Module 3: Yield Estimation Using Crop Cuts

1. Justification

Many programs or projects have as one of their key goals to improve agricultural productivity. To do so, it is critical to be able to monitor yields of the crops(s) of interest. Estimation of crop yields in farmer fields has been a major topic of discussion. While knowing the productivity of new or improved crop varieties in farmer fields is important in understanding whether these varieties are more profitable than the local counterparts, it is often very difficult to obtain accurate estimates of crop yields. Scientists have tried several methods of yield estimation. Of these, the two most used methods are crop cuts and farmer recall. Farmer recalls are by far the most frequently used among social scientists who depend on survey data to estimate farmer yields. The method involves asking farmers during a farmer survey to estimate the production and area under the crop in a specified season or year. Yield is then estimated using the ratio of production to area. As the name suggests, the data are usually collected after harvest, leading critics to argue that farmers are often unable to accurately remember production and areas, especially after considerable time has elapsed between harvest and the survey. Consequently some scientists get around this problem by collecting yield data while crop is still in the field, a method known as farmer prediction (Fermont and Benson, 2011). However, studies have shown that both of these approaches can be quite inaccurate.

Consequently, many scientists prefer to use the crop cut method to estimate yield. This method dates back to 1940s and was first used in India but later popularized by FAO (FAO, 1982; Murphy *et al.,* 1991). It involves demarcation of a subplot within the field/plot followed by measurement of production and area under the crop. In some cases, measurement is done on more than one subplot and an average taken. Crop yield is then calculated as total production divided by total harvested area in the crop cut subplot(s). This section offers guidelines on the planning and implementation of a crop-cut aimed at estimating yields in farmers' sweetpotato plots.

The other major approach being used is to obtain yield data from on-farm trials or demonstration plots, where improved clones or varieties are often being compared to dominant local varieties. Typically, these trials or demonstration plots have protocols for how to establish and monitor them, so they should be considered researcher-farmer managed yields to some extent. Detailed on-farm protocols are available for use in obtaining data that can be analyzed by breeders using the Excel-based CloneSelector program.

2. Objectives

The specific objective of this guide is to discuss the use of crop cuts in:

1) Accurate measurement of the productivity of the improved white-, yellow-, and orange-fleshed sweetpotato varieties
2) Interpreting yield data by major agro-ecologies and by gender of the principal sweetpotato producer

The crop cut is intended to provide information on the adjustment factor for farmer management compared to better management under demonstration trials or on-farm trials.

3. Tools

There are several ways of conducting crop cuts. Fermont and Benson (2011) indicate that one can use the quadrant method, random subplot, and subsampling of rows. The quadrant method can be in form of two large quadrants or multiple small quadrants. This guide however recommends a much simpler method of selecting the area to be harvested. That is, on the longest side of the plot, walk half-way down. To get the distance to the other side of the plot at that point, walk 1/3 of the way in to start the measurement. Then measure 3m x 2m and stake out the area with 4 big sticks. The staking of the area to be harvested for yield estimation should be done at planting or early in the season to avoid loss of some of the roots through piecemeal harvesting. The staked out area should have approximately 20 plants, assuming a spacing of 30 cm x 90 cm.

It is recommended that the project plans to conduct at least 8 crop cuts per variety of interest in each of the major agro-ecological zones. This will allow the collection of data from, at least, 6 crop cuts assuming that two of the selected fields/plots might be lost to pest, diseases, animal invasion or theft. For the purposes of gender equity, 4 out of the 8 crop cuts should be conducted in plots managed by female farmers, unless no women are involved in agriculture in a particular area.

Sampling: It is important that the farmers selected for the crop cut are representative of the other sweetpotato farmers in the targeted areas. Since most of the current sweetpotato projects in SSA are targeting households with children under 5 years of age, at least half of the farm households that meet this eligibility criteria should form the population from which to sample the participants of the crop cut activity. In order to give all the eligible households in the study area an equal chance of participating in the crop cut, it is recommended that the participants are randomly sampled. First, villages should be randomly selected from each of the major agro-ecological zone (AEZ). Next, 3-4 households that meet the eligibility criteria should be randomly sampled from the list used for vine distribution, in the case of mass distribution. Where a different method of vine dissemination is used, this list can be compiled with the help of community health workers, promoters or local implementing partners. In order to ensure equitable representation of female sweetpotato growers in each village, it is recommended that sampling of the participants in the crop cut be stratified by the gender, which requires that in compiling the sampling frame, separate lists should be made for female and male sweetpotato farmers.

Frequency of visits by the person collecting data. The person collecting data should plan to make at least 3 visits during the planning and implementation of the crop cuts:

1) For identification: This visit can be combined with the vine distribution visit to the village. It is used to identify the participating farmers whose fields will be part of the crop cut exercise.

2) Monitoring visit: This visit should be made approximately 1.5 months after planting. It should be used to verify that the sweetpotato variety being promoted was planted by the farmer, and ensure that the area to be harvested is marked and the field owner agrees to harvest it only when the data collector is present.
3) Harvest: The date for this visit should be set relative to the expected harvest date. During this visit, the staked area is harvested and essential data collected.

Data collection. The following data should be collected during the monitoring (*) or the harvest (+) visit using an ODK module:

Farmer identification and practices

1. Location, Name of Major Sweetpotato Farmer, Gender, Plot Number, and Household Identification *+
2. Number of varieties planted for a crop cut on the farmer's land *+
   For each variety on farm:
3. Name of variety planted (use code list; other specify to type in if not on list) *+
4. Location: a) Lowland b) Upland c) Highland (>1500 m) *
5. Slope: a) Flat b) Very gentle c) Gentle d) Steep *
6. Description of agro-ecological zone*
7. Date of planting*
8. Source of planting material*: 1) Own field 2) Nearby farmer 3) Farmer far away 4) Specialized vine multiplier 5) Extension agent-Government 6) Extension agent-NGO 7) Research Center 8) Market 9) NGO 10) This project 11) Other, specify
9. *If own field (1)*: How many seasons have you reused the vines for this variety?*
10. *If not from own field*: Did the vines come with a label?*
11. Was sweetpotato on this plot last season/year?*
12. Was manure/compost applied on this field last season/year?*
13. Was manure/compost applied on this field before planting?*
14. Was inorganic fertilizer applied on this field last season/year?*
15. Was spray used to control pest problem?*+
16. How many times has the plot been weeded since planting? *+

Plant density

17. Sweetpotato planting in: a) ridges b) mounds c) flat*
19. Total number of plants that have established*
20. Distance between plants (within same row or on mound) in centimeters*
21. Distance between rows/mounts in centimeters*
22. Distance from homestead: a) <500 m b) 500- 1 km c) 1.1-3 kms d) >3 kms*
23. Soil type: a) Very sandy b) sandy c) sandy-loam d) light clay e) heavy clay f) Other*

Harvest Visit

24. Number of varieties for harvesting on the farm+
25. Date of harvest+
26. Was plot: a) No b) By watering can c) Drip irrigation 4) With other equipment+

27. Was any manure/compost applied after planting? +
28. Was any inorganic fertilizer applied after planting? +
29. *If so:* Kind of inorganic fertilizer applied: _____ +
30. *If so:* Amount of inorganic fertilizer applied: _____+
31. How many times was the plot weeded since planting?+
32. Was spray used to control pest problem since planting?+
33. Total number of plants in plot to be harvested+
34. Number of commercial roots+
35. Weight (kgs) of commercial roots+
36. Number of roots with weevil or rot damage+
37. Weight of roots (kgs) with weevil or rot damage+
38. Number of other non-commercial roots+
39. Weight (kgs) of other non-commercial roots+
40. Weight (kgs) of vines+

4. Analysis

a. Determination of average root yield in tons/hectare

For each site per variety:
Total root weight (tons) = (commercial + non-commercial weight in kgs)/1000 kgs
Area estimation (hectares)= 0.0006 hectares (10,000 sq meters=1 hectare)

Sum up all the yields/site/variety and take the average.

b. Determination of average foliage (stems + leaves) yield in tons/hectare

For each site per variety:
Total foliage weight (tons) = (foliage weight in kgs)/1000 kgs
Area estimation (hectares)= 0.0006 hectares (10,000 sq meters=1 hectare)

Sum up all the yields/site/variety and take the average.

c. % of root yield that is commercial: kgs of commercial roots/(kgs of commercial + non-commercial roots) X 100

d. Alternative root yield determination (tons/hectare)

1) Calculate the kgs roots produced/plant harvested: total roots and commercial only
2) Determine the planting density per hectare:
Number of plants ESTABLISHED X 1666.67
3) Multiply kgs/plant X planting density per hectare divided by 1000 kgs/ton

e) Compare two methods for root yield determination and decide whether to take an average of the two methods or rely on one of the two methods

f) Compare yields between agro-ecologies and yields by gender of farmer across all agro-ecologies

g) *If have sufficient cases of fertilized plots:* Compare yields within the same variety on fertilized versus unfertilized plots

h) Compare yields from crop-cut method to yields from harvesting on-farm trials or demonstration plots (if applicable)

i) Calculate the harvest index for each variety: weight of roots/(weight of roots + weight of the foliage)

5. References

Fermont, A., & Benson, T. 2011. Estimating yield of food crops grown by smallholder farmers. *International Food Policy Research Institute, Washington DC*, 1-68.

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