Sub Regional Training Course on Sampling Methods for Producing Core Data Items for Agricultural and Rural Statistics

Module 3: Sampling Methods for Crop-Cutting Surveys

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Contents

Introduction

- Development of the agricultural sector is a pre-requisite for improving the socio-economic condition of people, especially in rural areas
- Adequate information on rural and agricultural sector is crucial for the planning of economic development initiatives, allocation of resources and monitoring the achievements
- Agricultural Statistics has great importance for the planners
- Crop Area and Crop Production are the backbone of any agricultural statistics system

Introduction

- Besides information on the structure of agriculture, which changes less rapidly than the other aspects of agriculture,
- Annual information on crop production of agricultural commodities is important not only for preparation of national accounts as well as decision making on import/export, price but also for day-to-day management of the crop sector which is subjected to the vagaries of the weather

Introduction

- Generally crop statistics published by Department of Agriculture are based on data collected biannually from individual farming households by extension staff using the farmer recall method, with a recall period of six months
- High degree of non-response, memory lapses, subjectivity is encountered
- The data collection work is entrusted to extension staff in the Ministry who are burdened with multifarious activities

Agricultural Surveys

Agricultural Surveys

- Agricultural Statistics
  - Stock of Resources
    - Number of holdings
    - Operational area & arable land
      - Irrigated & unirrigated
    - Land use
    - Machinery & equipment
    - Agricultural workers etc.
  - Agricultural Production
    - Qnty. & value of produce
    - Qnty. & value of inputs
    - Sale of produce
    - Labour inputs
    - Exports and imports
    - Consumption etc.

Agricultural Surveys

Collection of Agricultural Statistics

- Stock of resources data
  - These do not change rapidly and usually follow a secular trend with hardly any annual fluctuations
  - Mostly collected in Agricultural Census
  - Considered as baseline data
- Data on Agricultural Production
  - These are subject to annual and seasonal fluctuations
  - Thus these are collected more frequently – annually and for different seasons
  - Most of these are collected thru' *Agricultural Surveys*.

Agricultural Surveys on Crop Production

Types of production surveys

- Thru' mailed questionnaires
- Field surveys – interview based and by objective measurements
- Detailed survey like farm management studies

The ***crop cutting surveys*** are field surveys in which production data are collected thru' direct measurement.

Important Definitions

Relating to Pieces of land

- **Holding:** An economic unit under a single management for agricultural production.

In most of the developing countries, agricultural activities are carried out by individual households operating small holdings.

- **Field:** A **field**, for the purpose of the survey, is a distinct piece of land growing the crop under study. It is clearly demarcated on all its sides, either by bunds or by patch of other crops or left un-cultivated.
- **Experimental plots:** are randomly selected plots which are demarcated by following a specified procedure in which crop-cutting experiments are to be conducted.

Crop-Cutting Surveys (CCS)

Crop Cutting Experiments

- Crop cutting is a widely used technique around the globe for estimating yield of paddy, wheat and other major field crops
- It is a technique of selecting a plot randomly of a given size in the field of a specified crop and harvesting its produce by following specified methodology
- The crop cut is a physical act of harvesting mature crop from the selected plot (called crop-cutting plot) of a specified area created within a crop field in order to estimate its yield
- The harvested yield rate is calculated as the weight of the harvested crop divided by the area of the plot
- The technique was developed in India in 1940s and 1950s.

Steps involves in Crop-cut operation

- Selecting a field of mature crop ready for harvest
- Identifying the South-West corner of field from where crop cut has to be done
- Randomly demarcating the crop-cutting plot of a specified size
- Meticulously determining the plants to be included in the crop-cut plot
- Harvesting of crop cut plot
- Threshing and Winnowing to get cleaned harvest
- Weighing and adjusting the harvest to a specified level of moisture content
- Converting the harvest to a standard unit, for example, ton per hectare

Crop Cutting Surveys: Objectives

The Crop Estimation Survey conducted through crop cutting experiments are to obtain the following estimates :-

- Average yield per hectare of the crop at the block, district and state level.
- Production of the crop at the block, district and state level.
- Productivity of certain variety of the particular crop at the block, district and state level.
- To study the productivity of the crop grown under different cultural practices.

Crop Cutting Surveys: Sampling Design

The design adopted in the survey is Stratified multi-stage random sampling

- Community & Rural Development Blocks are taken as strata
- The notified census villages are the first stage units and
- The fields growing the crop under crop cutting experiments are the second stage units and
- The experimental plots of specified size are the ultimate stage units.

Sample Selection: *Selection of villages*

- In the strata, collect the list of all villages with area growing the experimental crop
- Let us assume that there are 30 villages in a CD out of which 5 villages have to be selected by SRS.
- Since 30 is a two digit number we have to refer to two digit random number table
- Any column of two digit random number table can be used for selection of sample
- Consider the 1st column of two digit random number table.
- First two random numbers in column 1 will be reject as these are larger than 30. The first random number selected is 30.
- The other four random numbers are 11, 06, 16, and 13.
- In case, in the process of selection, a column is exhausted then next column in the right may be used and so on.

Sample Selection: *Selection of fields*

- The first operation of the Field Assistant is to proceed to the selected village.
- All the cultivators in the village are to be listed and the serial number of the field is to be noted for the selection procedure.
- Assigned a random number for selection of field, then
- The highest field number in the village may be higher, equal to or less than the random number assigned.
- In case the selected random number is equal to or less than the highest field number, then the field number corresponding to the random number is selected.

Sample Selection: *Selection of fields*

- When the assigned random number is higher than the highest serially numbered field, then the random number is divided by the highest serially numbered field and
- the field number corresponding to the remainder is selected.
- In case the remainder is '0' then the highest serially numbered field is selected
- The assigned random number is 140 for the field selection and the
- The highest serial number of the field is 60 (say).
- Divide 140 by 60, we get a remainder of 20 which gives that the first experimental plot will be the field serial No.20.

Sample Selection: selected field: Conditions

- The area of the selected field should be more than the total area of CCE plots
- The experimental crop in the field is not meant for seed production or demonstration, and
- If (a) the experimental crop is not germinated or has failed (b) the field growing the experimental crop is grazed by cattle or damaged partially or completely by animals, or (c) the experimental crop is affected by pests / diseases / heavy rainfall / inadequate rainfall, in these circumstances the fields should be considered for selection.
- In no case field be substituted if it is found that crop growth is poor in the selected field.
- The enumerators are expected to be vigilant so as to avoid a situation of prior harvest by cultivators without intimation or late visit by primary worker.
- The crop cutting experiment should not be conducted in the selected field if a part or whole of the selected field has already been harvested.

Locating and marking of experimental plot:

Identification of south-west corner of the field:

- After selection of the field, the south-west corner of the field is to be identified.
- It is advisable to identified the south-west corner of the field so as to maintain uniformity in the conduct of crop cutting experiments.
- For identification of south-west corner a person should stand facing North. Then the South-West corner is one where the selected field is in the front and to the right hand side.

Locating of experimental plot:

- Start from the South-West corner of the field and measure in steps the length and breadth of the field.
- From the total number of steps of both length and breadth, deduct seven steps from each and we obtain the remainder.
- Select two random numbers. The first one should be the first number of the column not greater than the remainder for length and
- the second not greater than the remainder for breadth.
- The pair of random numbers so selected will determine the South-West corner of the experimental plot.

Locating of experimental plot:

- For example, if the length is 86 steps the remainder obtained is 86 – 7 = 79 and if the breadth is 45 steps the remainder is 45 – 7= 38.
- Select two random numbers one for length(<79) and other for breadth (<38)
- Let the pair of random number selected is 64 and 23.
- To locate the South West corner of the experimental plot by means of the selected pairs of random numbers say (64,23),
- Walk from the starting point of the field along its length and stop at a distance of 64 steps.
- From this point start walking perpendicular to the length inside the field and stop at a distance of 23 steps.
- Fix a peg at that point, say peg No. l. Do the measurement of as per prescribed size of plot

Harvesting grains in the selected Plot:

- Harvesting is to be done when the crop is fully matured and when the cultivators will normally harvest the crop.
- The date of harvesting is to be fixed by the Field Assistant in consultation with the cultivators concerned
- Produce from the three plots be harvested before harvest of the entire field.
- Before harvesting of produce it is important to determine which plants lying on the border are to be included/excluded.

Next Steps:

Threshing, winnowing , weighing of the harvested produce and recording of green/fresh produce

Driage experiments are performed to get marketable form of produce from cultivating fields.

The technique consists of drying a fixed quantity of harvested produce (generally 1 kg) in the experimental plot by keeping the produce for a few days for drying and weighing the produce everyday till the weightings on two successive days reveal 'no' or 'negligible' reduction in weight.

Alternatively, the weight of marketable produce of crop may be obtained by applying the moisture level recorded with the help of moisture meter to the normal level of moisture of the produce as per the formula stated below:

* FW = Fresh Weight
* MCG % = Moisture Content of grain when fresh (say 20%)
* WG14% = Weight of Grain adjusted to 14% Moisture Content
* WG14% = FW x (100 - MCG) / (100 -14) = FW x (100 - 20) / (100 -14)

KITS FOR CROP CUTTING EXPERIMENT:

The following are the essential equipments

- A Measuring tape of 30 meters length.
- A set of scales and standards weights up to the smallest units or a spring balance
- Small gunny bags for driage experiment
- Hessian Cloth
- Four straight, long bamboo pegs each of 1 meter length with spiked at one end and iron collars at the other end.
- A set of instruction table, schedules and the stationeries.

Crop Cutting Surveys: issues involved

The techniques of crop cutting vary greatly in different parts of the world.

The techniques used are dependent upon a number of factors.

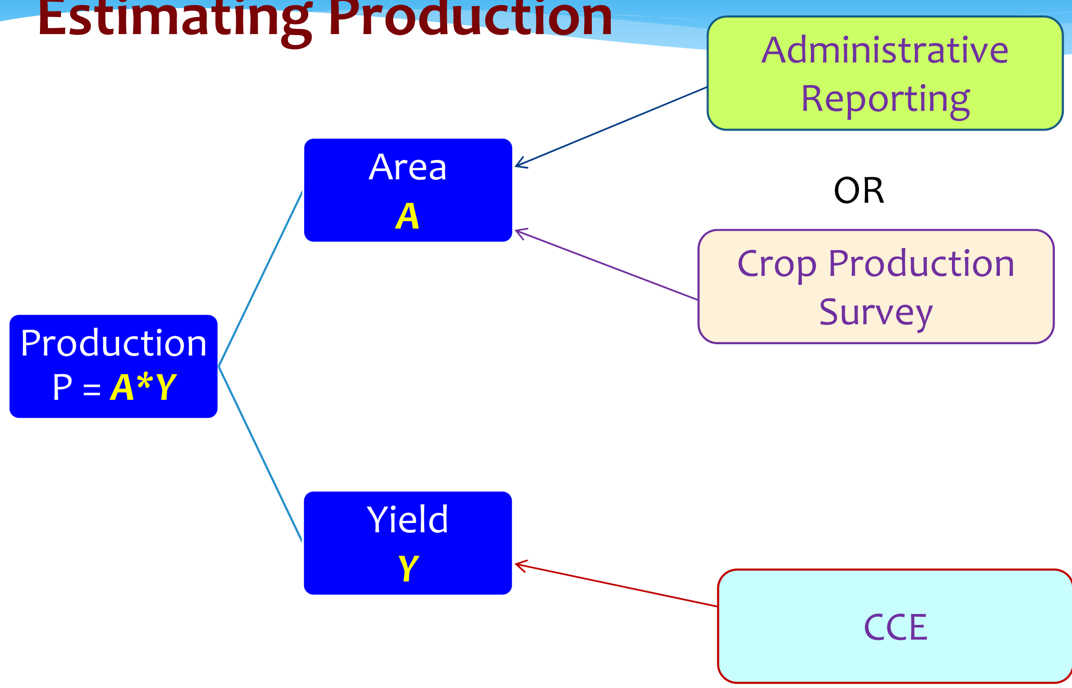
- the administrative setup, type and size of field staff, farmer cooperation, crop practices, and harvest conditions.

- Shape of the experimental plot
  - triangular or circular or rectangular?
- Size of the experimental plot
  - Involves a trade-off between accuracy and ease of operation
- Number of plots per field and field per village

It is not possible (nor desirable) to lay down a single uniform approach for crop-cutting surveys.

Agricultural Surveys

Estimating Production



Estimation

Procedure I

* In countries with regular agricultural reporting system, crop area ***A*** is obtained from the records on complete enumeration basis.
* Average Crop yield ***Y*** is estimated by CCE on a sample basis.
* Crop production, ***P***, is estimated as a product of area and yield estimates. That is

$$P = A * Y$$

Estimation

Procedure II

* In countries where there are cadastral maps available but no regular reporting system, both ***A*** and ***Y*** are estimated on the basis of sample surveys.
* Usually, a large sample of villages (primary units) is selected for crop area enumeration. This provides estimate of ***A***.
* CCE are carried out in a sub-sample of the primary units selected for area enumeration. This provides the estimate of ***Y***.
* Estimate of production is obtained in the same way as in the case regular reporting system.

Estimating Yield – CCS

- Stratified multi-stage random sampling design
- Typically, stratification is done at a District level.
- From each stratum

FSU

Villages — by SRS / PPS systematic

SSU

Field / Holdings — by SRSWOR / Systematic

USU

Experimental plot — selection

Estimating Yield

For a district:

- Number of stratum (*s*): S
- Area under the crop in the s^{th} stratum: a_s
- Number of villages (*i*): n_s
  selected by SRS
- Number of field (*j*) in the i^{th} village: n_{si}
  selected by SRS
- Experimental plot selected

Estimating Yield

If y_{sij} be the observed yield from the selected plot of the j^{th} field of the i^{th} village f the s^{th} stratum, then

Estimated average of *green yield* for the s^{th} stratum is:

$$\hat{\hat{Y}}_s^{\,g} = \frac{1}{n_s}\sum_{i=1}^{n_s}\frac{1}{n_{si}}\sum_{j=1}^{n_{si}} y_{sij}$$

Estimate of district level average yield of the *dry marketable produce* per hectare is given by

$$\hat{\hat{Y}}^m = d.f.\frac{\sum_{s=1}^{S} a_s \hat{\hat{Y}}_s^{\,g}}{\sum_{s=1}^{S} a_s}$$

where

d: driage ratio

f: conversion factor for green yield to dry marketable produce per hectare. i.g. Rice=2/3*Paddy

THANKS