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VEGETATION CLASSIFICATION USING SATELLITE IMAGERY AND AREA SAMPLING FRAME TO LOCATE SAMPLING STANDS

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ABSTRACT

This paper describes method of vegetation classification using satellite imagery and Area Sampling Frame Method. Area Sampling Frame Method is being used in the United States of America to sample crop acreage. This method was found useful in vegetation sampling in rangeland during an extended course at Remote Sensing Facility Centre, Nairobi, Kenya. Area to be sampled is divided into Strata, then into primary sampling units and lastly into sampling stands.

It was found necessary that each stratum which has been delineated separately be visited because different areas may have same colour but different plant composition or cover. This is so because reflection of light by plants depends on the surface and arrangement of the leaves.

This method is quick and very useful in looking at larger areas within a very short time. Although it is not detailed, it enables a planner to identify areas of high potential for detailed sampling.

PURPOSE OF VEGETATION SAMPLING

The main purpose for KREMU's sampling vegetation in rangeland is to monitor plant production and get data for determining range condition and use the information to determine trend. Vegetation, especially grass, is more than a resource; it protects the soil from erosion and improves soil texture and rainfall infiltration. Vegetation is also used as an indicator of the general physical environment, and so of range potential (Pratt, D.J. & Gwynne, M.D. 1977).

Vegetation of an area is a product of the plant material available and the environmental conditions prevailing. The vegetation of an area may indicate the stage in regression or a changing environment. In E. Africa, rainfall and temperature are the most important factors in determining vegetation types. The main criteria by which vegetation is described is the form or appearance of its characteristic plants combined with the relative density of those plants and the dominant features of the environment under which they occur (Pratt, D.J. & Gwynne, M.D. 1977). However, the great variation in climate and landform in Kenya leads to diversified vegetation types.

In E. Africa or any developing country, vegetation classification is needed to assist in resource mapping and development planning. This is why we have attached so much importance to vegetation mapping. Because of the low production in rangelands coupled with poor roads, the best approach is to begin by examining LANDSAT imagery. This enables the

ecologist to look over a large area covered by one scene, in a very short time.

METHODOLOGY

Using aerial photographs is the most accurate method but the cost makes it almost impossible in developing countries. The cheapest method available at the moment is LANDSAT imagery. It is also useful because of its repetitive data coverage. This report emphasizes the use of LANDSAT data for the construction of the area sampling frame.

Area Sampling Frame Method is being used in the United States of America in estimating crop acreage and collecting statistical data in agriculture. Since this method was found to be fast and cost-effective, particularly in large areas (Wigton & Borman, 1978), it was found useful in range areas, but with slight modification.

Area Sampling Frame Method was used in selecting the plot at random whereas Point Centred Quarter Method was used as the sampling technic. Four quartes were established at each point through a cross formed by two lines (Mueller-Dombois, Dieter, 1925). Four distances instead of one were measured from each point and forty points were sampled in each plot.

Study area

After two weeks of classroom work each student chose an area for his field work. I chose Baringo district which falls in Rift Valley, Kenya. The area is a typical rangeland which receives 500-750 mm. of rain each year. The rainfall decreases as you move to the north.

The study area is a low depression bordered by the Tugen hills on the west and Laikipia escarpment on the east. To the south it borders large estate farms.

Procedure in constructing area sampling frame

(a) Stratification

Construction of area sampling frame is carried out in several steps. The first step is the delineation of broad areas of homogeneous colour tone on Landsat imagery. These segments form a stratum. The whole study area was divided into five strata, and during this exercise, no reference was made to physical boundaries on the ground. This allowed concentration on pattern recognition and differentiation (Wigton and Borman, 1978).

Each stratum was not as homogenous as had been described, but this might have been due to the scale of Landsat imagery. The stratification was done on transparent overlays, and the information was later on transferred onto the topographic survey maps.

(b) Construction of Primary Sampling Unit (P.S.U)

The need for good physical boundaries applied to all further subdivision of the strata into primary sampling units and sampling stands. The overlay which had strata boundaries was placed on topographic survey map which was at the same scale as the overlay. The subdivision of the strata into P.S.U. was then carried out using physical features like rivers, escarpments and man made features like roads. The P.S.U. varied in sizes depending on the shape and number of physical features available.

(c) Construction of Sampling Stands (S.S.)

In order to save time, not all P.S.U. were subdivided. The P.S.U. were numbered and the numbers were used for random selection for further subdivision. The subdivision of P.S.U. into S.S. was to provide small areas for sampling. The division of S.S. was also based on physical features. The S.S. were of various sizes and shapes. These small units or sampling stands were easy to locate and relocate on the ground. The S.S. to be sampled were then randomly selected using random table.

Selection of S.S.

A random table and a pen were used. The pen was placed on the random table while looking somewhere else. The pen landend between two numbers. The first number indicated the column while the second number indicated the row. Thus the column and the row were randomly chosen. Along the column go down and the first smallest number reached decides which S.S. to be sampled. This was repeated until all S.S. were selected. More sampling stands were selected than were needed for sampling because if one could not be reached, either because poor roads, then an alternative S.S. was already chosen.

SAMPLING STANDS

P.S.U. No.	P.S.U. randomly chosen	Number of sampling stands	No. chosen for sampling
1_1	a	5	3
1_2	a	1	1
1_3	a	4	2
2_1	d	3	1
3_1	b	3	1
3_2	a	5	4
4_1	b	7	2
4_2	b	6	1
4_3	c	4	4
4_4	c	4	4
5_1	c	3	2
5_2	b	3	2

Out of twelve sampling stands chosen, only eight were sampled.

FIELD WORK

I had four range assistants helping me in field work. Three of us worked on P.C.Q., collecting data on woody plants while the other two collected data on herbaceous plants using Point Observation Plot Method. Each stand was sampled for one day only. The other four stands were not sampled because they could not be reached. Reasons were either the rivers flooded or there were not enough security.

Forty points were sampled from each stand, and although it was rather hard for people who were used to doing thirty points per day, we soon got used to it. Although with this new method we did only forty points as opposed to sixty which were previously done, this was compensated by the increased number of sampling stands.

WOODY LAYER (PCQ DATA)

Table 11.

P.S.U. 3-1

Sampling stan 1

Date 12/5/82

Plant species	Crown cover %	Freq. %	Basal area m^2/ha	Crown Vol. m^3/ha	Above Ground biomass kg/ha	Density (No./ha) 0.7-2	2-4	in height 4-6	Total
Ormocarpum trichocarpum	3.8	46.0	0.001	1.5	0.94	390.2	45.5	0.0	436.0
Acacia mellifera	3.7	4.0	0.004	34.9	40.34	6.0	32.5	0.0	39.0
Acacia reficiens	13.7	31.0	0.001	4.9	3.65	233.6	65.0	0.0	299.0
Acacia senegal	1.1	2.0	0.001	8.3	8.82	13.0	6.5	0.0	20.0
Commiphora africana	1.10	1.0	0.007	22.6	28.10	0.0	6.5	6.5	13.0
Boscia coriacea	0.7	6.0	0.002	1.7	1.35	26.0	32.5	0.0	59.0
Premna oligotricha	0.6	3.0	0.000	3.1	2.80	26.0	6.5	0.0	33.0
Grewia tenax	0.4	4.0	0.000	0.6	0.44	39.0	0.0	0.0	39.0
Maerua edulis	0.3	1.0	0.001	4.7	4.92	6.5	6.5	0.0	13.0
Total	25.4			80.8	91.36	740.8	201.5	6.5	951.0

WOODY LAYER (PCQ DATA)

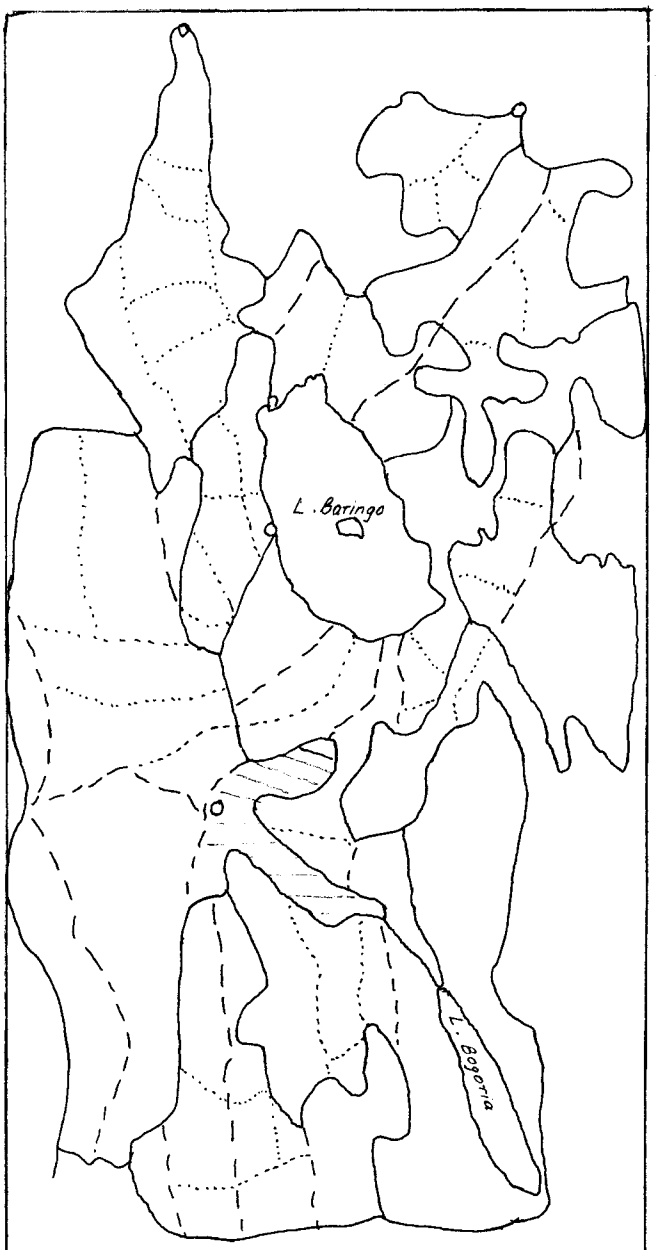
Table 10.

P.S.U. 1-1

Sampling stand 3

Date 17/5/82

Plant species	Crown cover %	Freq. %	Basal area m^2/ha	Crown Vol. m^2/ha	Above ground biomass kg/ha	Density (No/ha) by height class 0.7-2	2-4	4-6	6.8	Total
Acacia reficiens	8.6	53.6	0.000	1.7	1.1	345.2	63.3	5.8	0.0	414.0
Acacia tortilis	2.3	6.7	0.002	3.4	2.9	34.5	11.5	0.0	5.8	52.0
Acalypha fruticosa	1.6	29.8	0.000	1.1	0.7	230.2	0.0	0.0	0.0	230.0
Acacia nubica	1.3	1.6	0.003	20.1	24.9	5.8	0.0	5.8	0.0	12.0
Acacia mellifera	0.4	3.8	0.000	0.3	0.2	0.2	28.8	0.0	0.0	29.0
Boscia coriacea	0.2	2.2	0.005	1.1	1.0	5.8	5.8	5.8	0.0	17.0
Maerua edulis	0.07		0.000	0.2	0.1	11.5	0.0	0.0	0.0	12.0
Acacia senegal	0.2	1.6	0.000	0.1	0.1	5.8	0.0	0.0	0.0	6.0
Total	14.7			28.0	31.0	667.6	80.6	17.4	5.8	772.0



BARINGO STUDY AREA

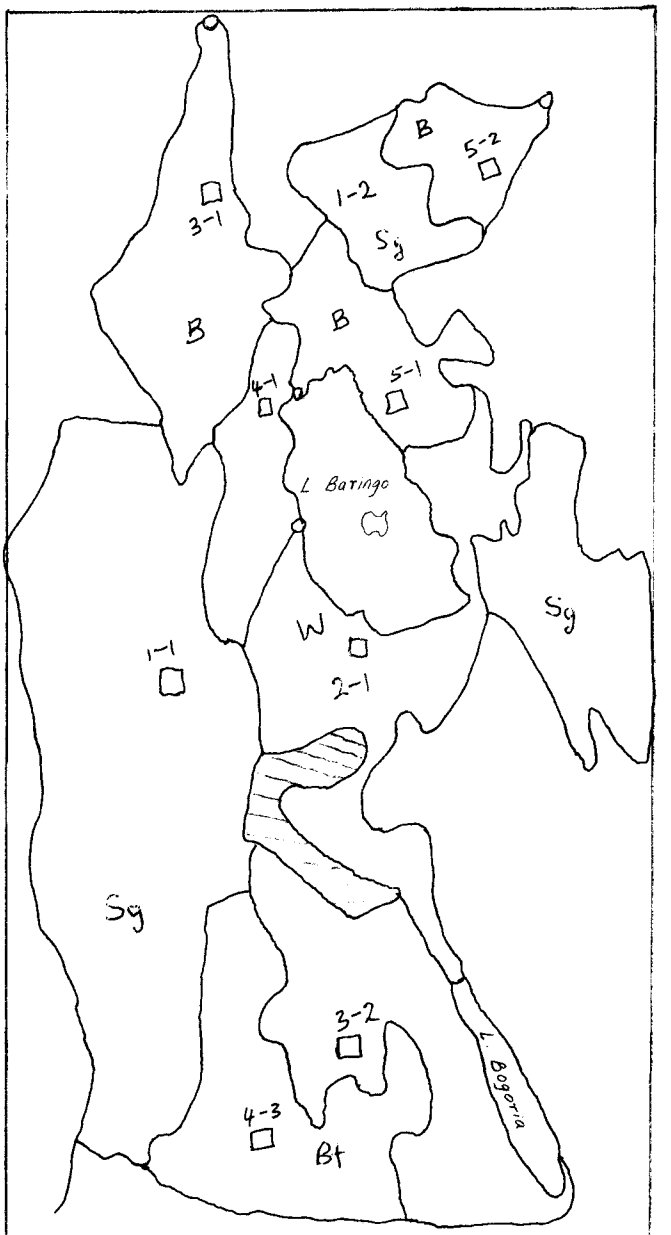
Construction of sampling frames

——— Strata boundaries

— — — P.S.U. boundaries

..... S.S. boundaries

Scale 1:450,000



BARINGO STUDY AREA

VEGETATION TYPES

Key

	Sg	Shrubby grassland
	B	Bushland
	W	Woodland
	Bt	Bushland thicket
		Water bodies

DISCUSSION

Only two out of eight data sheets have been included in this paper because of space. They show the type of information which we collect. During the construction of the Area Sampling Frame, some areas were grouped together but these later on appeared different when the field data was analysed. There are a number of factors which might have contributed to this discrepancy.

(a) Time lag:

The LANDSAT imagery used was for 25th March, 1975 while the field data was collected in May 1982. Area 4-1 and 4-3 looked the same in 1975 but as from 1979 Euphorbia Project was started around Loruk trading centre. This project brought in lots of people and provided employment opportunity for local people. The local people had to build their manyattas around and brought all their livestock along. This high concentration of people and livestock resulted in tree cutting, browsing and overgrazing. Thus 4-1 is no longer the same with 4-3.

(b) External structure of leaves

Leaves have on the outside a cuticle which is often glossy in appearance. It may bear hair or wax which influence the reflection of radiation (I.T.C. lecture notes, 1980). Having this in mind and considering the fact that different strata or plant communities had different plant composition, then naturally had different reflection characters. Area 3-1 with a percentage woody cover of 25 % was grouped together with area 3-2 with 49 %. If nothing had happened to woody cover at 3-1 then the dark tone might have been contributed by the dominating Acacia reficiens (14 % out of 25 %), while at 3-2 Acalypha fruticosa with a shiny leafy surface might have reflected a lot of light.

(c) Other activities

Area 3-2 which looked darker than area 4-3 had a lot of human settlement and shifting cultivation going on. This was seen during the 1982 visit and apparently by 1975 these people had not moved into this area. Area 4-3 had a dam which was silted and had no water in May 1982 when it was visited. If this dam was the only water source for the area, then it might account for regrowth of underneath species which resulted in 145 % ground cover.

CONCLUSION

(1) Area Sampling Frame Method is a good tool in locating sampling points using LANDSAT imagery. Sampling stands are easy to relocate because they worked using permanent physical features.

(2) Vegetation stratification using tonal differences as registered on LANDSAT imagery may mean that either the vegetation cover for those areas are different or plant composition are different.

(3) The whole process of constructing the sampling stands is a random method and has no personal influence.

(4) All different plant units are visited because they come out as different strata.

(5) The last and most important is the production of vegetation map which shows different vegetation types and plant communities.

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