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| Estimation of planted area using the dot sampling method |

Estimation of Planted Area using the Dot Sampling Method

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1 Back ground

The Dot Sampling Method (DoS Method) is a traditional method, but no one has ever applied it to the estimation of planted area. The reason why the DoS Method has not been applied to the estimation of planted area is that you had neither been able to put sample dots on a map nor identified the land usage at each sample dot on a map. But you know now that you can make it with web mapping service, i.e. Google Earth or the Google Maps.

This report shows you the concept of the DoS Method and how to apply it to the area survey.

2 Characteristics of the Method

2.1 Simplicity

The DoS Method is a simple method and easy to conduct. Even an unskilled staff can follow the way.

2.2 Efficiency

The DoS Method is an efficient method. You can save time, cost, and human resources at each stage of statistical activities, from preparation to estimation. Even an country advanced in a statistical system would benefit greatly from the Method.

2.3 Reliability

The DoS Method is a reliable method. Non-sampling error hardly happens, as what you conduct at the time of field survey is to check the category of the land usage on the sample dot. You don't need to get data from farmers but from sample dots.

2.4 No sample frame

The DoS Method doesn't require a sample frame. With the DoS Method, you are able to conduct an area survey without sample frame. Instead of sample frame, the Method requires a total area of the target region such as village, prefecture or any region you put sample dots on.

3 Process for the Estimation

3.1 Sample size

You decide the number of the samples after considering precision aimed and resources available.

3.2 Desk work survey

You put sample dots on the target region on a map.

3.3 Field survey

You conduct a field survey, when you need to check the category of a land usage at the sample dot. It is not necessary for you to conduct a field survey, when you have known the category already or you've checked the exact category from the map.

3.4 Estimation

You estimate the area of each land category in the target region.

4 Example of the Survey

4.1 To decide the number of the samples

Now you want to know the planted area in the target region. You've already had information on the proportion of cultivated land to the total area in the region: that is around 15 %.

Provided you set the sample size for 2,500 dots, the precision or coefficient of variation is estimated to be 4.76% (See Note below).

You consider the precision of 4.76% as well as available manpower and budget and decide that the sample size is 2,500.

Note:

The calculation is as follows:

Standard error of sample means $= \sqrt{p * q/n} = \sqrt{0.15 * 0.85/2500}$

Coefficient of variation = standard error of sample means/p

$$= \sqrt{0.15 * 0.85/2500}/0.15$$
$$= 0.0476$$

Where p = the proportion of cultivated land to the total area in the region

$q = 1 - p$

n = sample size or the number of the sample dots

4.2 To put sample dots on the target region on Google Earth

You put 2,500 sample dots in the target region on Google Earth.

Next, you check the category of land usage of 2,500 sample dots on Google Earth, and then you identify the land categories as follows:

Planted area	350
Dyke in cultivated area	9
Tree/Rock in cultivated area	1
Non-cultivated area	2075
Land usage unidentified	65
Total	2500

4.3 To conduct a field survey

You conduct a field survey, as you need to check the category of a land usage of 425 dots, i.e. 350 dots of planted area, 9 dots of dyke in cultivated area, 1 dot of tree/rock in cultivated area and 65 dots of land usage unidentified (See Annex 1). You don't need to go to 2075 sample dots, as their categories of land usages are non-cultivated area.

The result of field survey is as follows:

Maize	151
Cassava	78
Sweet potato	54
Banana	42
Beans	24
Rice	51
Dyke in rice cultivated area	9
Tree/rock in rice cultivated area	1
Non-cultivated area	15
Total	425

4.4 To estimate the area

You estimate the each area of a land category. At first, you calculate the share of each category (See Annex 1). Then you multiply the share of each category by the total area to estimate the area of each category.

Area of each category in the case that the total area is 2,500,000ha is as follows:

	Number	Share (%)	Area (1,000 ha)
Maize	151	6.04	151
Cassava	78	3.12	78
Sweet potato	54	2.16	54
Banana	42	1.68	42
Beans	24	0.96	24
Rice	51	2.04	51
Dyke in rice cultivated area	9	0.36	9
Tree/rock in rice cultivated area	1	0.04	1
Non-cultivated area	2090	83.60	2,090
Total	2500	100.00	2,500

5 Supplementary explanations

5.1 Why get information on the total area of the target region

The secret of the reliability of the DoS Method is to make use of the total area of the target region. With the DoS Method, you divide the total area into each category of land usage, while with conventional methods, you add fragments of area together to make the total area which often does not coincide with the true value.

The information of the total area of the target region is a key point to conduct area survey using the DoS Method. You can get the information of the total area from other sources or Google Earth. In the case of using Google Earth, you make square on Google Earth which is almost as large as the target region and you calculate the area of the square and put dots in the square, and then you calculate the area of the target region.

5.2 How to increase precision

In order to increase precision, you need to increase the number of sample dots.

For instance, when the proportion of the rice field to the total area is 10% and you need 3 % of coefficient of variation, the number of sample dots is 10,000 (See Annex 2).

5.3 How to develop organization of conducting survey

Usually you need to develop capacity of organization and resources to conduct area survey. But as for the survey with the DoS Method, you don't need any special preparation, as it is easy to conduct and requires neither any special equipment nor a sample frame. What you need is an environment to use Google Earth and short term training for staff as well as budget to put guide maps into print for enumerators.

Central/Local government staff is supposed to put sample dots on Google Earth and make guide maps, each of which shows you the spot of a sample dot to conduct field survey.

Central/Local government staff delivers guide maps to enumerators for them to check the category of a land usage at a sample dot.

Central/Local government staff estimates the area of each land category.

5.4 How to make sure the DoS Method is reliable

Please try to conduct area survey using the DoS Method at a familiar region. Then you will be surprised at the accuracy of the result. If you don't have time to conduct field survey, please conduct the survey only on Google Earth without conducting field survey. Still, you will find out the accuracy of the result.

6 Reference

"Annual Planted Area Survey Using Dot Sampling Method in Tanzania"
by **Mr.Issei Jinguji**, April 30, 2012

Annex 1

Estimation of the planted area (Example)

1. Desk Work and Field Survey

Category	Desk work	Field survey
Planted area	350	
Maize		101
Cassava		78
Sweet potato		54
Banana		42
Beans		24
Rice		51
Dyke in cultivated area	9	
Dyke in rice cultivated area		9
Tree/rock in cultivated area	1	
Tree/rock in rice cultivated area		1
Non-cultivated area	2075	
Land usage unidentified	65	
Maize		50
Non-cultivated area		15
Total	2500	425

Note: Cultivated area = Planted area + Dyke in cultivated area + Tree/rock in cultivated area

2. Estimation

Category	Number of dots	Share(%)
Maize	151	6.04
Cassava	78	3.12
Sweet potato	54	2.16
Banana	42	1.68
Beans	24	0.96
Rice	51	2.04
Dyke in rice cultivated area	9	0.36
Tree/rock in rice cultivated area	1	0.04
Non-cultivated area	2090	83.60
Total	2500	100.00

Relationship between sample size, precision

and proportion of the category

Proportion of the category	the number of samples					
	100	200	500	1000	5000	10000
1	99.5	70.4	44.5	31.5	14.1	9.9
2	70.0	49.5	31.3	22.1	9.9	7.0
3	56.9	40.2	25.4	18.0	8.0	5.7
4	49.0	34.6	21.9	15.5	6.9	4.9
5	43.6	30.8	19.5	13.8	6.2	4.4
6	39.6	28.0	17.7	12.5	5.6	4.0
7	36.4	25.8	16.3	11.5	5.2	3.6
8	33.9	24.0	15.2	10.7	4.8	3.4
9	31.8	22.5	14.2	10.1	4.5	3.2
10	30.0	21.2	13.4	9.5	4.2	3.0
15	23.8	16.8	10.6	7.5	3.4	2.4
20	20.0	14.1	8.9	6.3	2.8	2.0
30	15.3	10.8	6.8	4.8	2.2	1.5
40	12.2	8.7	5.5	3.9	1.7	1.2
50	10.0	7.1	4.5	3.2	1.4	1.0
60	8.2	5.8	3.7	2.6	1.2	0.8
70	6.5	4.6	2.9	2.1	0.9	0.7
80	5.0	3.5	2.2	1.6	0.7	0.5
90	3.3	2.4	1.5	1.1	0.5	0.3