(A) Sampling Design

3.1 Land Record States

3.1.1 In States where comprehensive land records exist, data on number and area of operational holdings according to different size-classes, social groups, types of holdings and gender of operational holder, is collected and compiled on complete enumeration basis through retabulation of information available in the Village Land Records. This implies covering all survey numbers within each village and preparing a list of ‘Operational Holdings’ therefrom. An operational holding is the basic unit of enumeration. The holding of the actual cultivator and not the owner is the unit for collection of data. Some holdings may not be located completely within the village and these may be spread over to other villages. For preparation of a list of operational holdings, necessary matching of the part-holdings scattered over more than one village has to be done. A holding may cut across boundary of a village/Patwari circle/Revenue Inspector Circle/Tehsil/District/State. A Tehsil is the outer limit for pooling of all the parcels of an operational holding. If a holding is spread over more than one Tehsil, that part of the holding which is lying outside the Tehsil of residence of operational holder is treated as a separate operational holding.

3.1.2 For the purpose of pooling of part holdings, the criterion adopted is the residence of the operational holder, but this is applicable to only those persons who are residing within the Tehsil. If operator is residing outside the Tehsil then, for the purpose of the Census, he is considered as resident operator of the village where his holding is located, and his holding in the village is treated as a separate operational holding. Necessary pooling of the part holdings has been done before preparation of Table-1 giving number of holdings and area operated for all the villages in the stratum.

3.1.3 For collection of detailed data, viz. (i) distribution of holdings according to the tenancy status; (ii) area under different land uses; (iii) distribution of holdings according to irrigation status; (iv) area irrigated source-wise and (v) area under principal crops, 20 percent of the villages selected randomly constituted the base. These 20 percent villages were those selected for Timely Reporting Scheme (TRS) for the reference year of Agriculture Census. In
these 20 percent villages, information relating to the above characteristics is compiled from the basic village land records, viz., Khatauni and Khasra in respect of all the resident cultivators. Resident cultivators of urban areas are also covered.

3.1.4 On the basis of the data obtained from 20 percent of the villages, tables are generated at the Taluk/District/State levels after adopting suitable estimation procedure as applicable in the case of Land Record States.

3.1.5 All the data is compiled separately for the operational holdings of the four groups, viz., Scheduled Castes, Scheduled Tribes, Others, Institutional and also the Total of all these groups. However, Table-1 is prepared gender-wise also.

3.2 Non-Land Record States

3.2.1 A stratified two stage sampling design is adopted for Agriculture Census in the Non-Land record States. In view of increasing demand of Agriculture Census data at Block Level, it has been decided that the Community Development Block or some other similar homogenous administrative unit should be taken as the stratum. The first stage unit within the stratum is the village and the second stage unit is the operational holding. In the States where geographical dispersion of the village is not much, at least 20% of the villages are selected by simple random sampling method from each stratum. These sample villages include all villages selected under the scheme for Establishment of an Agency for Reporting Agricultural Statistics (EARAS). In States where less than 20 percent villages are selected for EARAS, additional villages are selected using random sampling to bring up the percentage of selected villages in each stratum to recommended 20 percent. For example, if only 15 percent villages have been selected for EARAS, additional 5 percent villages in each stratum are selected and added to the list of EARAS villages, to get the list of villages where Agriculture Census has been conducted.

3.2.2 In case of all holdings other than institutional holdings, the second stage sampling is to be done in the States for canvassing Holding Schedule (H).

3.2.3 All the institutional holdings in the selected village are included in the sample for filling Holding Schedule (H).

3.2.4 For adoption of common software for tabulation, it is necessary that all the Non-Land record States follow the above sampling design. However, variations in the size of the sample at the two stages may be warranted to suit the pattern of distribution of holdings and/or villages.
in the States as also to ensure the presence of adequate number of units of each type in the sample.

3.2.5 The sampling of operational holdings is done separately for Scheduled Castes/Scheduled Tribes/Others categories of operational holders as estimates are to be worked out separately for each of these categories.

(B) Estimation Procedure

3.3 For States adopting Stratified Unistage sampling design (Land Record States)

3.3.1 The estimation procedure for population totals and their sampling errors at Taluk as well as District level in respect of specified characteristics relating to number of operational holdings and the operated area in respect of States having comprehensive Land Records is given below:

The estimate used is “Ratio Estimate in Simple Random Sampling”.

a. Let M - be the number of Taluks in a district.
b. $Y_{ij}$ - Value of characteristic in the $j^{th}$ village of $i^{th}$ Taluk in a particular size class (say $k^{th}$ size class)
c. $X_{ij}$ - Total number of operational holdings/total operated area in the $j^{th}$ village of $i^{th}$ Taluk in a particular size class (whichever is applicable)
d. $N_{i(k)}$ - total No. of villages in the $i^{th}$ Taluk, each village having at least one holding in $k^{th}$ size class
e. $n_{ik}$ - Number of selected villages in $i^{th}$ Taluk, each village having at least one holding in the $k^{th}$ size class.
f. $R_i(k)$ - Ratio of sample total of $Y_{ij}$ to that of $X_{ij}$ in the $i^{th}$ Taluk.
g. $X_{i(k)}$ - Total number of operational holdings/Total operated area in the $i^{th}$ Taluk for $k^{th}$ size class (whichever is applicable) based on complete enumeration.
h. $\hat{Y}_{i(k)}$ - The estimate of characteristic under study for $i^{th}$ Taluk for $k^{th}$ size class.
i. $Y_{D}(k)$ - The estimate of characteristic under study for the district for $k^{th}$ size class.

Note:- Taluk and Tehsil are synonymous terms. Where Revenue Inspector Circle are strata, the unit would be Revenue Inspector Circle in place of Taluk.

The estimate of characteristic under study for $i^{th}$ Taluk for $k^{th}$ size class viz. $\hat{Y}_{i(k)}$ is given by
\( y^\wedge_i(k) = \frac{\sum_{j=1}^{n_i(k)} y_{ij}}{\sum_{j=1}^{n_i(k)} x_{ij}} \cdot x^\wedge_i(k) = R_i(k) \cdot x^\wedge_i(k) \)

The estimate of characteristic under study for the district for \( k \)th size class viz. \( Y_D(k) \) is given by

\[
\hat{y}_D(k) = \sum_{i=1}^{M} \left[ \frac{n_i(k)}{\sum_{j=1}^{n_i(k)} x_{ij}} \right] \cdot x^\wedge_i(k) = \sum_{i=1}^{M} R_i(k) \cdot x^\wedge_i(k) = \sum_{i=1}^{M} \hat{y}_2(k)
\]

The estimate of variance of \( y_i(k) \) is given by:

\[
\hat{\sigma}^2(y_i(k)) = \frac{N_i(k)[N_i(k)-n_i(k)]}{n_i(k)[n_i(k)-1]} \sum_{j=1}^{n_i(k)} (y_{ij} - R_i(k) \cdot y_j)^2
\]

The estimate of variance of \( Y_D(k) \) is given by:

\[
\hat{\sigma}^2(y_D(k)) = \sum_{i=1}^{M} \frac{N_i(k)[N_i(k)-n_i(k)]}{n_i(k)[n_i(k)-1]} \sum_{j=1}^{n_i(k)} (y_{ij} - R_i(k) \cdot y_j)^2
\]

The percentage standard error of the estimate is given by:

\[
\%S.E.\left(\hat{y}_D(k)\right) = \frac{\sqrt{\hat{\sigma}^2(y_D(k))}}{y_D(k)} \times 100.
\]

3.3.2 For States adopting stratified two stage sampling design with systematic sampling at the second stage.

3.3.3 The estimation procedure for estimating the population totals and their sampling errors with regard to specific characteristics relating to number of operational holding and operated area in respect of the above Non-Land record states is given below:
The estimate used is “Simple Mean”.

1. Let $M_i$ be the number of Taluks in a district.
2. $Y_{ijp}(k)$ Value of characteristics in $p^{th}$ holding of $j^{th}$ village of the $i^{th}$ Taluk in $k^{th}$ size class.
3. $N_i$ Total number of villages in the $i^{th}$ Taluk.
4. $n_i$ Number of sampled villages in the $i^{th}$ Taluk.
5. $N_{i(k)}$ Total number of villages in the $i^{th}$ Taluk, each having at least one holding in $k^{th}$ size class.
6. $n_{i(k)}$ Number of selected villages in the $i^{th}$ Taluk, each having at least one holding in $k^{th}$ size class.
7. $N_{ij}(k)$ Number of holdings in the $j^{th}$ selected village of the $i^{th}$ Taluk in $k^{th}$ size class.
8. $n_{ij(k)}$ Number of sampled holdings in the $j^{th}$ selected village of the $i^{th}$ Taluk in $k^{th}$ size class.
9. The estimate of characteristic under study for the $i^{th}$ Taluk in $k^{th}$ size class viz. $Y_i(k)$ is given by:

$$
\hat{Y}_i(k) = \frac{\sum_{u=1}^{N_i} \frac{n_{ij(k)}}{n_i} \sum_{p=1}^{N_{ij}(k)} Y_{ijp}(k)}{\sum_{u=1}^{N_i} \frac{n_{ij(k)}}{n_i}}
$$

10. The estimate of characteristic under study for the district in $k^{th}$ size class.

$$
\hat{Y}_D(k) = \sum_{i=1}^{M} \frac{N_i \sum_{j=1}^{n_{i(k)}} \frac{N_{ij}(k)}{N_i} \sum_{p=1}^{N_{ij}(k)} Y_{ijp}(k)}{\sum_{u=1}^{N_i} \frac{n_{ij(k)}}{n_i}}
$$

The estimate of variance of $\hat{Y}_i(k)$ is given by:

$$
\hat{V}\left(\hat{Y}_i(k)\right) = \frac{N_i^2(k)}{n_i(k)} S_{ni}(k) = \left(\frac{N_i}{n_i}\right)^2 n_i(k) S_{ni}(k) \cdot n_i(k)
$$

where

$$
S_{ni}(k) = \frac{1}{n_i(n_i - 1)} \sum_{j=1}^{n_{i(k)}} \left[ t_{ij}(k) - \frac{n_{i(k)}}{n_i(k)} \sum_{j=1}^{n_{i(k)}} Y_{ijp}(k) \right]^2
$$

and

$$
t_{ij}(k) = \frac{N_{ij}(k)}{n_{ij}(k)} \sum_{p=1}^{n_{ij}(k)} Y_{ijp}(k)
$$
\[
\hat{V}\left(\hat{Y}_D(k)\right) = \sum_{i=1}^{M} \hat{V}\left(\hat{Y}_i(k)\right) = \sum_{i=1}^{M} \left(\frac{N_i}{n_i}\right) n_i(k) S^2_{n_i}(k)
\]

\[
\%S.E.\left(\hat{Y}_D(k)\right) = \left[\frac{\hat{V}\left(\hat{Y}_D(k)\right)}{\hat{Y}_D(k)}\right] \times 100.
\]

3.4 For states adopting stratified unistage sampling design (Non-Land record states)

3.4.1 The estimation procedure for estimating the population totals and their sampling errors at Taluk/Block as well as District level in respect of specified characteristics relating to number of operational holdings and the operated area in respect of the non land record States is given below:

The estimate used is “Simple Mean”.

1. Let \(M\) be the number of Administrative Units/Gram Sevak Circle Blocks/Taluks in a district.
2. \(Y_{ij}(k)\) Value of characteristic in the \(j^{th}\) village of \(i^{th}\) Taluk in a particular size class (say \(k^{th}\) size class).
3. \(N_i\) Total number of villages in \(i^{th}\) Taluk.
4. \(n_i\) Number of selected villages in \(i^{th}\) Taluk.
5. \(n_i(k)\) Number of selected villages in \(i^{th}\) Taluk, each village having at least one holding in \(k^{th}\) size class.
6. \(\hat{Y}_i(k)\) The estimate of characteristic under study for \(i^{th}\) Taluk for \(K^{th}\) size class.
7. \(\hat{Y}_D(k)\) The estimate of characteristic under study for the district for \(K^{th}\) size class.

The estimate of characteristic under study for \(i^{th}\) Taluk/Block for \(K^{th}\) size class viz., \(\hat{Y}_i(k)\) is given by:

\[
\hat{Y}_i(k) = \frac{N_i}{n_i} \sum_{j=1}^{n_i(k)} Y_{ij}(k)
\]

The estimate of characteristic under study for the district for \(k^{th}\) size class viz., \(\hat{Y}_D(k)\) is given by:

\[
\hat{Y}_D(k) = \sum_{i=1}^{M} \frac{N_i}{n_i} \left( \sum_{j=1}^{n_i(k)} Y_{ij}(k) \right)
\]

The estimate of variance of \(\hat{Y}_i(k)\) is given by:
\[ V\left( \hat{Y}_i(k) \right) = \frac{N_i (N_i - n_i) n_i(k)}{n_i(n_i(k) - 1)} \left[ \sum_{j=1}^{n_i(k)} Y_{ij}^2(k) - \frac{\left( \sum_{j=1}^{n_i(k)} Y_{ij}(k) \right)^2}{n_i(k)} \right] \]

\[ V\left( \hat{Y}_D(k) \right) = \sum_{j=1}^{M} \frac{N_i (N_i - n_i) n_i(k)}{n_i(n_i(k) - 1)} \left[ \sum_{j=1}^{n_i(k)} Y_{ij}^2(k) - \frac{\left( \sum_{j=1}^{n_i(k)} Y_{ij}(k) \right)^2}{n_i(k)} \right] \]

The percentage standard error of the estimate is given by:

\[ \%S.E.\left( \hat{Y}_D(k) \right) = \left[ \frac{V\left( \hat{Y}_D(k) \right)}{\hat{Y}_D(k)} \right] \times 100\% \]

(C) Limitations of data

3.5.1 Agriculture Census 2005-06 was not conducted in the States of Bihar, Jharkhand and Maharashtra. Hence, an estimate only for important parameter, viz., number and area of operational holdings has been done for Bihar and Maharashtra.

3.5.2 Agriculture Census 2010-11 has been conducted in all 35 States/UTs.

3.5.3 The comparison of data relating to priority Table-1 providing information on number of holdings and area operated in Agriculture Census 2010-11 has been done based on the data available for 34 States/UTs out of 35 and for other items, like, tenancy, terms of leasing, land use, irrigation, dispersal of holdings and cropping pattern, the data for 32 States/UTs i.e. excluding Bihar, Jharkhand and Maharashtra out of 35, have been taken into account.

3.5.4 There is no data for Jharkhand in the Report for Agriculture Census 2005-06.

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