AN ASSESSMENT OF LANDUSE AND ITS TRANSFORMATION USING REMOTE SENSING TECHNIQUES "A CASE STUDY OF MARADUN AND ITS ENVIRONS" ZAMFARA STATE

BY

ATTAHIRU MOHAMMED MARADUN
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BEING

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CERTIFICATION

This is to certify that this research work – An Assessment of Landuse and its transformation using remote sensing technique "a case study maradun and its environs' in Zamfara state; has been undertaken by Alhaji Attahiru Mohammed Maradun Under my supervision and approval.

Dr. Akinyeye Major Supervisor	Date
Dr. M. T. Usman H. O. D. Geography	Date
External Examiner	Date
Professor J.A. Abalaka Dean Post Graduate School	Date

DEDICATION

To my late parents Alh. Muhammadu Tambari and Safiya

ACKNOWLEDGEMENT

I wish to first express my gratitude to Allah (S.W.A) for sparing my life and giving me good health, which enabled me to complete this phase of my academic endeavour.

My sincere appreciation goes to DR Akinyeye my wonderful supervisor and Examination Officer of the Geography Department. He has been helpful and inspired me throughout the project work. His constructive criticisms saw me though and standardized the project.

I thank my wife for bearing with my absence and also for her unflinching moral support throughout the project "AISHA' I thank you once more. Finally my appreciation goes to my elder brother Major Aliyu M. Maradun, my friend Mohammed Mansur Maccido and all well wishers whose inspirations and support spire me into action.

It is recommended that higher resolution imageries are the best for use in the study of landuse/landcover transformation i.e the spot panchromatic Xs and Landsat TM, these satellite systems have higher resolution, with this settlements and other minor features can be delineated with which will provide a more accurate information regarding transformation dynamics.

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- Hot dry season (Bazara) from March to June
- Warm wet season (Damina) from July to September
- Cool fry season (Hunturu) from October to February.

In the soil profile content it consist sandy top soil and a clayey sub-soil in which concretion is common because the tope soil are readily washed off rain water. Generally, the soil of the area is of heterogeous nature, there are the old soils, sub-recent and the recent alluvial deposites, the soil can be divided into two types:

- The well drained soils
- The poorly drain soils.

The vegetation of the area is characterized by having grass cover, and in some area, sporadic tree covers are observed which are between 75-15 metres high. The temperature of the area is relatively high through out the year (30^0c) except for changes between the night and day temperatures and during the harmattan period.

1.3 PROBLEMS STATEMENT

The landuse and land transformation is very important for many reasons to make a study upon on. The land is man's resource base from which be obtains his resource necessary for life as well as those for his luxury.

increase in the surface run off in this area and this is a contributory factor in climatic changes in the area leading to drier conditions (Udo 1970 a process of desertification).

The construction of the Bakolori Dam resulted in a conflict and imbalance in the landuse in the area; between the traditional land use and the modern land use systems by damming as is the case of Bakolori in Nigeria and Africa in general has a lot of the impact on the flood plain economies by disrupting the flood plain agriculture. In this circumstances, two separate factors are at work:

- Change in the water quality
- Change in the amount of water available especially the amount and timing of the flooding patterns.

The quality of the water changes as a result of the depositions in the dam of silts carried by the river upstream. This process rub the area downstream of fertility as most of the fertile silts are deposited in the dam, thus causing reduction in the yield, except where artificial fertilizers are used and the colour of the water in the dam changes to brownish colour.

Controlling the water in the dam affect the flood plain communities in the downstream area up to Sokoto, Kware and Rabah by affecting the timing, extent and the depth of flooding, initially this causes a lot of problems in the areas downstream of the

also to map out the ecological changes so as to determine the degree of desert encroachment. Finally, to evaluate the changes that occur in the landuse systems and vegetation cover of the area as a result of the construction of Bokolori dam.

1.5 JUSTIFICATION

Adefolalu (1986) pointed out that Zamfara, Sokoto, Kano and Borno states located on the desert fringes are experiencing the harsh effect of desertification where the arable land has been reduced to about 42.89% in the Zamfara amd Sokoto for instance.

And Maradun is situated in the aforementioned areas therefore a continuous monitoring of the land use in the area is very necessary for the development of the area.

The construction of the dam has introduced a modern technology into the traditional culture of the area. These have effect on the landuse system, therefore increasing the rate of the transformation of the land, which if not monitored, will lead to desertification and general environmental degradation.

The construction also have great impact on the economics of the downstream settlers which leads to general reduction in production of the area by opening up lands unsuitable for production of certain crops e.g. millet and sorghum.

The construction of the dam also affects the fishing activities where by reducing the catch. This singular factor lead to some settlers of the flood plan area engaged in fishing activities migrating to as far as Maiduguri, chad and Lokoja areas.

Also regulating the floodwater lead to reduction in floodwater supply to the downstream areas which lead to the famous Bakolori riot in the early 1980's. During this period, the pleasant farmers who practiced fadama agriculture rioted because of the lack of water which was held back as a result of the regulation of the flood water in the dam. The study of the landuse and dynamics is very important for the purpose of planning and development of all sorts for studying the rate of environmental deterioration and quality.

This project on the assessment of land use and transformation a case study of Maradun in Zamfara state using the modern technique of monitoring the environment provide a fast, accurate and repetitive coverage of the study area and is relevant to the Nigeria as a whole.

1.6 SCOPE AND LIMITATION OF THE STUDY

The topographical maps and aerial photographs with information obtained from field cheek is the main source of information and the aerial photographs used to study the land use

pattern before the construction of the dam provides alternative source of information.

A prerequisite for better land use assessment is the acquisition of information on the existing land use pattern and the transformation that is occurring overtime. These assessments was done on Maradun town and its environs.

CHAPTER TWO

2.1 LITERATURE REVIEW

Modern techniques of remote sensing has been utilized in Nigeria for about 26 years when the science was used for oil prospecting project and forestry. But prior to this period, aerial photographs which was the earliest form of remote sensing technique then has been used to produce topographical maps.

Nigeria as one of the developing countries in the world, faces the problem of shortage of reliable data for research and development purposes, and remote sensing offers a fast and reliable source of data collection for development at purposes. It was then the establishment of the NISORS (Nigerian Society of remote sensing) in November 1980, which promoted the development and utilization of science, and technology of remote sensing for national development.

The study of landuse and its transformation is closely related to the study of vegetation, crops and soil of an area, and the study of land-use is very important for the planners who have to make decisions concerning land resources management, that are strongly economic in nature. The data on land-use and its dynamics are usually presented in map form accompanied by area statistics for each category of land-use (Lo 1985).

Settlements (HABITAT) and the master plan project unit (MPPU) of Lagos state government. It was noted that Agege (NW of Lagos) was one of the urban fringe areas where rapid changes occurred (Adeniyi, 1978).

In the United State, the USDA (United State Department of Agriculture) undertook a large scale crop inventory experiment and Agricultural Resource Inventories through Aerospace remote sensing to determine the usefulness, cost and extent to which aerospace remote sensing data can be integrated into the existing USDA information system to improve the objectivity, reliability, timeliness and adequacy of information required to carry out the monitoring of Agricultural crops from planting to harvesting (crop production). The crop (wheat) yield was estimated with accuracy of considerably better than 90% at 90% significant level, and the information was worth about 200 million dollars to the US agricultural industry. These estimate on wheat production were obtained region by region, 6 – 8 weeks before harvest (Barret 1982).

Adefolalu (1986) used landsat data in combination with data obtained through SLAR and the grand truth method using the four pixel quadrant technique to map out the landuse situation in West Africa and he documented 5 major vegetal covers i.e the woodland/grassland, shrub land, farm land, forest and barre ground.

He also observed that Maiduguri, Yobe, Sokoto, Kebbi and Zamfara States located in the desert fringes of Northern Nigeria were experiencing the harsh effects of desertification. In these areas the arable land had reduced to 19.29% and 41.89% respectively, and grassland and shrub land were 59.97% and 38.35% respectively. The study forecasted here these 2 states (Kano and Kaduna State) use a high percentage of their land for intensive agriculture. That by 1991 – 2000, the arable land in the states would be turned into shrub land and Sahel proper. e.g

Helldeu (1985) studied drought impact in the Sudan using land use and cultivation transformation based on the interpretation of aerial photographs, landsat imageries of 1972 and 1979. The proportion of the cultivated zones were determined on the satellite image and then compared with the same area from the 1962 aerial photographs. Bare dunes were also studied using the same method. Helldeu concluded that no desert like condition were created within this period 1962 – 1979, but severe drought impact were observed which reduces the crop yield between 1964 and 1974.

In Canada, landsat MSS data was used to reveal a part of the province of Manitoba, the capital city Winnipeg was clearly visible as a large light toned urban areas rinsed by roads. Also nother light

toned area comprising of mostly dead vegetation was observed surrounded by medium toned Agricultural area. The light toned area was observed and identified to be a tornado and hail scar which was formed as a result of the storm that occur and destroy a lot of agricultural produce. This landsat imagery was used by the crop insurance company to help settle the crop loss claims that resulted from that storm in 1984 (Lillesand 1987).

Larsson (1994) uses SPOT imageries to study landuse, water and vegetation of Munnessa area in Ethiopia. The result was found to be very interesting. The remote sensing data was complemented with both aerial photographs and topographical map of the area coupled with information gathered from ground truthing to come out with the following findings:

1. The major landuse were identified and demarcated from forest bush land, farming and grazing land.
2. Identified and mapped out the significant hydrographical features including the major river divides.
3. Infrastructures such as villages roads and fences were also demarcated.

Adefolalu (1987) used aerial photography to map the landuse changes and their distribution in Samaru area of Zaria. The study was conducted in 1980 where two panchromatic aerial photographs

taken in February, 1974 and July, 1979 at scale 1:20,000 were used.

Okhimamhe, A. A. (1993) also uses SPOT HRV acquired in 1986 and corroborated the remotely sensed data with aerial photograph of 1974 to detect the changes in the landuse/land cover in the Burun/Tiga area as a result of the construction of the Tiga dam over the period of 12 years. The result showed shrub land had increased by 104%, she also found out that the sandy area has increased which are indicators of desertification with an estimated annual increase of the sandy area by 12%.

Roger (1985) also conducted a study to quantitatively assess the land transformation occurring as a result of man's activities or as an impact of climate variability. Multi-temporal landsat imageries of 1970, 1976 and 1979 covering the St. Lawrence valley in Quebec, Canada were used to monitor the seasonal and long term variations in the landuse and vegetation covers. Four types of land cover were distinguished. Forest, Agricultural land, Anthropic area (Urban, water and others), follows abandoned land where young forest are regenerating. The result showed that deforestation occur and there was significant decrease in farmland and a marked process of urbanization.

Mohammed (1998) in his findings for landuse/ land cover situation in Mafara town of Zamfara State using visual interpretation of landsat MSS find that, of the total of 140,000 hectares or land under study, the analysis revealed that 78,540 hectares of the land area has been transformed either positively or negatively. It means 56.1% transformation of land was done within that period of his findings, he added, the grass/shrub land was the most highly affected, and the area covered by that land cover decreased from 30,5560 hectares or 38.91% of transformation and the Agricultural land on the other hand gained more land where the irrigated land increased by 8,310 hectares the fallow land increased by 2,930 hectares.

Adeniyi et al (1988) used both visual and digital analysis of landsat MSS to identify, classify and monitor the impact of dam construction in the Sokoto-Rima River Basin in North Western part of Nigeria. The landuse/land cover types were classified using the maximum likelihood procedure and the standard visual analysis procedure to investigate the changes in the dam site area. Significant changes in landuse/land cover were identified especially in the flood plain and downstream areas of the dam. It was concluded that the combined use of digital and visual analysis of a

higher resolution data like SPOT (HRV) would provide baseline data for detailed agricultural resources planning and management.

Patrick (1993) used two sets of aerial photographs to identify features of gully erosion in the guinea savanna area of Taraba State to map out erosion black spots in general. The sets of data generated include landuse types and changes over the years, channel frequency and lengths within different landuse change category and total stream lengths for 1964, 1978 and 1987. the result obtained were used to analyze the relationships between erosion and landuse through the impositioning of data materials. The total length of gullies was then classified into serious, not serious, moderately serious, very serious and severe serious and an erosion black spots, map was produced indicating these different intensities. He concluded that danger areas can be detected from the air using photographs, but to be able to predict future areas of erosion would require using a set of photographs flown regularly, at suitable scales and seasons.

Esrin et al (1995) used ERSI data to monitor long term changes caused by human activities in the tropical rainforest area of Indonesia. The deforested area where the forest has been totally or partially cleared by logging activities can be readily seen. Also evident are the burnt out fields used by the local inhabitants for

agricultural purposes, and regions where secondary forest growth has claimed, those fields that have been left to fallow are also readily visible, also identified are selectively logged forests settlements and clear cuttings.

E. Topographical maps at scale 1:250,00 covering the study area, and printed by the federal survey Department of Nigeria, 1960 and 1962.

3.2 SOURCE OF DATA

The aerial photographs at scale 1 40,000 taken in 1974 and 1.30,000 and 1:20,00 both of 1976 were obtained from SRRBD (Sokoto –Rima River Basing Development Authority). The landsat MSS image with identification number 5-190-51 acquired 18/Nov./87 for the dry season and 5-190-51 acquire 22/Oct. /89 for the wet season, both processed by telespazio for ESA-EARTHNET IN November, 1991; are obtained from professor Adefolalu under the auspices of the federal environmental protection Agency (FEDA). The imagery is of high quality and cloud free it is very important to obtain a good quality imagery for the assessment and detection of law use and its dynamics, it make identification much easier and faster with visual and computer assisted techniques of interpretation.

The table 1 below gives a summary of the data used and their characteristics:

3.4 METHODOLOGY AND PROCEDURE FOR DATA INTERPRETATION

The stereoscope and magnifying lenses were used to usually interpreter the aerial photographic, this is aimed at interpreting landuse and the landcover systems of the Maradun its environs prior to the construction of the Bokolori dam. The same instrument (magnifying lenses) was use for the visual interpretation of the landsat imageries.

During the interpretation process the image was read with the use of image interpretation elements such as tone, colour, pattern, texture, shape, size, site and association to make the interpretation keys. Tracing papers was then over laid on the satellite imagery and aerial photographs to bring out the landuse system of the area.

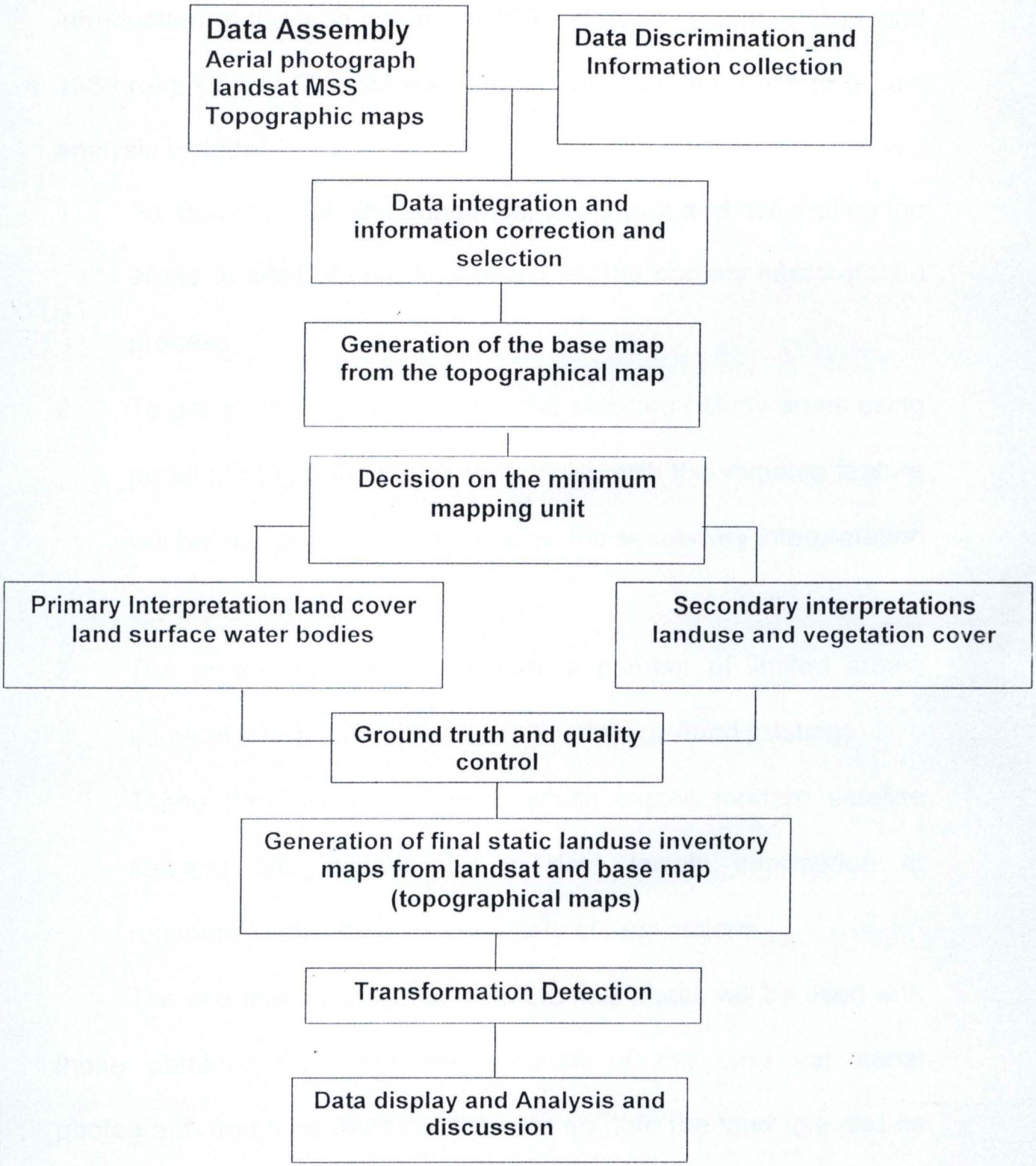
The topographical maps were at the same scale with the satellite image which makes it much easier for change detection analysis. The study area was mapped out from the two topographical maps this newly from map of the study area becomes the base map for the study of the land-use / transformation study.

The image was then appropriately registered to the newly formed base map using settlements, escarpments and drainage channels. The dam (Bakalori) and the lake kazama as registration points, the base map therefore aided the interpretation exercise.

The image is cloud free and of high quality making identification possible and with relative ease. Ground control points were identified and chosen in relation to some reference cartographic points. Identified on the image based on associations, shapes, size, patterns, texture and tone. This made it possible to compare the image with the map based on the same projection

The Idrisi software used initially enhances the study area and then classification was made (supervised classification) such enhancement technique have been used in a variety of different environment studies (Thompson et al 1982). They are often most appropriate in natural environment where charges are relatively subtle, having been used successfully to monitor flooding (Hawarth and Wickware 1981). Changes in the forest cover (Banner and lynham, 1981) and changing quality of land in the semi arid environments (Robinove, 1980 and Frank 1984)

The enhancement technique for change detection involves the modification of the original images to alter their visual and / or digital characteristics in a manner that improves the information contents (Sabins 1979) the flow diagram on (figure 1) shows the procedure followed and the basic characteristic of the data source.



Source: By the Author

In the study, a three level approach is used so as to obtain the best results. This approach is a new step in the development of terrain inventory and monitoring techniques which results from the

CHAPTER FOUR

4.1 DATA ANALYSIS

This chapter is divided into two main parts, which corresponds with analyzing the two main data used for assessing the land use and its transformation over the period of 15 years between 1976 and 2001.

TABLE 4.1 LANDUSE/LANDCOVER SITUATION IN 1974

S/NO	LEVEL 1 LANDUSE/ LANDCOVER	LEVEL II CLASSIFICATION	HECTARAGE	PERCENTAGE
1	Agricultural land	1.1 Irrigated land	4,130	2.95%
		1.2 Fallow and pasture land	4,900	3.5%
2	Vegetation	2.1 Grass/Shrub land	62,860	44.9%
		2.2 Thick Vegetation	1,930	1.3%
3	Water body	3.1 Muddy water	-	-
		3.2 River	4,100	2.92%
		3.3 Deep reservoir	-	-
		3.4 Shallow reservoir	2,100	1.5%
4	Wetland	4.1 Vegetated wet land	3,640	2.6%
		4.2 Non-vegetated wetland	8,190	5.85%
5	Bare surface	5.1 Exposed Rocky surface	13,600	9.71%
		5.2 Sandy area	12,210	8.72%
		5.3 Literate	20,840	14.88%
6	Settlement	6.1 Settlement	1,500	1.07%
		TOTAL	**140,000.00**	**100.00**

Sources: By the Author

From the table 4.1. It is observed that grass and shrub land covers 44.9% of the total land surface which is 62,860 hectares of the 140,000 hectares of land, and its is found uniformly distributed over the study area. The laterite surfaces covers 14.88% and is next to the grassland. Agricultural land, which is mainly irrigated land along the two major rivers and their tributaries that drains area, this irrigated land covers 2.95% of the total area. The rivers covers 4,100 or 2.92%, exposed rocky surface cover 9.71% and is found more prominent around maradan main town.

In 2001 as shown on table 4.2 Grass land covers 31.42% of the total land area and, agricultural land that is irrigated covers 4.95% this includes the surface irrigated area and sprinkler irrigation. The fallow and pasture landcovers 4,900 hectares or 3.50%. While the shallow reservoir covers 4,200 hectares i.e 3.00% and the deep reservoir made up of the Bakolori dam covers 5.71% of the total area or8.000 hectares, and to the lower southeastern part of the dam is muddy water which is covers the site of the former Maradan and Bokolori Villages. The vegetated wet landcovers 4.02% and non-vegetated wetland covers 4.42%. The sand area and exposed rocky surface covers 8.00% and 9.00% respectively. Settlement covers 1930 hectares or 1.37%.

4.2 LANDUSE TRANSFORMATION BETWEEN 1974 - 2001

Of the total 140,000 hectares or land study the analysis revealed that 78,540 hectares of the land area has been transformed either positively or negatively.

It therefore means that, there is 56.3% transformation of the land within the period of study.

hectares showing a decrease of 18,870 hectares or 30% of transformation. The agricultural land on the other hand gained more land where the irrigated land increased by 2,800 hectares of land and fallow land remain as it is. Te construction of Bakolori dam increased the water body by 8,000 hectares or 5.71% and there is increase in the amount of water in the river from 4,100 to 5,600 hectares especially during raining season when the dam start discharging to maintain its capacity level.

Both the vegetated and non vegetated wet lands witnessed some changes by increasing and decreasing in the area they cover which is 2,000 hectares increase and 2,000 hectares decrease respectively in the wet land area.

The settlement also records increase due to population density.

people engaging in agricultural which is practiced throughout the year as a result of the supply of water for irrigation from the Bakolori dam.

Area covered by the sand is also witnessing a decrease as more lands are engaged in agriculture.

rainy season which some times results in the collapse of buildings thereby making people homeless, and the problem of mosquitoes also which causes fever and death in children.

I will therefore recommend that necessary action should be taken by the authority concerned to organise for mobile clinics and supply the hospital at Maradun with adequate drugs to cater for the sick.

The road leading to the main irrigated area from the truck road is very bad and a high yield is derived from this area, in order to reduce the cost of transporting these agricultural produce to the consumer at lower costs, the roads has to be repaired and the government should repair the roads and more revenue will accure to it.

I will also recommended the acquisition of remote sensing data particularly the SPOT and Landsat imageries so as to make a multi-temporal study of the area using the computer which is very fast and reliable and fast means of monitoring the environment in general with this any negative change can be easily and early detected and appropriate measures taken. This final recommendation is for the study of any kind of landuse/landcover study and in any part of the country.

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