

4.5 The anticipated effects of the factors are listed below in Table A3 1.

Table A3 1 Factors affecting area

Rainfall		
Conditions	**Effect**	**Possible Impact**
Good pre-season and early starting rains	Long cultivation window:	All possible areas cultivated
	maximum area cultivated	Plenty of time for all forms of cultivation. Opportunistic use of common land, reduced fallowing[15]
	early or timely sowing.	Less intense competition for contractors; hiring rates stable.
		Long-cycle crop areas increased.
		High and even germination rates

[14] In 2000, the dramatic floods in the southern point of Mozambique provided conditions for an excellent second season for short cycle crops.

[15] Afghanistan-the CFSAM in 2000 noted a massive 40% increase in total cereal area due to expansion of rain-fed farming in a very good rain year compared to 1999.

Late starting rains.	Heavy clay soils uncultivable early: delays in cultivation delays in sowing Sandy soils: dry-sowing increased	Cultivation window reduced: hand-dug areas *may* be reduced. pressure on contractors, hiring rates increased areas *may* be reduced[16]. long-cycle crop varieties; areas *probably* reduced short cycle crops; area *probably* increased. [17] *probably* no effect on area sown. Fields may need to be gap-filled when rains begin.
Broken / false start to season.	Seeds germinate then die.	Reseeding necessary; Reduction in area if seed supply limited[18] Area switches from cereals to later sown crops *eg* pulses or ground nuts.
Excess rain at sowing time	Water logging	Cultivation /sowing delayed on heavy soils. Problems similar to late starting rains for farmers on heavy soils using machinery/ machinery contractors.
Floods mid-season.	Land-loss, crop loss BUT may be a opportunity to replant crop on residual moisture	Main crop area reduced Area increases in minor or opportunistic crops.
Prolonged rainfall at end of season.	Harvest–time rain Lodging Sprouting in head Post harvest rain Improved water stocks	Mechanised farmers/contractors may miss some areas. [19] Some areas not harvested. Opportunistic planting of second crops. Increases in dry season irrigated area.

[16] Increased pressure on contractor's services with concomitant increases in labour rates, oxen hire rates, tractor hire rates. Under these conditions either i) less land is cultivated by those using contractors or ii) number of passes reduced; or iii) best sowing time missed as planting season extended beyond preferred period.
[17] Overall area may be the same.
[18] Very important consideration for wheat, barley (sowing rates-120 to 200+ kg/ha); less important for sorghum and maize (10-25 kg/ha)
[19] In Ethiopia, there is opportunistic planting of *sassa* barley in East Tigray to capitalize on late rains; In Mozambique, a second crop of short cycle maize is grown in southern provinces. Rice is grown in the swampy/ waterlogged areas. In South Sudan a second crop of groundnuts is grown in west Bahr el Ghazal and sweet potatoes in Bahr el Jebel.

Irrigation water supply. Increased. Decreased	 More water available for dry season cultivation. Less water available for dry season cultivation	 Area increased. Area decreased.

(b) Man-made factors

Inputs		
Factor	**Effect**	**Possible Impact**
Early availability of farmer seasonal ***credit,*** improved ***seeds*** and basal dressing ***fertilizer.***	Market-oriented farmers have timely access to inputs which boosts farmer investment: Maximum area cultivated Early or timely sowing.	All possible areas cultivated Plenty of time for all forms of cultivation. Opportunistic use of common land, reduced fallowing Less intense competition for contractors; hiring rates stable. Long-cycle crop areas increased. High and even germination rates
Late arrival of inputs	Market orientated farmers have reduced time for investment.[20] Credit supply low or not available Credit demand high. Delays in sowing Black market thrives	Optimum sowing time missed. HRV[21] areas reduced Area of long-cycle crop varieties *probably* reduced. Area of short cycle crops *probably* increased. [22] Input prices increase
Increased prices of inputs.	Market orientated farmers have increased outlay.[23] Decline in sales possible May get increase in share-cropping Small farmers don't buy inputs	HRVs; Reduction in area. Traditional varieties. Area switch to low-input cereals Areas stay same but ownership changes.
Serious Conflict/ war	Farms abandoned	Production ceases

[20] Subsistence farmers less effected, use their own seeds and may not use fertiliser.
[21] HRV- high response varieties.
[22] Overall area may be the same.
[23] Response depends on expected crop prices; guarantees or no guarantees, stocks from previous years.

Labour		
Crisis displacement with labour shortage early in season	Abandon village fields- early season. New clearings unlikely.	Cultivation stopped. Area reduced Area switch to late-sown crops No expansion of cultivated area
Crisis displacement with labour shortage late in season.	Abandon village fields late season.	Harvest missed. Area lost
Long term migration.	Farming population reduction.	Fewer farming households. Possible area reduction[24] Possible land redistribution/share cropping[25]
Power sources		
Draught animals- viral diseases (epidemic eg rinderpest);	Dramatic loss, oxen sharing cannot keep- up with demand.	Fewer animals to cultivate. Area reduction.
Draught animals- distress selling (most households)[26]	Dramatic loss, oxen sharing cannot keep- up with demand.	Fewer animals to cultivate. Area reduction.
Fuel availability disturbed.		
Fuel supply late	Contractors raise prices Black-market flourishes. Investors reduce area unless price forecasts good. Owner- farmers struggle to find fuel.	Area probably sustained, quality falls. Area reduced or redistributed to very wealthy.
Prices dramatically increased	Owner- farmers struggle to find fuel.	Area reduced or redistributed to very wealthy.

[24] Angola- areas deserted by influential landlords left unfarmed by peasants remaining for many years.
[25] Afghanistan- monied households left but land farmed by others in their absence (share-cropped)
[26] DO NOT CONFUSE REGULAR SALE OF DRAUGHT ANIMALS IN AREAS WITH LIMITED GRAZING / TRYPANOSOMIASIS WITH DISTRESSED SELLING. Rapid turnover of draught animals is valid strategy in such areas. (Buy pre-season-sell post season; avoid feeding expenses/risk in dry season)

Farmer Confidence		
Local conflict/insecurity-confidence draining.	All farmers.	All farmers.
	No far fields.	Area reduced[27]
National war threat-uncertainty.	Boosted self sufficiency programme.	Area of staples increased[28]
	Maximum planting unless near frontier.	Stocks held on farm. Prices increase.
Stable prices of outputs/commodities.	Planning possible. Sustained practices.	Area expansion sustained at a predictable level.
	New investors	
Increased prices of all commodities.[29]	Market orientated farmers and mechanized farming increases.	Rapid and widespread area expansion.[30]
Increased prices of some commodities.[31]	Crops switched by large scale farmers[32]	Crop area ratios change; total area *may* remain similar.
	Subsistence farmers with plenty of on-farm stocks	Reduce planted area, increased fallow area.[33]

[27] South Sudan –local areas fluctuate, since peace negotiations began, area increases in each locality are being noted each year as more and more far-fields are being cultivated. Mozambique showed massive increase in planting post civil war. Where law and order breaks down the converse is true.
[28] Eritrea (1996/7-8) increased mechanized farming in western lowlands. This was immediately reversed when war broke out and the security in the area was threatened.
[29] eg when export trade opens.
[30] May be accompanied by land grabs with agro-pastoralists being dispossessed of farm/grazing lands. (Darfur 2000; East Sudan, 1994/5; Somalia 1986)
[31] eg when export trade opens.
[32] North Sudan (2000/1-2002/3) massive changes in rainfed sorghum areas –switch to sesame.
[33] Noted in Mozambique 2006.

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