

**Application of Global
Navigation Satellite and
Remote Sensing For
Environmental
Sustainability :A Case
Study of Tin Mining
Region of Nigeria.**

BY

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Abstract

- This study examined the mechanism through which, population characteristics influence environmental variables in a specific ecosystem. Using the tin mining region as an ecosystem, this study seeks to reveal the environmental consequences of human actions and the socio-demographic consequences of environmental degradation.
- The interpretation and analysis of (Landsat TM) image of 1987 provided a comprehensive information of the area especially regarding the various land uses and the associated environmental problems. Global positioning system (GPS) was used to take the coordinates of the different areas/spots used as training sites for the supervised classification. Further analysis was carried out using the key population variables

- The study determine among others, the distinct processes/mechanisms of population and environment relationships especially the action/ inactions of man that impact negatively on the environment and concludes that the prevailing relationships is humanly and ecologically unsustainable and therefore not viable in the long run. It reveals that even under the same ecosystem with identical climatic and soil conditions, the environmental sustainability or otherwise is implicit on the various vocations/economic activities
- The notion of population growth as the principal factor of environmental degradation does not hold in the tin mining region. The reasons for continued environmental crisis witnessed in the area go beyond the idea of pressure of numbers on resources.

Introduction

- The interrelationships between population, resources and development in most developing nations have been the subject of social concern and scientific study. In Nigeria, the integration of Population-Environment dimension in development planning is still in its early stages.
- In the field of population studies, the concerns for sustainable development have been expressed in the concept of carrying capacity (Hogan 1992).

- Simply put, carrying capacity may be seen as the number of persons sharing a given territory who can, for the foreseeable future, sustain a given physical standard of living utilizing energy and other resources (including land, air, water and minerals) as well as enterprise, skills, and organization (UNESCO 1984). This concept is usually used simplistically at high level of aggregation to arrive at the conclusion that population growth is too high.

- In this way, the mechanism of the relation between population and resources are not identified. Furthermore, the idea of population growth as the principal factor of poverty and environmental degradation has since given way to a vision that incorporates technology and resource distribution. UNFPA in 1991 argued that if the 25% of the world's population which lives in the developed countries consumes 75% of the world's energy, 75% of fuels and 85% of wood product, the population/environment relation must be sought in a more complex perspective

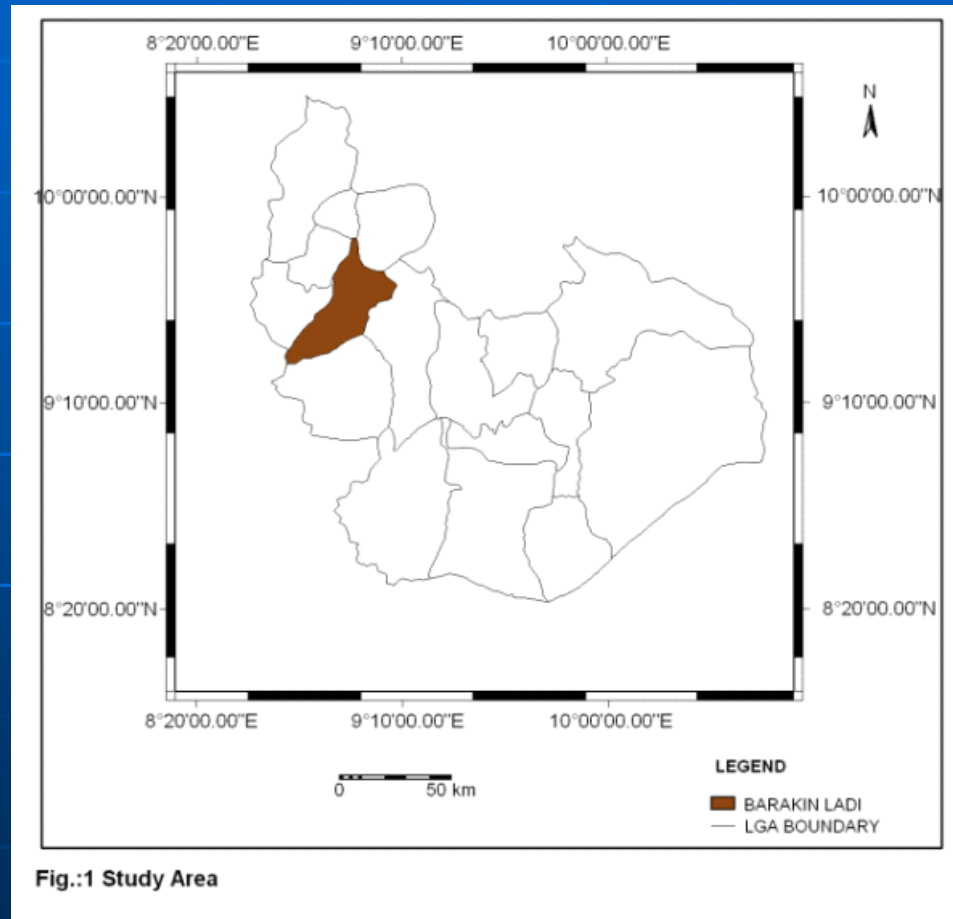
- Our knowledge of population/environment relationship is largely characterized by assumptions, affirmation, pointing to possible but unproven relations. It is important to note that the population, environment interface is complex and generalization may not really explain any detail required for planning. Population and environment factor interact in different ways in different places to determine and influence the composition and pace of development. The environmental crisis challenges demographers to discover these mechanisms and to elaborate analytical schemes which go beyond the idea of the pressure of numbers on resources (Hogan, 1989a)

- The actual tin mining region of the Jos Plateau (about 7,400km) is an ecosystem that may reveal probable spatial differences in the environmental consequences of human action and the socioeconomic and demographic consequences of natural resource depletion and degradation.
- This study therefore seeks to investigate these relationships in Barkin Iadi, an emerging urban centre which today encompasses a multiple range of environment ills.

Study Area

- The study area falls within the Naraguta North-East area (covered by 1:50,000 sheet 168). It is about 516km² between latitudes 90 00'N – 90 45'N and longitude 80 32' – 90 15'E (fig. 1). The soil and climatic conditions favour the production of wheat, maize, Irish potatoes, and vegetables, among others. Significant about the history of the study area is the commercial mining of tin and associated minerals which lasted for several decades. The relative balance/harmony between man and the environment maintained over the years was disrupted as the environment suffered unprecedented degradation. The subsequent but gradual decline of the mining industry beginning from the late 1960s brought some remarkable changes in the area. Many of the former tin workers decided to take agriculture as an alternative occupation. This led to a considerable amount of agricultural activities taking place throughout the year.

Figure of study area



Methodology

- Data for this study were sourced through field survey and questionnaire administration, acquisition of satellite image (Landsat ETM) of 1987 with spatial resolution of 30m. Copies of the questionnaire were analyzed using descriptive statistics. The image was georeferenced and processed using the ILLWIS version 3.3 software. Using the supervised classification approach, training sites in the image was located using GPS coordinates obtained from the field exercise. The training sites were based on six classes- agricultural land, degraded land, bare surface, built up area, water body and scrub, grasses and scattered cultivation.

- Using the training sites, a supervised classification scheme (maximum likelihood classification) was carried out on the image to obtain a classified image of the study area. Thereafter, a hard copy of the classified image was taken to the field for ground truthing exercise. The purpose of this was to verify and validate the degree of harmony between the classified image and the features on the ground in terms of accuracy, reliability, completeness, etc. Through this exercise, useful observations/corrections were made that serves as feedback input into the study

RESULTS

Demographic changes

- The 1991 national population census put the population of Barkin Ladi at 152,808 comprising of 75,577 males and 77,231 females. The area recorded a total of 19,074 households. The average population density of the area is 41 persons per sq. km. Report from the field survey, reveal that about 51% of the respondents have between 4 to 5 children while 40% of them have 6 children and above. The average number of children is 6. Although the fertility is high but field observation revealed that the entire settlement has not experienced a rapid spatial/expansion during the last ten years.

Environmental Degradation

- Barkin Ladi settlement presents a good example of how human exploitative activities disrupt the ecological balance of an area as well as the effects of such degraded environment on the quality of life of the local people. Today the region is still witnessing accelerated ecological degradation even with the absence of large scale commercial tin mining while the people are each day confronted with the consequences of environmental degradation.

- As shown in table 1, the most severe problem is land degradation which accounted for about 63% of the respondents. Associated with the severe degradation is the preponderance of mined ponds which account for 24% of the respondents

Table 1: Most Severe Environmental Problem

Problem	Frequency	%
Mining Ponds	8	24.2
Poor Sewage Disposal	2	6.1
Erosion	1	3
Land degradation	21	63.6
Others	1	3
Total	33	100

- Environmental problems triggered by the commercial mining of tin and associate minerals are today sustained by the activities of man especially in their quest for survival. As shown in table 2 the two principal economic activities that disrupt the environment are farming which account for 60.6% and informal mining which account for 30.3% of the respondents. The people are predominantly farmers.

Table 2: Major Causes of Environmental Problems

Causes	Frequency	%
Farming	20	60.6
Mining	10	30.3
Dumping of Refuse	2	6.1
Others	1	3
Total	33	100

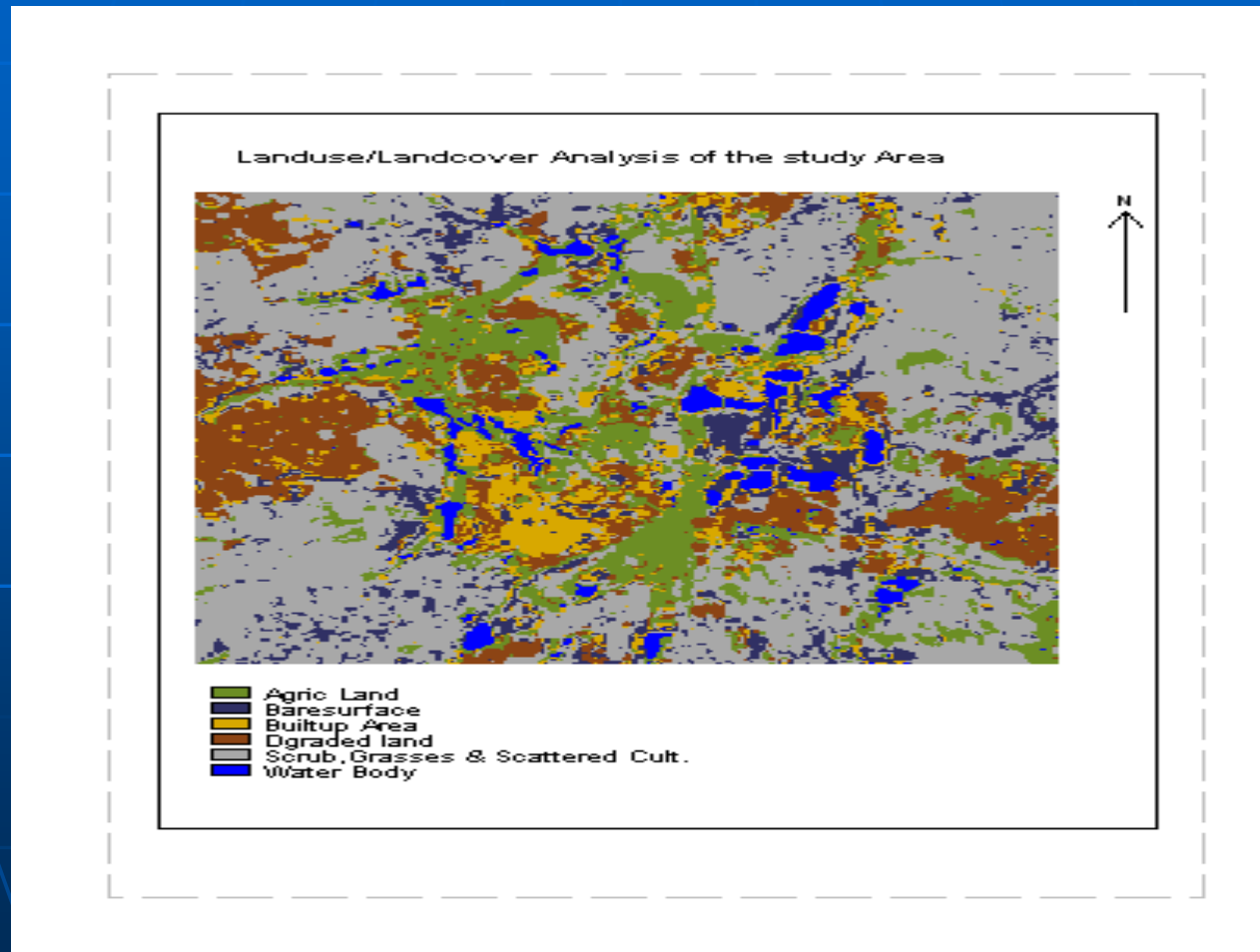
- Cultivation is all year round. Dry season or irrigation farming is made possible as a result of the numerous mined ponds where water now accumulates and serves as sustainable source of irrigation water supply. As the population of farmers' increases there had been a gradual shift from extensive use of land to land fragmentation and intensification of agricultural activities. Besides these two key economic activities is the molding of local block for building which has also affected the environment as shown table 3.

Table 3: Major Environmentally Unfriendly Actions of the People

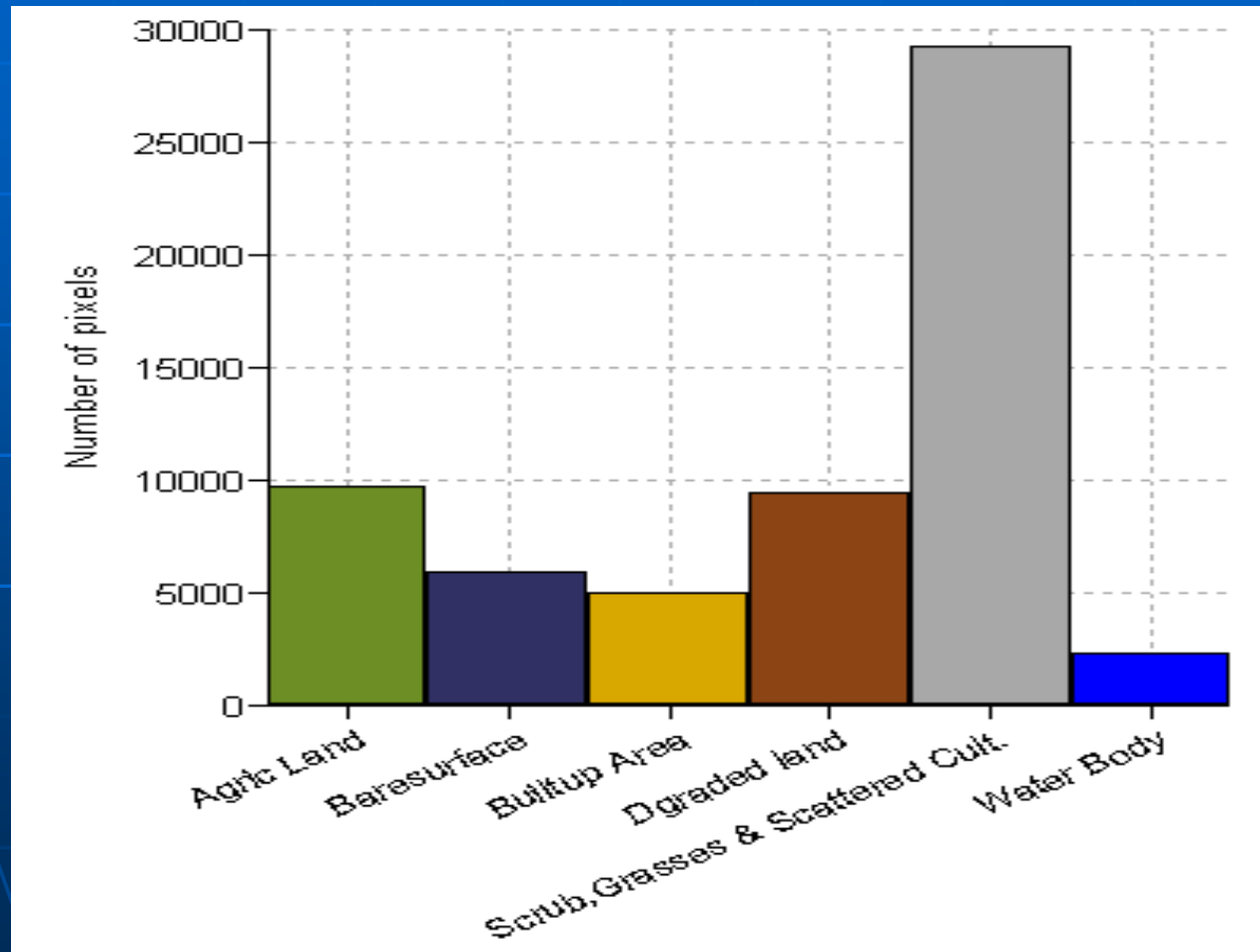
Actions	Frequency	%
Illegal Mining Activities	7	21.2
Bush Burning	3	9.1
Deforestation	3	9.1
Farming	16	48.5
Others	4	12.1
Total	39	100

- The major land uses/land cover as shown in fig.2 includes degraded land, bare surface, water body and agricultural land which sustains intensive rain fed and dry season farming all year round. The Spatial contiguity that exists among these major land uses makes the entire area a unique landscape. While the numerous water bodies/mined ponds serves as good source of irrigation water supply the degraded land however posed a formidable constraint on agricultural land use and settlement expansion.

Fig. 2: Landuse/Land cover analysis of the study area



Histogram of the different Land use land cover classes



DISCUSSIONS

- **Interactions between Population and Environment**
- After several years of the decline of commercial tin mining, Barkin ladi is still witnessing progressive environmental degradation. The community is essentially an ecosystem where human actions /inaction rather than population number have contributed immensely to further environmental abuse and degradation.

- The inhabitants of the mining region have been faced with several challenges arising from Population- Environment (P-E) disharmony. These are environmental degradation, soil deterioration, farmland appropriation, reduced economic opportunities and rural income, high unemployment and worsening situation of poverty. A number of people are at risk directly and indirectly at varying degrees. The population group that is most at risk regarding the disharmony is women, children, the urban poor, farming households and the elderly.

- Today, the local people are being forced by adverse effects of the P-E disharmony and by the overall harsh economic condition to adopt and try out several survival strategies and to improve their lot and hence more pressure on the environment. The growing rates of informal miners reveal the magnitude/rate of unemployment, underemployment, loss or shortage of farmland, and insufficient yield. The situation is further exacerbated by the fact that the carrying capacity of the region has, in effect, been exceeded in the present circumstances, not necessarily because of large population, but mainly because the environment has been devastated and the local resource available to the people greatly restricted and destroyed.

- Despite the high fertility the considerable out migration has serious implication on the absolute size of the population as well as the degree of settlement spatial expansion. The severe degradation is an important push factor for the migration rate.
- It is interesting to point out that in a situation of extreme poverty; the individual marginalized from society has no commitment to avoid environmental degradation if the society does not impede his degradation as a human being. Many people, particularly, the poor within the mining region have been degraded and, today, they further the degradation of the environment as they try to eke out a living out of the degraded environment. That is out of economic necessity and lack of option, the poor prey on already degraded land and marginal lands.

CONCLUSION

- The cultural, economic and ecological diversity of Nigeria explains that the intensity of resource use and the eventual degradation will vary across the nation. This trademark calls for the need for ecosystem specific analysis to define the economic and environmental vocations of distinct ecosystems and to generate data for local planning. Environmental quality in Barkin ladi has not improved over the last few decades. Combating degradation of agricultural lands by small farmers the major actors of degradation in the area requires investment in Bank credit, extension services, evaluation of soil quality as well as environmental education.

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