

Consideration of statistical accuracy on Master Sample Method

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- Based on the result of agricultural land area sample survey in Khammouane province, Lao PDR-

1. Framework and Framework information in ALIS

(Agricultural Land Information System)

In case of conducting sample survey, it is requested to be prepared a statistical framework (hereinafter referred to as “framework”) which it becomes an overall target of statistical data considering want to get. The framework means the entire class which becomes the source of value and attributes of survey target. For example, the agricultural land area cannot be estimated from a framework of the factory list if you want to estimate the agricultural land area from the sample. Because the framework consisting of factory list has no attributes and values corresponding to the agricultural land. If you want to estimate the agricultural land area, is assumed that agricultural land area will become clear by hearing the owned agricultural land area from farmers or conducting field survey and it is considered that farmers list (list frame) and area map (area frame) would become the framework having the attribute and value which is capable of estimating the agricultural land area.

The information which specifies the sample attribute in the framework is called as framework information. The statistical framework information must be added to the individual samples and this information must be updated if it is needed. As a framework in Khammouane province, Lao PDR, ALIS sets a sample of an Area Mesh 300m × 300m that was created by a Google Map and the framework information is the calculated agricultural land area in each Area Mesh on the Map. The total 18,311 meshes were created as a framework on the agricultural land area estimation process. The additional processing for framework information in ALIS is a processing which the agricultural land area calculate by displaying the each sample of mesh on the PC screen and adding the agricultural land area borderline, therefore, it is requested the considerable labor to add the statistical information for all samples in the framework.

2. Master Sample Method^{note1}

Therefore, ALIS reduces the operation labor of adding framework information using Master Sample Method. As described above, in the agricultural land estimation process in Khammouane province, Lao PDR, was

^{note 1} Japanese statistician, Mr. Kazunari Jinguji proposed this method for the purpose of keeping up statistical accuracy and reducing work effort of adding framework information.

randomly selected 3,383 meshes as the first sample from the framework of agricultural land area of 18,311 meshes, and added the framework information only for the first sample. This process means the replacement of operation procedure from the normal sample estimation procedure which extracting sample after adding the framework information. Since, on the ALIS process, extracts 169 meshes as second sample from first sample which is added framework information, and conduct the field survey only for second sample. In the field survey, check the agricultural land borderline which is added as framework information to the survey sheet, and modify the land borderline in accordance with the present situation in the field. In other words, the replacement of operation procedure of adding the framework information and extraction of first sample will not affect the results of extraction for second sample and field survey^{note2}.

Master Sample Method is a process which adds framework information only for the samples that were extracted firstly from the framework, as well as makes the provisional framework extracting the survey samples as the Master Sample from the sample group, and estimates the entire framework too.

By using Master Sample Method, it is possible while maintaining the statistical accuracy and reduces the huge operation labor on adding framework information. In the agricultural land area estimation process in Khammouane province, the total operation work^{note3} of adding the framework information became 1/5 or less with original work.

3. Accuracy of Master Sample Method

Agricultural land area in Khammouane province by ALIS estimation was 82,033 ha. It notes again the number of samples^{note4} based on the processing

^{note 2} However, we have to consider that the whole accuracy estimating from framework information cannot make early judgment in case of adding framework information only to first sample. When using Master Sample Method in ALIS, we have to consider to raise how far the accuracy of agricultural land area estimating from first sample, in other words, the number of first sample give the influence to the whole accuracy.

^{note 3} ALIS has been developing based on the concept reducing of operation work and has variety functions for system operation simplification. (ALIS Operation Manual)

^{note 4} The number of samples in Khammouane province was defined the number as 5% target accuracy based on the results of the feasibility study of ALIS in Vientiane province conducted in the previous year. However, it has resulted in accuracy increases considerably than the target accuracy. This is presumably

procedure, creating 18,311 meshes as the area framework, and extracting in random 3,383 meshes as the first sample, and then conducting the operation of adding framework information to the first sample area mesh by drawing the agricultural land borderline on the PC. Continuously, extracting in random 169 meshes as the second sample from the first sample, and conducting field survey for this second sample to check the current situation of agricultural land borderline. Master Sample Method, since the method for estimating the whole by simple estimation in the first sample, and estimating ratably by the change rate of the first sample and second sample, so it is necessary to calculate the accuracy of each value. The formula of accuracy calculation as follows;

- (a) Accuracy calculation of overall estimation in first sample

$$\sigma^2 = \frac{\sum(y_i - \bar{y})^2}{n-1}, SE\bar{y} = \sqrt{\frac{N-n}{N-1} \frac{\sigma}{\sqrt{n}}}, SER\bar{y} = \frac{SE\bar{y}}{\bar{y}} \times 100$$

Standard error: 4.64a. Standard error rate: 0.93%

- (b) Accuracy calculation of change rate in second sample

$$\sigma^2(x - Ry) = \frac{\sum(x_i - \hat{R}y_i)^2}{n-1}, SE\bar{x} = \sqrt{\frac{N-n}{N-1} \frac{\sigma}{\sqrt{n}}}, SER\bar{x} = \frac{SE\bar{x}}{\bar{x}} \times 100$$

Standard error: 11.26a. Standard error rate: 2.68%

- (c) Accuracy calculation of entire

$$SEY = \sqrt{SE^2\bar{y} + SE^2\hat{x}}$$

$$SERY = \sqrt{SER^2\bar{y} + SER^2\hat{x}}$$

Standard Error: 12.28a. Standard error rate: 2.84%

In this result, the agricultural land area in Khammouane province has the confidence interval of 95% to 82,033ha ± 4,394ha.

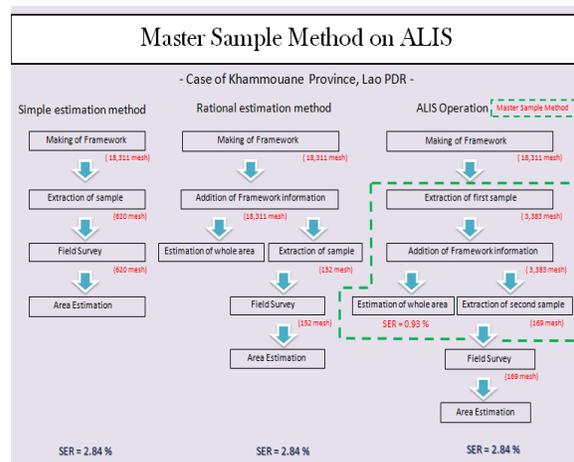
4. Other estimation method and number of samples

Attachment "Master Sample Method on ALIS" shows the flow of the statistical processing and requiring number of samples in simple estimation and ratio estimation using ALIS function for obtaining the same 2.84% standard error derived by Master Sample Method. In case of simple estimation method, it is not necessary to conduct the operation of adding the framework information by drawing the agricultural land borderline on the PC, reducing the operation labor is expected, but it needs to conduct the field survey for the

620 mesh samples in order to obtain the accuracy rate of 2.84%, as a result, the expenses for the field survey will be increased^{note5}. In addition, the researchers are required a new work drawing the land borderline while confirming the current situation of the picture map.

In case of ratio estimation method, it is necessary to conduct the operation of adding framework information to all frameworks of 18,311 meshes; as a result, the operation labor would be required significantly. Incidentally, the framework needs to consider the fluctuating possibility with the area and the rate of agricultural land of the estimation target province. On the other hand, since it estimates by the whole framework and it is the method of carrying out ratio estimation with the change rate of sample^{note6}, 2.84% of accuracy is expected by conducting field survey to the little sample of 152 meshes rather than 169 meshes in Master Sample Method.

Master sample method on ALIS



note 5 In ALIS activity, the highest costs are researcher's wage in field survey, and personnel expenses by the traveling expenses and the daily allowance at the time of attending to researcher meeting. The increase of survey sample is directly linked with the increase of the whole cost.

note 6 Refer to Note: 2.

because the framework information (agricultural land borderline) in the second sample has been close to the current situation by Google Map of Lao PDR was updated and could use a photo map of the most up-to-date for the survey in Khammouane province since a feasibility study in Vientiane province. Therefore, the change rate of agricultural in field survey is reduced and the accuracy has been much better.

