Palay Production Survey

Sampling Methodology

1   Sampling Frame

The 1991 Census of Agriculture and Fisheries (CAF) provides the basis for the sampling frame for the Palay Production Survey (PPS). With the exception of Isabela, Laguna and Bukidnon where the traditional complete enumeration strategy was employed, the 1991 CAF used sampling techniques for selecting the primary sampling units – the barangays.

The largest barangay in a municipality was taken with certainty while a one in two sampling rate was used in selecting the remaining barangays in the municipality. This scheme effectively resulted in the generation of two subuniverses: a subuniverse of barangays with probability of selection equal to 1.0 and another subuniverse of barangays with probability of selection equal to 0.5.

This characteristic of the 1991 CAF is taken into account in the sampling design for the BAS Palay Production Survey.

2   Sampling Design

The domain of the survey is the province. A two-stage stratified sampling design is used. The primary sampling unit (PSU) is the barangay which is selected using probability proportional to size (PPS) sampling. The farming household, systematically selected, serves as the secondary sampling unit (SSU). Moreover, to provide ease and flexibility in estimation, rotation of samples, etc., a replicated sampling design is instituted. The complete design includes four (4) independent sets of sample replicates (Figure 1).
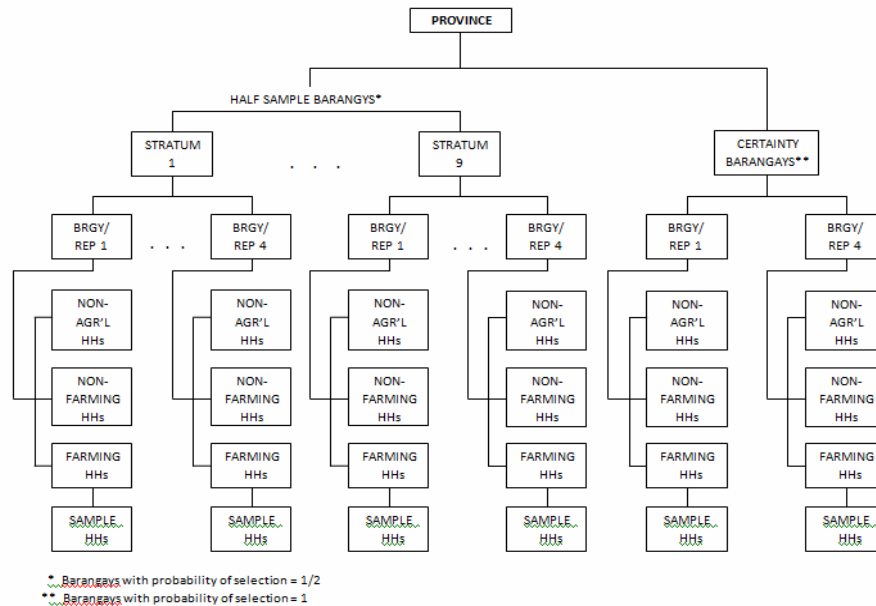
2.1 First Stage (Primary) Sampling Unit Selection

A general feature of the sampling design used for the survey is the division of primary sampling units into strata of approximately equal sizes relative to total farm area devoted to palay. Considering, however, that the 1991 CAF effectively curved out two subuniverses, the division of the barangays within the province was effected as follows:

All barangays with probability of selection equal to 1.0 (certainty barangays) were first lumped into one stratum (generally, it is the 10th stratum). The remaining barangays (those with probability of selection equal to 0.5) were then divided into nine strata such that the aggregate palay farm area of all the barangays constituting anyone stratum was approximately of the same magnitude with the rest of the individual strata. To compensate for the unlisted barangays in the 1991 CAF and to have an estimate of the palay farm area in the province, this aggregate area was doubled for provinces with

half-listed strata. Using the estimated area to devoted to palay as the estimated size of the barangay, a PPS sample of four (4) independent barangays were selected from each stratum. Each sample barangay represents the ith replicate sample for that stratum.

Figure 1. Schematic Diagram of the sampling Design for the Palay Production Survey

2.2 Second Stage (Secondary) Sampling Unit Selection

Households in each sample barangay were categorized as either farming or non-farming based on the following definitions:

Household – a person or a group of person who sleep under the same dwelling unit and usually have a common arrangement in the preparation and consumption of food. The household members may not necessarily be related by ties of kinship, although they are usually relatives. In some instances, more than one household may occupy the same dwelling unit

Farming household – any household in which a member operates an agricultural land, either solely or jointly with other members, and the aggregate area operated by the operator-members of such household qualifies to be called a farm

Non-farming household – any household in which a member operates an agricultural land, either solely or jointly with other members, and the aggregate area operated by the operator-members of such household does not qualify as a farm

Non-agricultural household – any household in which none of the members operates an agricultural land

Operator – a person who takes the technical, financial and administrative responsibility in managing the farm, including the management and supervision of hired labor;   he may work on the land himself or may employ others to work on the land. He may or may not be the owner of the land

Farm – a parcel or parcels of land which has a total land area of at least 1,000 square meters (one-tenth of a hectare) used for agricultural purposes

Parcel – a piece of agricultural land which meets any of the following characteristics arranged in order of importance:

   a) Contiguous area with natural boundaries;

   b) Under only one tenurial status; and

   c) Regarded as such by the farmer

For this survey, selection of sample households has been limited to the group categorized as farming households. The number of sample households drawn for each sample barangay varied. The size of sample households was determined using the general formula:

$$n_{khi} = \frac{1}{b_h} \cdot \frac{P_{kh}}{P_{khi}} \cdot \frac{N_{khi}}{R_k}$$

where:

n_{khi} = number of sample farming households in the ith sample barangay in the hth stratum;

N_{khi} = total number of farming households in the i^{h} sample barangay in the hth stratum

R_k = uniform raising (expansion) factor used for the kth province

b_h = number of sample barangays in the hth stratum (=4)

P_{khi} = palay area of the ith sample barangay in the hth stratum

P_{kh} = aggregate palay area in the hth stratum

This will result in a self-weighted sampling scheme that will facilitate estimation of the survey characteristics.

The uniform expansion factor R_k for the kth province used in determining n_{khi} is:

$$R_{k \text{ (rounded off to the lower 50)}} = \frac{1}{\overline{b}_k} \cdot \frac{\overline{P}_{k.}}{\overline{P}_{k..}} \cdot \frac{\overline{N}_{k..}}{\overline{n}_{k..}}$$

Where:

$\overline{b}_k =$ average number of sample barangays per stratum (=4)

$\overline{P}_{k.} =$ average total area planted to palay per stratum, or

$=$ $\dfrac{total\ area\ planted\ to\ corn\ for\ the\ H_k\ strata}{H_k\ strata}$

where H_k is the total number of strata in the kth province

$\overline{P}_{k..} =$ average total area planted to palay per barangay

$\overline{N}_{k..} =$ average number of farming households per barangay

$\overline{n}_{k..} =$ average number of sample farming households per barangay (=10)

For economic reasons, sample size at the SSU level was set to a minimum of 4 and a maximum of 25 households. To correct for this limitation of the design, the use of the so-called household weights was instituted. The uniform household weight for the ith barangay, W_{khi} , was computed as follows:

$W_{khi} = 1.00$ if $4 \leq n_{khi} \leq 25$;

$W_{khi} = \dfrac{n_{khi}}{4}$ if $n_{khi} < 4$;

$W_{khi} = \dfrac{4}{n_{khi}}$ if $n_{khi} > 25$;

$W_{khi} = \dfrac{n_{khi}}{N_{khi}}$ if $n_{khi} > 25$ and $n_{khi} > N_{khi}$.

Replace the barangay if none of the above conditions is met.

3   Estimation Procedure

3.1   Stratum Estimates

Each replicate (represented by the sample psu) in a stratum will yield an independent estimate for the stratum. Hence, there will be four (4) independent

estimates and the mean of these four (4) estimates will be the unbiased estimate for the stratum.

For the hth stratum of the kth province, the independent estimate of total from the ith psu is obtained from the equation

$$x'_{khi} = \frac{P_{kh}}{P_{khi}} \cdot \frac{N_{khi}}{n_{khi}} \cdot W_{khi} \cdot \sum_{j=1}^{N_{khi}} x_{khij}$$

$$= b_h \cdot R_k \cdot x_{hi}$$

$$= 4 \cdot R_k \cdot x_{hi}$$

where:

x_{khij} = value obtained from the jth sample farm household of the ith barangay in the hth stratum of the kth province;

x_{khi} = weighted total for the ith barangay

$$= W_{khi} \cdot \sum_{j=1}^{N_{khi}} x_{khij}$$

and

W_{khi}, n_{khi}, N_{khi}, P_{kh} and P_{khi} are the ones defined in the sampling design.

The unbiased estimate of total for the hth stratum is simply the mean of the four (4) independent estimates, that is,

$$x'_{kh} = \frac{1}{b_h} \cdot \sum_{i=1}^{b_k} x'_{khi}$$

$$= R_k \cdot x_h,$$

Where x_h is the weighted total for the hth stratum. The variance of x'_{kh} is given by

$$v(x'_{kh}) = \frac{\sum_{i=1}^{b_k} \left(x'_{khi} - x'_{kh} \right)^2}{b_h(b_h - 1)}$$

3.2 Provincial Estimates

Estimates of total for the province are obtained simply by aggregating all the stratum estimates in the province. Hence, the estimate of total for the kth province is given by

$$X'_k = \sum_{h=1}^{H_k} X'_h$$

where H_k is the total number of strata in the kth province (domain), and its variance is estimated by the sum of the stratum variances, that is,

$$V(X'_k) = \sum_{h=1}^{H_k} V(X'_{kh})$$

3.3 Regional and National Estimates

Estimates of total for the region and for the whole country, together with their respective variances, are obtained in the same manner as those for the province, that is, by aggregating relevant stratum estimates. These may also be obtained by aggregating relevant provincial estimates (for the region) and aggregating relevant provincial estimates (for the whole country).