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THE USE OF COMPUTER AND MANUAL ANALYSIS IN DETECTION OF LAND USE CHANGES IN JOS, PLATEAU STATE, NIGERIA

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ABSTRACT

The Land use changes of Jos region with assisted Computer and manual approaches has involved visual examining of the satellite image data which have been reprocessed to remove geometric distortions and radiometric errors. Land use interpretation accuracy depends on the land use classification scheme which was designed with regard to the cultural character of individual environment. The UGSG scheme designed by Anderson et al (1976) has a valuable guide for the design. The concept of different levels of land use land cover details interpretable according to the different scales of the imagery and hence the special resolution quality is adopted. Computer utilization involve computer trade offs of time and resources against projected benefits and designed to minimize the time required for researcher. The research material used are aerial photographs for 1976 and 1991 were scanned into the computer using mustek 600 111 Ep plus. The scanned imageries were concatenated and analyzed to assess the use of computer in related studies. The result shows that a lot of growths have taken place in the study area. It has the annual growth percentage of 0.95 in which more buildings of different types now occupy most of the open spaces with a reduction of-15.54% due to population increase. Comparisons were made between the applications of Satellite Remote Sensing tools to determine the reliability and capability of either for effective monitoring. Methods of inventorying and their relative advantages and principles are shown.

KEYWORDS : Computer, Landuse, Environment, Population and Remote sensing

The activities of man in the process of fulfilling human needs such as food, shelter, security and amenities accelerates the pace of change on earth surface either for a short or long term (Jiya, 2000).For that, man in his inventiveness has determined how to use and manipulate his environment for self satisfaction. Mining activities in Jos plateau state cover a large area extending to other towns such as Bukuru, Vom, Barkin Ladi, Makera, and Miango. Tin is basically associated with the younger granites of the Jos plateau in form of heavy black granulated grain mixed up with sand and gravel and deposited in alluvial beds called tin wash. The undulating topography of the plateau is a fundamental necessity of life in which the social, political and economic activities of the people function. But even in the absence of people change goes on. Since all developing countries' economies depend largely on agriculture and mining of mineral resources, they are dependent solely on land and its products for subsistence. However, the inventory and control of land and land use are generally useful through application of Remote Sensing and GIS in surveying and mapping techniques.

A tremendous development in data acquisition and computeraided analysis techniques has become possible to derive subtle and diverse information regarding the physical (i.e. size, shape, and area) with chemical properties of the features and surfaces of the land. This new approach known as remote sensing has found increasing application in develop and developing countries. Remote Sensing Application deals with the science of acquiring information about objects from measurements made without coming into physical contact with the objects concerned. In multipurpose planning, inventory and management of land resources and environmental protection constitute one of the primary issues of economic development. The inventory of land resources calls for current situation of mapping while the control and management of these resources and monitoring of environmental change demand repetitive coverage with proper planning to meet the growing population challenges (Halilu, 1993). Both aerial Photographs and Land Sat have been used in various studies to assess soil condition and type as inputs into the degradation of soils. Fagbemi, 1986 in Makurdi area, Nigeria, used landsat and aerial Photographs to map and assess the condition of soils including their Physical limitations such as erosion as well as flood hazard problems. Agbu and Ojanuga, 1986 used aerial Photographs in soil survey of part of Dange area of Sokoto to classify soil based on slopes, landforms, drainages, erosion features and vegetation. Carter, 1958 used Photographs to study sheet erosion and gully erosion in eastern Nigeria River Njaba and

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attributed the degradation of the agricultural land to the nature of the slope, run-off and human activities. Akinyede, 1993 used SLAR in conjunction with aerial Photographs to map geological characteristics of Biu in Plateau and found that remote sensing has the ability for easy and quick production of geology map. Visual interpretation of satellite imagery, using method of image analysis has proved to be very important in mapping lithological units (Geols et al., 1985). On the ground, gullies are not readily apparent but on the aerial photographs they can fully be investigated. This is because gullies areas are distinguishable even on single Photograph by their tonal expression due partly to lack of vegetation and irregularities of their edges (Patrick, 1993). On Stereoscopic photographs, most gullies are easily identified even in the ground cover because of their distinctive morphological expression especially their sharp and clear cut headscarps (Ologe, 1971).Land use change is seasonally dynamic and most requirements are not only for mapping of the existing land use but also for a system to monitor regularly changes that are occurring. These changes could be expansion and the loss of agricultural land, changes in river regime, the effects of erosion and desertification and so on. On a broader sense, land cover designates the visible evidence of land use to include both vegetative and non vegetative features and is subjected to direct observation (Campbell, 1983). A planned approach to changes in land use has recently become wildly recognised. The agricultural land is influenced by urban development as this is where the most rapid changes occur. To understand natural and uncontrolled changes so as to evaluate their importance and the possibility of avoiding the unnecessary and harmful changes where applicable, land must be studied comprehensively.

The study aims to use computer and manual techniques to analyse land use changes with a view to examine the use of remote sensing technique in land use change detection of Bukuru-Jos area; to interpret through the aerial photographs the land use changes that occurred between 1976 1991; to measure the percentage growth between the periods of 1976-1991; to make recommendations on the use of Remote Sensing in modern planning and growth.

MATERIALS AND METHODS

Study Area

The study area is the Jos Plateau which lies in the central part of Nigeria. The Plateau covers a total surface area of 9400km^2. It is underlain by crystalline rocks. The

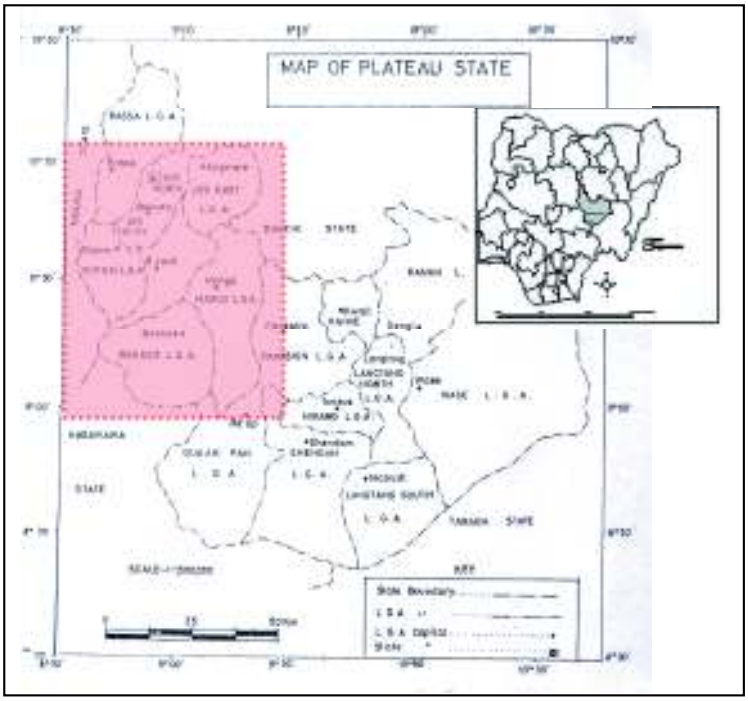

Figure 1: The Location of Jos, Plateau State

Plateau is bounded by latitude 10° 11'N and 8° 55'N and longitudes 8° 21'E and 9° 30'E to the North by Bauchi State, to the West by Kaduna State, to the South by Nassarawa State and to the East by Taraba State. (figure 1)

The data used were derived from aerial photographs acquired from the ministry of lands and survey department, of Jos plateau state. The aerial photographs are for 1976, and 1991 with a scale of 1: 10.000 and 1:8.000 respectively. The topographic and political maps of Bukuru were also collected for consultation and delineation of the study area respectively. Mirror stereoscope was used in delineating features on the sequential aerial photographs using the elements of interpretations. Transparent papers were used for tracing of the delineated areas. The aerial photographs for 1976 and 1991 were scanned into the computer using mustek 600 111 Ep plus. The scanned imageries were concatenated and analysed to assess the use of computer in related studies. The aerial photographs for the two periods were adequate and augmenting one another in instances of permanent features such as outcrops and roads that were improved upon. The photographs were drawn into mosaic on tracing sheets.

Types and Principles of Interpretations

The two types of approaches to image interpretations are manual interpretation and computer aided interpretations. Computer approach to image interpretation is a classification process involving a number of procedures to be followed by various uses. Computer approaches are done when the image is in digital format. This is why a set of photographs were scanned into digital number and interpreted. Manual interpretations are direct interpretation of images that were printed. It involves identifications and mapping of various objects and calculating the area extents of the various features. Depending on the availability of any type of data, one can use either approaches. These approaches have their different advantages and disadvantages. In case of the size of data, time frame and accuracy digital images are better. When one looks at the expenses, types of classification of buildings and accessibility one would be forced to consider aerial photograph.

The various photographs were laid to overlap each other by 60% and gave the stereoscopic view of the features contained on both the photographs. Using the elements of interpretations features such as built up areas, bare rocks, ponds preservation area, public uses, Roads, open spaces and cultivated land were delineated for 1976 and 1991 set of photographs. The two mosaics were traced interpretation could not overlay because of the flight line that varied. The two mosaics were drawn and reduced to the same scale by first registering the permanent features on all the tracing papers used for the multi date data.

The 1991 mosaic was over laid on 1976 and changes that occurred for the period of fifteen years were drawn and traced to the same scale. Land use interpretation accuracy also depends on the land use classification scheme which has to be designed with regard to the cultural character of the study area. The USGS scheme designed by Anderson et al., 1976 has provided a valuable guide for the design. The concept of different levels of land use or land cover details is interpretable according to the different scales of the imagery and hence the spatial resolution quality is normally adopted. However each of these land uses will be identified by a single digital symbol indicating the level one category interpreted from aerial photographs of 1976 and 1991 respectively. The land use classes used for the manual classification are given in table 1 With reference to the modified level 1. USGS classification scheme, the

Table 1: USGS and Modified Land use Classification Scheme

S/NO	USGS Classification Scheme	Modified Classification Scheme
1.	Urban or Built up land	Built up area
2.	Agricultural land	Cultivated land
3.	Range land	Reservation
4.	Forest land	Public uses
5.	Water	Ponds
6.	Wet land	Bare rocks
7.	Barren land	Open spaces
8.	Transportation	Roads

researcher designed eight classification scheme of the study area.

The definition of these classifications is -

1. Built up area - This is where the political, economic, social, moral and educational institutions are intensively put into practice. These bring about a development trend as the level of cooperation, integration and competition highly exists among the people. Built up area is therefore a place of focus for a purpose and is the most interesting scene for mankind.
2. Bare rocks - These are rocks that appear in scattered form in the study area. They maintain the same size and shape for several years.
3. Ponds - These are open areas where mining activities have taken place .Ponds have water in them which increases in volume and dept during rainy season.
4. Reservation area - Land primarily used formerly for mining activities and now placed under fallow while reclamation is taking place as well.
5. Public uses - These are places set apart for public uses like markets, games and sports fields, cinema houses, hospitals and so on.
6. Roads - This is referred to transportation network such as foot path, minor roads, major roads, and railways.
7. Open spaces - The remaining areas undeveloped for a purpose in the study area.
8. Cultivated land - This is where farming activities takes place such as fish farming, cropland and pasture, orchards and nurseries.

2.3 Computer Assisted Interpretations

A set of aerial photographs 1976 and 1991 were scanned using mustek 600 111 plus into Idrisi for windows. The scanned images were concatenated to form a mosaic on the screen .For each feature chosen, using image processing realm 1 Con, ten training sites were selected for such categories. Signatures were created on the number of categories chosen. Using maximum likely hood the areas were then classified into eight. From the analysis realm, the areas covered by each category were calculated in percentages. These data formed a basis for comparism with manual interpretation. The results were also indicating which extent any of the works could be relied upon.

RESULTS AND DISCUSSION

Interpretation of 1976 Aerial Photograph

The 1976 aerial photograph (figure 2) shows that the built up area occupied 5.84% of the area. The growth tends towards the south western and north western part of the area from the southern junction to the stadium and main market were developed bringing about much settlement in these places (figure 2) The Bare rocks maintain 1.84% (table

Figure 2 : Jos-bukuru Land Use Map (1976)

Table 2 : Land Use Percentage Coverage for the Two Periods

	LAND USE CATEGORY	1976 LAND USE IN %	1991 LAND USE IN %
1.	Built up areas	5.84	20.06
2.	Bare rocks	1.84	1.84
3.	Ponds	3.35	3.35
4.	Reservation area	2.93	2.93
5.	Public uses	3.68	4.29
6.	Roads	16.14	17.12
7.	Open spaces	37.63	25.67
8.	Cultivated land	28.59	24.74

Data source: Author's analysis of Aerial photographs of 1976 and 1991 Bukuru Jos

2) of the total area occupied . They are found scattered in all places except in the south and south eastern part. The ponds scored 3.35% of the total area which can be found in the north eastern, south and south eastern part. Ponds are of tremendous assistance to the exiting populace of the area in terms of domestic uses, fish farming and dry season cultivations. Reservation area occupied 2.93% tending towards south west of the study area and most places where mining activities have taken place are on reserved. The public uses occupied about 3.68% of the total land area. The stadium, Government secondary school and market are in the south western part of the area. Roads including footpaths, seasonal, minor/major, and railway occupied 16.14% of the study area. Railway and major road runs from south western to the central part where they crossed (figure 2). The railway maintain the central run through while major roads passes through the western and the central parts linking places. Other roads such as foot path, minor and seasonal roads run all over the study area connecting places of interest. Open spaces occupied the highest land area of 37.63% which can be found in the north western, extreme south western, north eastern and south eastern part of the area which is dominated by very short grasses as its vegetation. The cultivated land has 28.59% (Table2) which spread towards all places except north western part of the area.

Interpretation of 1991 Aerial Photograph

Based on USGS design method of classification, built up areas occupied a total land of 20.06% (table 2) towards the south west and north western part of the area. Bare rocks that seem to be of the same size occupied 1.84%

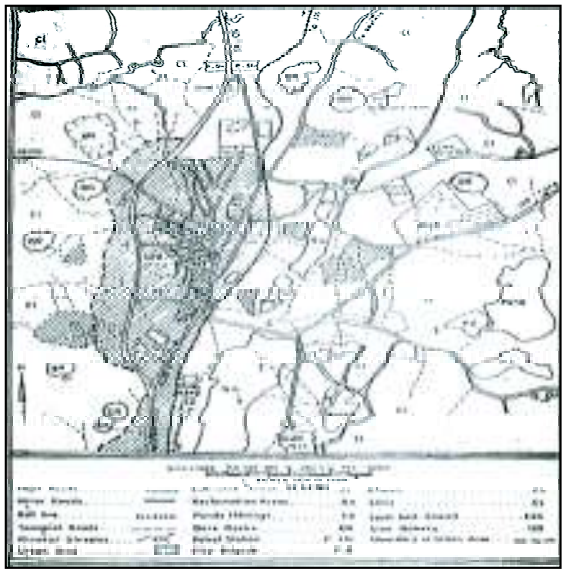

Figure 3 : Jos-Bukuru Land Use Map (1991)

of the area. The rocks are scattered in all places except in the south eastern part. Ponds are scattered in the area except in the north western part which occupied a total land area of 3.35%.Reservation area occupied 2.93% of the area in the southern and central parts(figure 3) The public uses occupied 4.29% (Table2) of the total land and scattered in the built up area. Roads comprises of major, minor, rail line, seasonal types occupied 17.12% of the area. Open spaces leading from North to East to South Eastern part and also to the North Western part of the area occupied 25.67%. The highest score is the cultivated land which occupied 24.74% of the area. The sudden growth can be attributed to the abolition of tin mining in Jos plateau region.

Land Use Change Between 1976 and 1991

The land use a change for the period between 1976 and 1991 is shown in figure 4 from the analysis, it was

Table 3 : Land Use Percentage Change for the Period of Fifteen Years

	LAND USE CATEGORY	1976 IN %	1991-1976 CHANGES IN %	REMARKS
1.	Built up areas	45.70	70.84	Increased
2.	Bare rocks	0	0	No change
3.	Ponds	22.49	0	No change
4.	Cultivated land	100	-15.54	Decreased
5.	Reservation area	14.23	0	No change
6.	Public uses	59.09	14.06	Decreased
7.	Roads	46.14	5.77	Increased
8.	Open spaces	-107.73	-46-59	Decreased

Data source: Author's analysis of Aerial photographs of 1976-91 Jos.

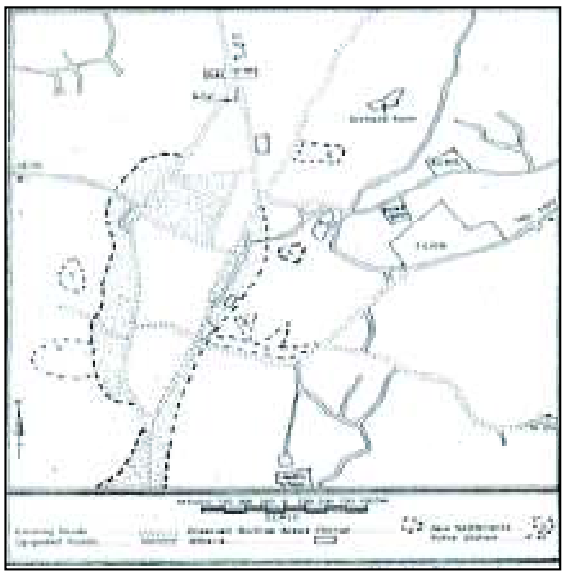

Figure 4 : Jos-Bukuru Land Use Map Showing Observed Changes Between 1976 & 1991

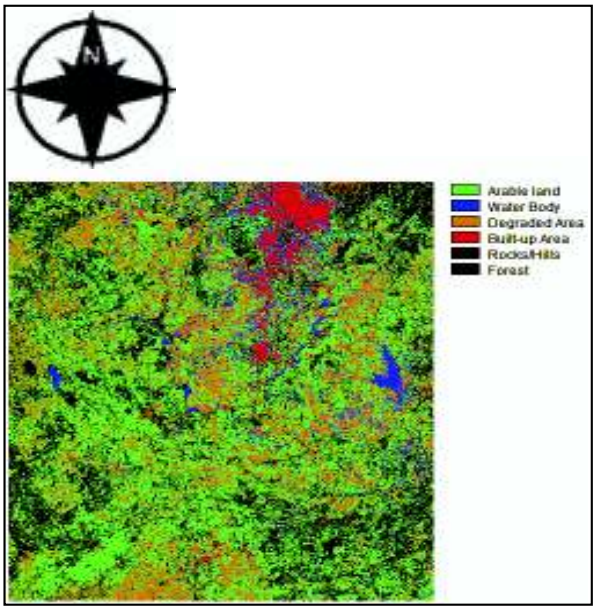

Figure 5: The Land Use Pattern and the Extent of Mining Degradation from Land Sat ETM+ 2005

revealed that three classes noticed no change. They are ponds, bare rocks and reservation areas. While other five categories recorded decreases and increases respectively. Built up area recorded a great change increase of 70.84% than any other category.

This shows that a lot of growths have taken place in the study area. It has the annual growth percentage of 0.95 in which more buildings of different types now occupy most of the open spaces, cultivated land and so on. The cultivated land recorded a reduction of -15.54% (Table 3) changes. This could be due to fast growing and expansion of Jos. Public uses has been recorded to be 14.6% showing a decrease in the area due to growth of Jos city. It also recorded an annual growth of 0.04%. Roads have a record of 5.77% increase with0.07% (Table 3) 0f its annual growth. The roads linked up all connectivity of the area. Open spaces has a record of -46.59% showing a decrease. This is due to increase changes in built up area and other catgeories respectively. The annual growth rate is 0.80% of the study area.

The classified map above reveals an increase in arable land and Water bodies due to an increase in extensive farming and grazing practices among the inhabitants, and also resultant increase in the number of water filled mining ponds and adverse erosion effect from intensive mining activities respectively. The built-up area has also increased due to increase in population and development (Urbanization) in the area.

Actions and Implications of Study

It has been observed that the dynamic and static record of results in the categories, built up area has witnessed a tremendous increase changes. While a reduction in cultivated land reduced to minimum level. The implication of this action is that many people have become subsistent farmers at the expense of fast growing population of the area. Efforts have been made to reclaim the land which miners have disorganised and agricultural practices made impossible for several years ago. Other categories also have negative effect on cultivated land. The mining ponds are spread in most part of the area and stagnant in nature. The large majority of people use water in these ponds for domestic purposes while animals mostly pigs, dogs and cattle drink from these ponds. Such development is dangerous to life existence. The open nature of the ponds are converted to fish farming in which chemicals of various types may be used for catching fish which could be dangerous to living things that may use the water. Another implication is the open spaces of the study area which help reduce tension of space likely to affect Jos city. Many offices and house accommodation are cited in Bukuru due to rocky

nature of Jos where extension has become a big problem. However Bukuru has turned to be a satellite town of Jos which encourage competition and cooperation among the people.

CONCLUSION

The use of computer and manual analysis has proved to be a viable tool in the study of land use changes. The future of the earth's dwindling resources rests on the ability to analyse data quickly and accurately and in a manner that the general public can understand. The growing population of the study area uses land more intensively than expected. Urban land is used for urban activities than their rural counterparts. Land is both a resource and a property and unlike most properties, the owners are restricted in its use by regulations. This leads to the notion that much of the value of urban land can be ascribed to public investments, institutional decisions and economic interdependencies of urban activities.

It is also a conventional wisdom that land use problems lies at the very heart of planning, building and managing human settlements. As such, severe competition, cooperation and conflicts for land use often prevail in and Jos. Monitoring changes on land use from current data will certainly help to reduce and control much pressure placed on land. The use of aerial photographs with result discussions and finding will certainly help the local state and federal government take good measure to improve living standard by putting some infrastructures in place. The study enlightens policy officials at all levels about the relevance of remote sensing techniques as a check and quick means of finding solutions to environmental resources and its management.

Further research can be based on integrated physical development plan, upgrading poverty alleviation programmes, transportation, housing programmes and public social services delivery system are a few of the many areas of public needs which are influenced by and have effects on urban spatial form and location. Because of the great complexity of urban systems like Jos, modelling will have great potentials as an aid to formulating and analyzing public programmes in these and other policy areas.

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