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What you can do with the Dot Sampling Method using Google Earth

No1 **Area Survey**
No2 **PPS Sample Selection**
No3 **Two-dimensional Scale**

This paper has been written to describe the practical aspect of the Dot Sampling Method. We would be glad if this document could arouse your interest in the Dot Sampling Method. The Method enables you to conduct the theory which was discovered long time ago but had not been practiced until Google Earth emerged. We believe the Method has a power to reform the traditional way of Planted Area Survey or other surveys. We hope you will challenge the Method to improve agricultural statistics.

1. What the Dot Sampling Method is in brief

1.1 You put a certain number of dots on a map.

With the Dot Sampling Method, you put any number of dots on Google Earth to conduct survey on an attribute of each dot or use dots as sample spots.

For instance, in case of a rice planted area survey in a village, with the Dot Sampling Method, you put a certain number of dots randomly on a village and count the number of dots which falls on planted rice and estimate the total area of rice planted field in the village.

Note: In order to put a certain number of dots on a region, Excel Macros have been developed to put dots on Google Earth which the Method uses as a map.

1.2 The Dot Sampling Method has settled long-standing issues of agricultural statistics.

There have been long-standing issues on agricultural statistics. The followings are such issues and what the Method has resolved:

The number of human resources is limited.

→ The Method requires fewer human resources.

Staff members don't have enough knowledge of statistics.

→ What you do is only to count the number of dots. Even the unskilled can follow the Method.

It is almost impossible to measure the planted area even once a year.

→ The Method doesn't require you to measure the area but count the number of dots, so you can conduct survey any time you would like to do.

You need tremendous effort to maintain a population.

→ The Method doesn't require a population to extract samples.

It is not easy to estimate the real value and calculate the precision.

→ The Method uses Yes/No questions to estimate the proportion of units that possess some characteristics or attribute or fall into some defined class, whose theory is simple, so you can estimate the real value and calculate the precision easily.

Non-sampling errors happen extensively.

→ With the Method, non-sampling errors hardly happen, as what you do is to check at a sample dot if it falls on, for instance, rice or not.

It is time-consuming to select samples for crop cutting in order to estimate average yield in the target region.

→ The Method could be applied to not only area survey but also selecting samples for crop cutting with Probability Proportional to Size as mentioned later in 3.2, so you can select samples easily through the Method.

The results are not reliable.

→ With the Method, the results are reliable because of the characteristics of the Method mentioned above.

2 Let's use Excel Macros for Dot Sampling.

You need three files: 1) LL Table Maker
2) Save Range As KML File
3) LL Sheet for the dot sampling

2.1 First Step: Put six necessary data, from (2) to (7) below, in the T-1 table of LL sheet for the Dot Sampling.

T-1 Basic data to generate sample dots (Sampling Design)

Target area	Size of the Target area km^2	Sample size	Starting point (latitude)	Starting point (longitude)	Finishing point (latitude)	Finishing point (longitude)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Timor-Leste	15,000	1,500	-8.123	124.04	-9.51	127.37

Note for filling in: (1) Any name

(2) & (3) density of dots (number of dots per area)

(4) any latitude on the north of the northernmost of a target region

(5) any longitude on the west of the westernmost of a target region

(6) any latitude on the south of the southernmost of a target region

(7) any longitude on the east of the easternmost of a target region

2.2 Second Step: Automatically sample dots are put on Google Earth.

3. With the Excel Macro, you can conduct three different activities:

With the Excel Macro, you can conduct three activities as follows:

No1: You can put any number of dots on a target region.

No2: You can put any number of dots on rice fields or any attribute in a target region.

No3: You can put a sample dot every 10a, every 1ha or any size.

3.1Activitiy No.1: You can put any number of dots on a target region.

You can put any number of dots on a target region to estimate the proportion of rice planted area or any other attribute in a target region.

Note1: The way of estimation of area:

In case that you put 100 dots in a target region of 6,561,000ha, and the number of dots that falls on rice planted fields is 10,

estimation of rice planted area is 6,561,000ha $\times \frac{10}{100} =$ 656,100ha

Note2: The procedure of area survey:

1st: You put dots in a target region on Google Earth.

2nd: You conduct preparatory survey.

3rd: You conduct field survey.

4th: You estimate rice planted area.

Note3: The number of necessary sample dots by aimed precision:

Please see Annex.

The followings are examples of area survey.

3.1.1 Result of Preparatory Survey before conducting field survey, Sri Lanka

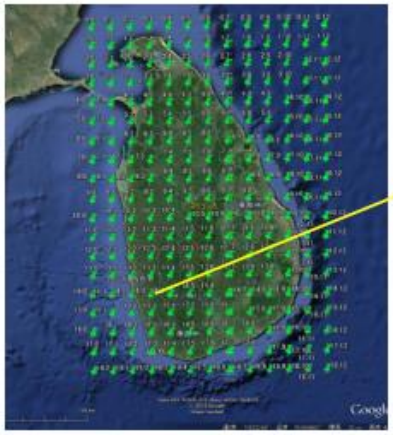


Figure 17: Sample dots on Google Earth

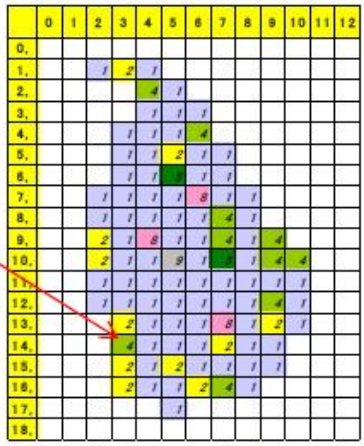


Figure 18: Questionnaire for preparatory survey

Table 12: Land Use Statistics

Category Name	Code	Number of Sample	Rate	SE	CV	Estimate (1,000ha)
Non-Cultivated land	1	73	0.73	0.04	6.1	4,790
Cultivated land (Upland)	2	11	0.11	0.03	28.4	722
Dyke (Upland)	3	0	0.00	0.00		0
Lowland(paddy)	4	10	0.10	0.03	30.0	656
Lowland (Dyke)	5	2	0.02	0.01	70.0	131
Tentative	8	3	0.03	0.02	56.9	197
Low resolution	9	1	0.01	0.01	99.5	66
Total		100	1.00	0.00	0.0	6,561

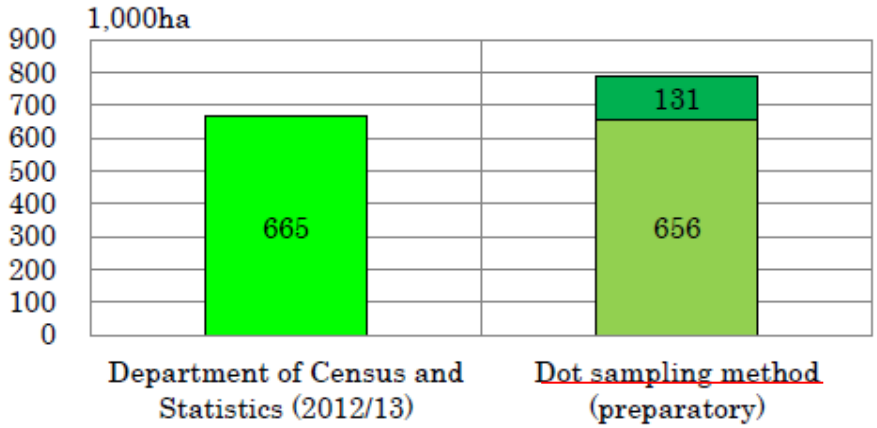


Figure 20: Comparison (Harvested area/Lowland)

Source: Mr.Issei Jinguji, Dot Sampling Method for Area Estimation, February 2014

3.1.2 Result of Preparatory Survey before conducting field survey, Thai

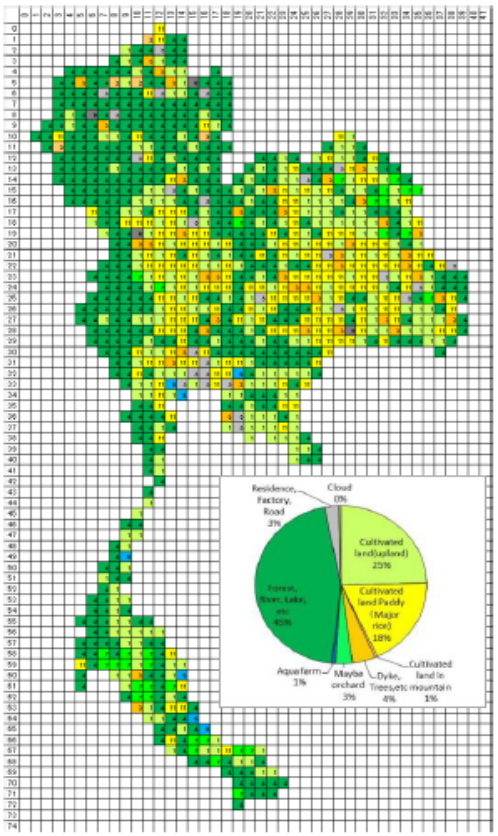


Figure 21: Land use map

Table 13: Land use statistics

Category		Code	Number of dots	Rate(%)	Area(ha)	SE	CV
Cultivated land		---	517	51.8	26,554,859	1.581	3.1
Cultivated land/Breakdown	Cultivated land(upland)	1	246	24.6	12,635,387	1.363	5.5
	Cultivated land Paddy (Major rice)	11	184	18.4	9,450,859	1.226	6.7
	Cultivated land in mountain	2	5	0.5	256,817	0.223	44.6
	Dyke, Trees,etc	3	43	4.3	2,208,625	0.642	14.9
	Maybe orchard	7	32	3.2	1,643,628	0.557	17.4
	Aqua farm	8	7	0.7	359,544	0.264	37.7
Forest, River, Lake, etc		4	451	45.1	23,164,877	1.574	3.5
Residence, Factory, Road		5	27	2.7	1,386,811	0.513	19.0
Cloud		6	4	0.4	205,453	0.2	49.9
Total			999	100.0	51,312,000	---	---

Category		Number of dots	Rate(%)	Area(ha)	SE	CV
Paddy field	Pure planted area (Major rice)	184	18.4	9,450,859	1.2	6.7
	Dyke, Trees,	31	3.1	1,592,264	0.5	17.7
Total		215	21.5	11,043,123	1.3	6.0

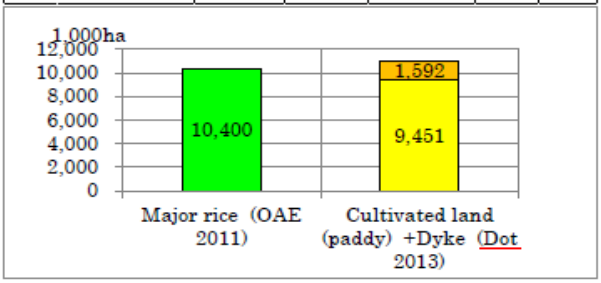


Figure 22: Comparison of the official and dot

Source: Mr. Issei Jinguji, Dot Sampling Method for Area Estimation, February 2014

3.1.3 Result of Preparatory Survey before conducting field survey, Lao PDR

Targe 2,177,400 ha
n = 100 P

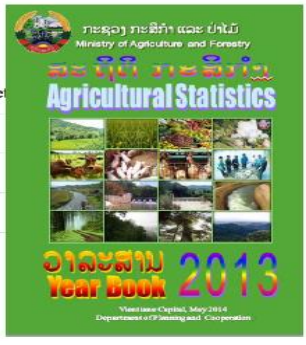
Category	NUMBER	Estimate(ha)	SE	CV	Share (%)
Paddy	10	217,740	3	0.3	10
Dyke	2	43,548	1.4	0.7	2
Residential land (include bulding, garden, parking, trees,..)	7	152,418	2.6	0.364496	7
Road	2	43,548	1.4	0.7	2
Irrigration, River	1	21,774	1	0.994987	1
Forest	75	1,633,050	4.3	0.057735	75
Cultivated land	3	65,322	1.7	0.568624	3
Total	100	2,177,400	0	0	100

Area	217,740	ha
yield	3.78	Ton/ha
Production=Y x A	823,057	Ton

Table 03: Total rice paddy (rainfed and dry season rice): area, yield and product

	Name	Planted Area: (ha)	Harvested Area: (ha)	Yield: (ton/ha)	Production: (ton)
		2013	2013	2013	2013
13	Savannakhet	212,840	202,565	3.78	766,030

Source: Department of Agriculture



Source: Mr. Sengphachanh Khounthikoummane, Lao PDR, 17 August 2014

3.1.4 Result of Preparatory Survey before conducting field survey, Timor-Leste

District	Sample dot	Share of District	Estimated Area (A)	Area by Wikipedia (B)	Difference (A-B)
	number	%	㎢	㎢	㎢
Lautem	184	12.3	1,830	1,813	17
Baucau	150	10.0	1,492	1,506	-14
Viqueque	188	12.5	1,870	1,877	-7
Manatuto	182	12.1	1,810	1,782	28
Dili	39	2.6	388	367	21
Ailiu	73	4.9	726	737	-11
Manufahi	128	8.5	1,273	1,323	-50
Liquiçá	60	4.0	597	549	48
Ermera	75	5.0	746	768	-22
Ainaro	83	5.5	826	804	22
Bobnaro	140	9.3	1,392	1,376	16
Cova Lima	117	7.8	1,164	1,203	-39
Oecusse	81	5.4	806	814	-8
Total	1,500	100		14,919	0

Note1： Target region is the whole country
Note2： Total area of the target region is a total of each destrict area from Wikipedia: 14,919㎢.

3.2 Activity No.2: You can put any number of dots on rice fields or any attribute in a target region.

In case that total area of rice fields in the target region is 370km^2 and you want to select 100 samples from rice fields for crop cutting, you just put 370 and 100 in the T-1 table of LL sheet for the Dot Sampling.

T-1 Basic data to generate sample dots (Sampling Design)

Target area	Size of the Target area km^2	Sample size	Starting point (latitude)	Starting point (longitude)	Finishing point (latitude)	Finishing point (longitude)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crop Cutting Spot	370	100	-8.123	124.04	-9.51	127.37

You can put any number of dots in the rice fields that are selected by Probability Proportional to Size.

So you can get not only theoretically proper spots for sampling, but also you can reduce an effort to select samples for crop cutting as well as estimate average yield in the target region in a simple way.

3.3 Activity No.3: You can put a sample dot every 10a, every 1ha or any size.

If you want to put a dot every 10a, for example, you just put 1km^2 and 1000 dots in the T-1 table of LL sheet for the Dot Sampling or other combinations such as 0.001km^2 and 1dot.

T-1 Basic data to generate sample dots (Sampling Design)

Target area	Size of the Target area km^2	Sample size	Starting point (latitude)	Starting point (longitude)	Finishing point (latitude)	Finishing point (longitude)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1 dot = 0.1 ha	1	1,000	36.032451	140.1226	36.026	140.1329

You count the number of dots. When the number of dots is ten, the area of that region is 0.1 ha/dot ×10 dots = 1 ha.

You can use this method as if each dot is a division of scale. This is so called a two-dimensional ruler. In the case above, the ruler is graduated in 10a.

4. Reference

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(Annex)

Number of Necessary Sample Dots by Aimed Precision in case of Preparatory Survey and Field Survey

Share of rice planted area in a target region	Aimed Precision CV = 3%		Aimed Precision CV = 5%		Aimed Precision CV = 10%	
p %	Preparatory survey	Field survey	Preparatory survey	Field survey	Preparatory survey	Field survey
1	110,000	1,100	39,600	396	9,900	99
2	54,444	1,089	19,600	392	4,900	98
3	35,926	1,078	12,933	388	3,233	97
4	26,667	1,067	9,600	384	2,400	96
5	21,111	1,056	7,600	380	1,900	95
6	17,407	1,044	6,267	376	1,567	94
7	14,762	1,033	5,314	372	1,329	93
8	12,778	1,022	4,600	368	1,150	92
9	11,235	1,011	4,044	364	1,011	91
10	10,000	1,000	3,600	360	900	90
20	4,444	889	1,600	320	400	80
30	2,593	778	933	280	233	70
40	1,667	667	600	240	150	60
50	1,111	556	400	200	100	50
60	741	444	267	160	67	40
70	476	333	171	120	43	30
80	278	222	100	80	25	20
90	123	111	44	40	11	10

Note: Calculation fomulas are as follows:

Sample size for Preparatory Survey = $\frac{Variance\ of\ p\ in\ Population}{Aimed\ Standard\ Error^2}$

$$= \frac{\frac{p}{100} \times \left(1 - \frac{p}{100}\right)}{\left(\frac{p}{100} \times \frac{CV}{100}\right)^2} = \frac{p \times (100 - p)}{\left(p \times \frac{CV}{100}\right)^2}$$

Number of dots for Field Survey = Sample size for Preparatory Survey $\times \frac{p}{100}$