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APPLICATION OF SOME REMOTE SENSING IMAGES IN MAPPING AGRICULTURAL LAND USE CHANGES IN SOUTH WESTERN NIGERIA

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ABSTRACT

SPOT HRV of 1986 (multispectral mode of 20 metre resolution) at a scale of 1:50,000 and aerial photographs of 1977 (at a scale of 1:25,000) were used to examine and map changes in land use area during 1977-1986 period. Seven land use categories were identified and the area changes of each land use was measured by Dot - grid method.

Results show that for the 9 - year period, dramatic changes occurred between land uses. For example, 963 ha of forest land representing 16.17% of the total area mapped was converted to other uses principal among which is agriculture. A major settlement in the area, Erimo attracted an influx of people leading to increased demand for residential areas. Thus built up area increase by 37.44 ha or 0.65 percent. A new road was also opened up in the area during this period from Ile-Ife through Ilesha to Akure. This gave rise to excavations and the breaking of stones to provide building materials thus, rendering 356 ha or 6.2 percent of the area bare and unproductive.

It is concluded that to plan effectively for land development, and maximum, utilization of resources, adequate information must be acquired on existing resources and how they are being utilized. Remote sensing opens up new avenues of acquiring such data relatively cheaply, quickly and accurately.

INTRODUCTION

In Nigeria, basic information on the present extent, location and productivity of land are difficult to obtain and often unreliable due to the method of collection (Anon, 1981). Early workers such as Prothero (1952) and Smyth and Montgomery (1962) used the field traverse method to collect

agricultural land use data directly in the field. Progress of work was very slow as a result of (i) the lack of base map at suitable scale; (ii) the inadequacy of the road network; (iii) the difficulty of movement and visibility in forest areas and (iv) the high cost in terms of time and labour (Wikkamatileke, 1959)

The need for reliable resource data prompted the use of remote sensing. By comparison of recent photos with older coverage, such as urban development, reversion of farmland to forest and development of new farm land by clearing, draining, or irrigation can be ascertained (Liney and Dill, 1970). Aerial photos and satellite imagery show the type and extent of land cover and sensors record the reflectance from crops and vegetation, rather than the soil and other environmental features beneath. Thus the scientist studying land use and vegetation changes have a priviledge place in remote sensing studies since the cover in which they are interested, is what is directly sensed. (Allan, 1980).

Mapping of agricultural land use using aerial photograph has been limited by the availability of only medium - scale aerial photos, a scale often not suitable for land use mapping as well as its poor resolution (Adeniyi, 1986). In addition, farm plots in this country are of variable size, small and widely scattered with irregular boundaries and plot size frequently changing often resulting in incorrect classification of land use (Larin - Alabi, 1978; Anon, 1979).

The French Spot Imagery, apart from the synoptic view, also exhibits a greater probability of generating cloud - free data around the equator since it can observe an area seven times in every 26 - day cycle. In addition, it has enhanced spatial resolution of 10m and 20m for panchromatic and multi spectral modes respectively which makes mapping land use in these areas easy and accurate. The success of a similar exercise on the savanna area of Ibadan using Spot Imagery (Sogunle and Fagbami, 1990) prompted the desirability of mapping the land use of the forest area of Ilesha, an area well known for its rice cultivation on the narrow quartzite ridges.

MATERIALS AND METHODS

Location

The area under study is located between latitude 7°34′ and 7°38′N and longitudes 4°49′ and 4°55′E on the 1:50,000 Ilesha sheet 243 S.E of the Federal Survey Topographic map (Fig. 1). The area is about 60km^2 and lies within the humid tropical forest.

Climate

The area receives a mean annual rainfall of about 1500mm with double peaks (in July and September). The dry season which lasts for four months is noted for the presence of dry winds (harmattan) in December and early January. The temperature is high all year round (27 - 31°C) with the months of

January, February and March being the hottest months.

Vegetation and Soils

In many places, the forest area has been degraded to secondary forest as a result of shifting cultivation for arables and a few plantations of cocoa along the slopes of the river banks. Smyth and Montgomery (1962) classified the soils of three area into three associations: Okemesi, Egbeda - which are well drained soils and Jago association found along valley bottoms.

Data Source and their characteristics

The following materials were assembled for the studies:

(a) Panchromatic black and white aerial photographs of the area at a scale of 1:25,000, taken in February 1977, were obtained from the Federal Survey Department, Lagos.

(b) A sub-scene transparency of SPOT HRV (Mss) false colour composite (Fcc) taken on the 19th May, 1986 was generated from the computer compactable tape (CCT) on the image analysis system at the Regional Centre for Training in Aerospace Surveys (RECTAS) in Obafemi Awolowo University (O.A.U), Ile-Ife.

(c) The Nigerian Topographic map, Ilesha sheet 243, S.E (1:50,000) was used in the creation of the base maps and for the general orientation and geometric registration of the imagery.

(d) Vegetation and land use map sheet NB 31-4 compiled from SLAR imagery in 1977 at the scale of 1:250,000 was obtained from the Federal Department of Forestry, Ibadan.

To obtain information on land use change in the area of study, aerial photographs for February 1977 and SPOT imagery for May 1986 were used. For change detection purposes, it is generally, considered important to choose images acquired at roughly the same time of the year. Such imageries characteristically exhibit minimal differences due to climatological factors or phenological differences in vegetation. The situation above could not be met because of the inherent problems in acquiring remote sensing data, as outlined by Adeniyi (1986) and Fagbami (1986).

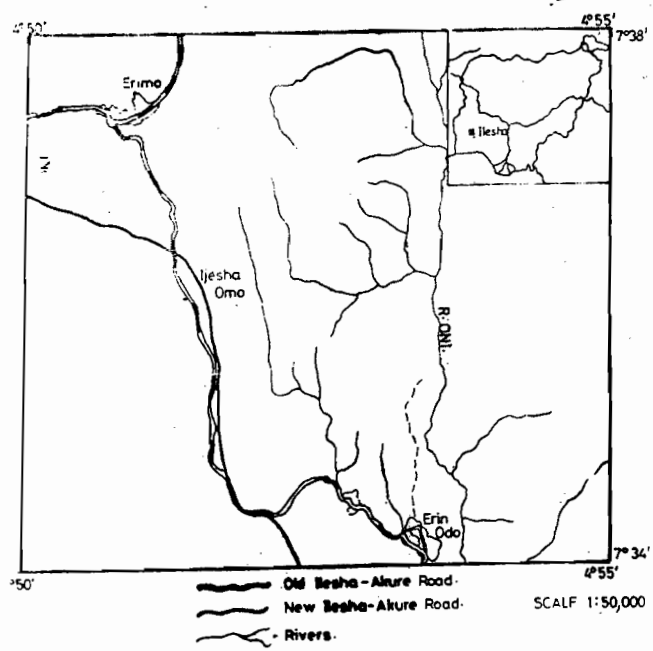

FIG. 1: LOCATION MAP OF EASTERN ILESHA

The procedure followed is a modification of that adopted by Adeniyi and Olugbie (1987) a shown in Figure 2. There was no previous land use classification scheme in the area and therefore one had to create an appropriate multi level classification scheme.

The interpretation of the aerial photographs was carried out with the aid of mirror stereoscope with 3x magnification. The SPOT false color composite was interpreted on the procom-2 equipment at the Department of Geography, University of Lagos. In both cases, image elements such as tone/colour, texture, pattern, size and shape were used for the data interpretation.

The boundaries of each land use identified were drawn onto overlays. As a result of the differences in the scales of the imagery, and aerial photos, a common base at a scale of 1: 25,000 was constructed. The landuse maps were checked in the field in June 1992. Because of the time difference between the field work period and the acquisition dates of the data set used, the field checking was carefully conducted so that the changes in land use which occurred between 1977 and 1986 were not recorded as interpretation error. In addition, farmers, government workers and residents of Erimo, Erin-Odo and Ijesha-Omo were interviewed. This was to gain an

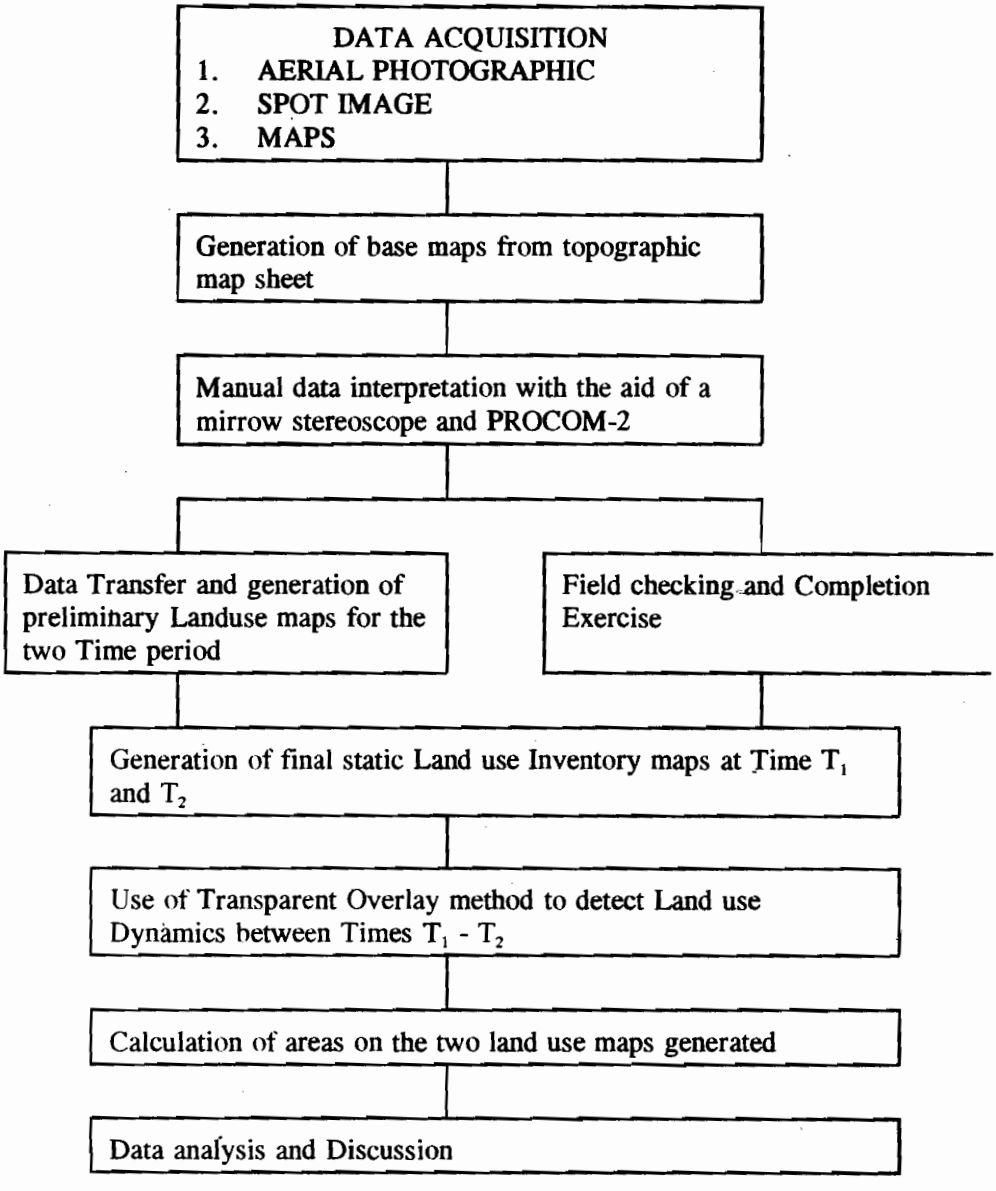

Fig 2. A flow diagram illustrating the research procedure. Culled from Adeniyi and Olugbile (1987)

insight into the process leading to the changes in landuse in the area.

After the field check, the overlay method which permits the determination of the nature of change and the location was used. The area of each land use category as well as land use change was measured with Dot grid.

RESULTS AND DISCUSSION

The discussion of the results is done under three subheadings;

(a) the landuse situation in 1977 and 1986;

(b) the changes that occurred between 1977 and 1986, and.

(c) the consequences of such change.

Land Use Situation in 1977

Measurements from the aerial photos in 1977 show that the forest (Dry and Raparian forests) occupied the major part of the study area (74.8%). Coming next to the forest is the fallow which occupied 17.6% and because the photos were taken in the dry season of February, the area cultivated to crops was small (5.77%). The built up area was the smallest (1.76%). This is made up mainly of Erimo and Erin-Odo villages *(Table 1.)*

Majority of the forest lands were on the high Erin-Odo and Ijesha-Omo hills. The high and undulating topography of these places must have been responsible for the little interference as compared to the fallow in the basin of Oni river.

Table 1. Land use - land cover of study area from AP and spot

SYMBOL	CODE	AREA IN 1977 AP HA	PERCENTAGE OF TOTAL AREA	AREA IN HA FROM 1986 SPOT	PERCENTAGE OF TOTAL AREA
11	SETTLEMENT	101.56	1.76	139.00	2.42
21	CROPLAND	332.00	5.77	1090.00	18.94
22	FALLOW	1017.00	17.67	828.00	14.39
41	RAPARIAN FOREST	1731.00	30.07	1279.00	22.22
42	TYPICAL RAINFOREST	2575.00	44.73	2064.00	35.86
51	BARELAND	—	—	334.00	5.80
71	BARE LAND (QUARRY)	—	—	22.00	0.38

The Situation in 1986

Table 1 shows the landuse situation in 1986 from the SPOT imagery. The forest continued to dominate the area coverage with (58.1%) while the crop land came next with 18.94%. The increase in the crop land area is due to the fact that data was recorded in May during which most land had been cultivated for the season. The land fallow decreased to 14.39% while the build up area increased to 2.42%. During this period, the land area that are burnt and bare and not yet cropped recorded 5.8%. 22ha (0.38%) of the land were either excavated or used as quarry sites for stone breaking.

Changes that occurred between 1977 and 1986

As shown in Table 2, the area under study went through a tremendous change between 1977 and 1986. The built up area increased by 37.44 ha or 0.65%. This increase came mainly from Erimo due to influx of people during this time period.

Unlike the built up area which experienced tremendous growth during the period under investigation, the agricultural lands suffered a considerable decrease. The area under fallow decreased by 189 ha or 3.28%. This is mainly due to the time differences in the acquisition of both AP and SPOT imagery. The AP was acquired in February when most crops had been harvested and the land left to regenerate its fertility while the SPOT image was acquired in the month of May when planting of newly cleared burnt fields were just over. This is also responsible for the increase in the area under cultivation by 13.2% in 1986. The cultivated land centred mainly on the

basin between the Erin-Odo hills and the Ijesha-Omo hills which runs parallel to the new Ilesha-Akure Road. A larger portion of the whale-back hills at Ijesha-Omo were also brought under cultivation.

Both the dry land and the raparian forests experienced reduction in the area coverage 452 ha or 7.85% of the raparian forests were converted into other uses while 511 ha or 8.8% of the dry forest suffered the same fate. The forest was undergoing deforestation at the rate of 1.86% annually. The information about the nature of change is very important because it provides an insight into the processes of the changes. Between 1977 and 1986, 334 ha or 5.8% and 22 ha o.38% of the forest lands were converted into bare land and quarry sites respectively. The bare lands are areas where sand were excavated to fill the newly constructed road between Ilesha and Akure while the people of the area suddenly found new means of livelihood in breaking stones (Fig.3). A larger portion of the forest around Erin-Odo were cut down for fuel. During the period under study, the prices of cooking gas and even kerosine went up to levels beyond the reach of the common man so that the people had to find solace in firewood (Fig. 4).

Implication of the findings

Since man's role in land degradation is that of land misuse and over-exploitation of the natural resources, one would want to examine whether the changes above are the result of misuse or over-exploitation.

One of the major findings of this study is that a large area of the forest land (963 ha) has been opened up for cultivation between 1977-1986. Such large scale conversion in an area with steep narrow hills and heavy torrential type of rainfall can have far reaching consequences in the degradation of land via soil erosion. This could also invariably lead to more pressure on the remaining land even including the marginal lands such as the hill slopes with high gradient which might eventually be opened up for use, inviting further degradation of the environment.

The increase in the bare surface and quarry sites also leads to lands that are perpetually put out of production. Such excavation and digging go beyond the top horizons resulting in permanent loss of the land for agricultural production and accelerated erosion.

The high conversion of the forest land to urban dwelling is not accomplished by corresponding growth in industries which could have absorbed some of the farmers that lost their farm lands thereby reducing the pressure on the remaining land. The growth in built up areas is as a result of providing shelter for the influx of workers as a result of changes in the status of Erinmo.

Table 2. Area Difference Between Spot Image (1986) and Aerial Photographs (1977)

CODE	AREA FROM SPOT (1986) HA	AREA FROM A.P (1977) HA	DIFFERENCE IN HA	PERCENTAGE DIFFERENCE
11	139.00	101.56	+37.44	0.65
21	1090.00	332.00	+758.00	13.17
22	828.00	1017.00	−189.00	3.28
41	1279.00	1731.00	−452.00	7.85
42	2064.00	2575.00	−511.00	8.88
51	334.00			
71	22.00			

CONCLUSION

The changes that occurred in landuse of the eastern part of Ilesha through the interpretation of multi-temporal and multi-data remote sensing was examined.

From the findings, it was discovered that nature of landuse changes tend to enhance the process of land degradation which is not conducive to the growth of the study area. Although there is need to open up a land for agricultural production and shelter for people, the social implication of such conversion needs to be adequately addressed but this can be done only after the acquisition of knowledge about the resources, the environmental process and social economic variables of the area.

The capability of remotely sensed data to generate data which will be useful in urban planning and environmental conservation has been proved by this study. SPOT (HRV) imagery, with higher spatial resolution and cartographic capability, will enhance the acquisition of environmental and resource information especially when used in conjunction with other remotely sensed data.

Fig. 3: Stone-breaking rendered a permaent damage to the land (1993)

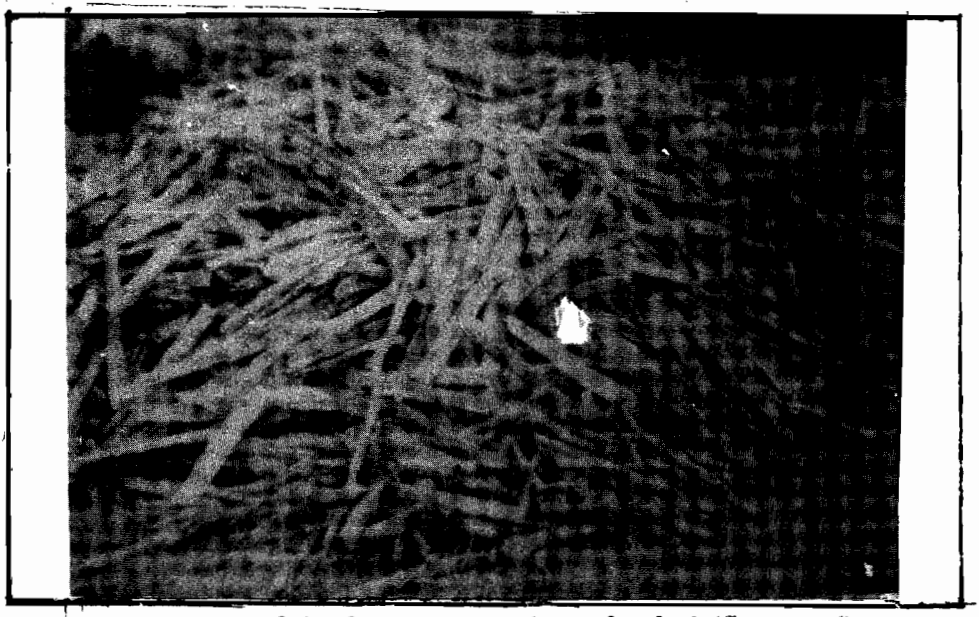

Fig. 4: Most of the forest are cut down for fuel (fire-wood) as prices of cooking gas and kerosine went up. (1994)

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