The Application of Stratified Sampling, Double Sampling and List Sampling in the Investigation of Animal Husbandry in Henan Province, China

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1.Design Requirement

(1) The sample design must meet the needs of economic management at different administrative levels and data supervision from upper administrative level to lower level.
(2) The sample design must satisfy the calculation of the production of pig, cattle, sheep and poultry, the sample design should be representative to the corresponding objectives of the three populations at province, city and county.
(3) The samples of the three levels should be compatible in order to reduce the survey cost and abate the workloads of the lower grades' surveys.

2.Design Techniques and Theory of Sampling Method

2.1 The selection of sample
2.1.1 Sampling method
(1) Within the territory of a county all the agricultural production units which are not farmers' households and farmers' households are as a population. On the basis of the list sampling principle and with an unified standard in the whole province, the population is divided into 100% survey population and sampling population. Some villages are selected from the sampling population and one farm-group is determined from one of the sampled village by balanced systematic cluster sampling method. 100% survey population and sample population are as the population of list sampling at the level of county. The list sampling result is used to estimate the target amount of the sub-population at the level of county.
(2) Within the territory of a city, 100% survey units and the farmers' households which are over the quantitative criteria cutting point in every county are as the 100% survey population of list sampling at city level. All sampled populations from every county consist of the second sampling population of city level. The sample population of city level is selected by the method of balanced systematic cluster sampling. The target amount of the sub-population of city level will be estimated by the results of list sampling.
(3) Within the territory of whole province, 100% survey units and the farmers' households which are over the quantitative criteria cutting point in every county are as 100% survey population of list sampling at province level. All sample populations drawn from every county consist of the second sampling population of provincial level. For the management of samples, all sample populations of some counties are selected by the method of balanced systematic cluster sampling. It consists the second sample population of provincial level. The target amount of provincial population is estimated by the survey results of list sampling.
(4) Based on the design of stratified sampling, every county is as the sampling sub-population at the levels of city and province. The target amount of every county estimated by list sampling is as the county target amount. Every county target amount is added to the city level target of the first phase

sampling. The target amount estimated by the first phase sampling is supervised by the target amount estimated by the second phase sampling at city level.

2.1.2 Accuracy of sampling

The allowed maximum sampling error is controlled within ± 5% in the levels of county, city and province under the probability of 95%.

2.1.3 Calculation of sampling error

Separately calculating the sampling error at levels of county, city and province.

2.1.4 Establishment of sampling frame

Sampling sits are selected and sampling frame is made by the lined relative objectives among which the household average output of pig, cattle, sheep and poultry is as main variable and the number of household which are added up is as assistant variable.

2.1.5 Calculation of necessary sampling number

Based on the characteristics of livestock production, the sampling error of main objective is controlled by ± 3%; the error of other item is by ± 5%. The probability is 95% (i.e. t=1.96). The sampling number at every level is calculated based on above conditions.

2.1.6 Selection method of the sample population for every level

The sampling methods of sample population at every level are all based on the designed sampling frame and necessary sampling number by way of balance systematic sampling with random start.

2.1.7 Representative test

The formula of representative error is

$$\left(\frac{\sum \bar{X}_i / n}{\bar{X}} - 1\right) \times 100\%$$

here, n is the sampled number of village; $\bar{X}_i$ is the sum of household average value of an objective for the selected villages; $\bar{X}$ is the household average of an objective for the whole population.

It is required that the representative error of the household average production of pig, cattle, sheep and poultry is within ± 3%; those of other eight items are within ± 5%. The item which error is over the criteria will be adjusted by error coefficient.

2.2 Based on the real situation of animal husbandry in Henan Province, the criteria of cut point for farmers' household is determined. The database of 100% survey units is set up at the base of the date of agricultural census

2.3 The estimation and summarization of main objectives for animal husbandry

2.3.1 At the level of county and city

The value of every objective for whole animal husbandry contains two parts, one is the calculation of cluster sampling and the other is the value of 100% survey. The sum and estimation formula is:

$$Y = Y_1 + Y_2$$

In which, $Y_1 = \bar{X} \cdot n$ $\quad Y_2 = \sum X_{21} + \sum X_{22}$

here, Y is the value for county or city (the output of pig, cattle, sheep and egg); Y_1 is sampling estimated value for an objective; Y_2 is the value for 100% survey; $\bar{X}$ is the household average value of sampled farm-group; n is total households deducted 100% survey households in a county or city; X_{21} is the objective value of production units which are not households; X_{22} is the value of 100% survey households.

2.3.2 At the level of province

The total amount of an objective for the whole province is estimated by

$$Y = \bar{X} \cdot n + Y_2$$

here, Y is the estimated objective value for whole province; $\bar{X}$ is the household average value of the investigated thirty three counties; n is the household number of whole province deducted by 100% survey household number; Y_2 is the total 100% survey at all level.