VISION FOR SUSTAINABLE AGRICULTURE AND PROPER DATA MANAGEMENT AS FEASIBLE OPTIONS FOR MANAGING LAND DEGRADATION IN NIGERIA

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Introduction

In 1992, representatives of 179 countries met at the United Nations Conference on Environment and Development (UNCED), also known as the Rio Summit, to seek ways to hall and reverse the effects of environmental degradation. The conference agreed on an action plan for sustainable living, known as Agenda 2 I.They recognized three environmental issues as being of such global significance that each became the subject of an international convention. These key issues are *the loss of biodiversity, global climate change and desertification.(Hoffman* and Ashley, 2001; and Postlethwait and Hopson, 1995).

Land degradation has been defined by UNCCD (1995) as:

> Reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland or range, pasture, forest and wood Sands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and /or water (ii)deterioration of the physical, chemical and biological or economic properties of soil: and (iii) long-term loss of natural vegetation... (Hofrnann and Ashwell, 2001).

Nigeria's execution of 8 environmental activists, notably Nobel Peace Prize nominee Ken Saro-Wiwa, made headlines in late 1995 and brought to light the serious environmental degradation of Nigeria. According to Mongabay.Com (2003) Nigeria currently earns about $4.45 billion per year from oil. However, oil production in Nigeria does contribute to global warming because the country flares (flaring refers to the burning of excess gas that comes up with crude) more gas than any other country. The methane produced has a much higher global warming potential than carbon dioxide (64 times as active a greenhouse gas as carbon dioxide). Although the Nigerian government may spend as much as $500 million per year on environmental protection, the costs of annual environmental degradation are estimated to exceed $5 billion and the value of lost forest cover is estimated at over $750 M per year. Besides direct damages from oil pollution and open mining operations and clearing for agriculture like oil palm plantations, deforestation rates are high and have resulted in massive topsoil erosion and expanding desertification. Today virtually no primary forest exists in Nigeria except for a small section in Cross River park. The government recently granted a concession in the park, maybe spelling doom for more native species. Habitat loss has caused wildlife populations to plummet throughout Nigeria and many species are on the brink of extinction. Pollution, deforestation (loss of spawning habitats), and over-fishing may lead to a complete collapse of Nigeria's marine resources. The government's conservation strategy is to achieve a target of 25% forest cover, even though current forest reserve covers only about 10% of the country. The majority of this is savanna woodland, while less than 5% is rainforest in the south of the country. Nigeria aims to accomplish this ambitious goal through a ban on log exports, promoting of agroforestry and community-based conservation schemes, increasing energy and fuel efficiency, and encouraging plantations and reforestation, programs.

Since attaining independence, Nigeria has made swift economic development a priority without any regard for its environment. Unfortunately, this dangerous path may soon be followed by other developing sub-Sahara nations. This is why this review is being made to explore possible solutions to the problems of land degradation in Nigeria.

Causes and Consequences of Land Degradation in Nigeria

The very term 'degradation' really has no meaning in the absence of human use of the land. The natural processes of erosion and leaching become 'degradation' only when land is related to its possible uses. When land is 'degraded', its productivity declines and the food security problem which has already been threatened in Nigeria would be worsened. Human effort can sometimes restore that

productivity or prevent further losses. But either way the yields of human labour and capital are adversely affected. We find that degradation occurs most often when land managers find they must produce more with the same or less labour and land. This is in consonance with the view of Van don Berg (2001) who hinged his cause on Schumpeter's concept of "creative destruction in economic growth". We term this 'pressure of production' to distinguish it from the simpler idea of'pressure of population'. To understand 'pressure of production[1] we need to understand the social forces impinging on farmers, rich and poor. A study conducted by Chup (1999) showed that land degradation in Nigeria were chiefly caused by over-cultivation, acquisition of land for mining activities which have combined to cause impoverishment of soil thus accelerating the processes of erosion, flooding and desertification, as well as intensifying the effects of draught. Overpopulation, deforestation, caused by need to get firewood and other plant parts, overgrazing and bush burning were equally identified as causes. Eboh (1995) agreed with the assertion that poverty, population growth and environmental degradation constitute the enigmatic trio in the vicious cycle of human misery in the rural areas.

In addition to these, the Federal Ministry of Environment (2004) observed that the frequency as well as the magnitude of the environment related disasters threatening large populations living in diverse ecological zones show a dramatic rise everywhere in recent years. Where hazards of exogenous factors are concerned, such as drought, floods and landslides, natural factors such as climatic change or fluctuation may, at least in part, account for this increase; the consequences of human interactions on the environment also play an important role.

Critical analyses of the causes of the environmental degradation in Africa including Nigeria could be surmised in the conceptual framework adopted by Hoffman and Ashwell (2001) that drew the concept thus:

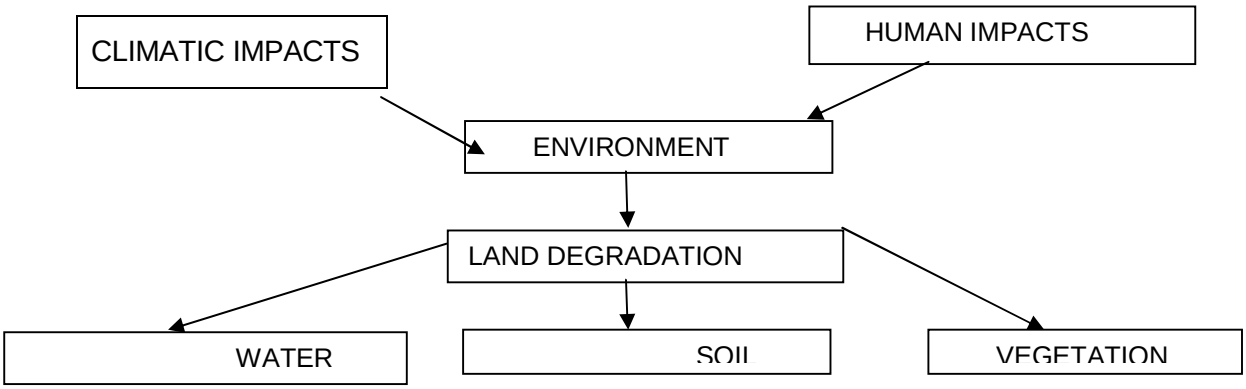

Fig. 1: A Conceptual Framework for Land Degradation (Source: Hoffman and Ashley,200I).

Strategies for Addressing the Issue of Land Degradation Problems in Nigeria

Recent advancements in science and technology continue to create hope and produce new techniques which help to collect up-to-date data for monitoring environmental degradation problems. These, according to Federal Ministry of Environment (2004), include the application of remote sensing in area of mapping, monitoring and predicting environmental degradation and hazards. In fact, many dynamic geophysical processes occurring in remote locations are difficult to reach and survey. This restricts the monitoring of changes on the land by conventional means which may be too difficult and time consuming. Remote sensing offers an alternative, often more efficient and cost effective technique of data capture. Remote sensing refers to data collection concerning objects of the earth from a platform mounted with sensors above the earth surface. The approaches proposed by the Federal Government of Nigeria via the Federal Ministry of Environment (2004) are discussed as follows:

Aerospace Technology for Managing Environmental Degradation and Nigeria's Participation in Global Monitoring Systems

The complexity of environmental degradation requires an integrated and global approach in the acquisition and the organization of appropriate data. Aerospace technology, especially satellite remote sensing, plays an important part in this regard. Monitoring of degradation processes is basic for early warning system (ID NDR: 1995). Thematic maps showing the configuration of the land are essential for hazard zoning with Geographic Information System (GIS) as a major tool. Thus, necessary timely action can be taken including, engineering works, physical planning; awareness raising, degradation scenarios and so on.

The African Real Time Monitoring and Information System (ARTMIS) operated by NASA and FAO for monitoring rainfall and biomass deficiencies for the governments of affected countries including Nigeria, is an outstanding example. The proposal for a Global Emergency Observation and Warming (GLOWARM) by European Satellite Agency (ESA) and National Space Agency (NASA) participants of the International Space University in 1993 is another opportunity. It is conceived as a combination of remote sensing and satellite communications that would constitute a global system for disaster warning and degradation support management. Recently, UNEP has made an offer to Nigeria to supply remote sensing data from the UNEP-GRID through the Federal Ministry of Environment on regular basis. It is hoped that such data, when integrated into our existing GIS database, will assist us in generating appropriate strategies for proper monitoring and management of the dynamics of environmental degradation in Nigeria.

Global monitoring of flood is a rapidly expanding field. This is important in global change research and has a role in the reduction of flash-flood disasters. In direct connection to this is the monitoring of the atmosphere which is a fast growing field. It includes monitoring of temperature, euthrophism/pollution, cloud patterns, ozone content, etc. The Total Ozone Monitoring Satellite (TOMS) is a breakthrough in the area of Ultra Violet- 13 studies. It is hoped that Remote Sensing data from Nigeria Sat-1 shall complement all above stated programmes.

Specific Examples of Application of Landsat, Slar, Spot and Other Data

The use of Landsat, Side Looking Airborne Radar (SLAR) and SPOT imageries in environmental studies all over the world has renewed and strengthened rapid and reliable assessment, and improved the productive ability of the methods. For example, Abdulkadir (1993) found that through a conjunctive use of thematic map (TM) and aerial photographs, it was possible to monitor the conditions of Land-cover and detect calcareous, gypsiferous and saline soils using different bands and ratio images. Others have demonstrated, how remote sensing can be applied to assess changes in evaporation rates, evaporative power of the atmosphere, surface thermal features and thermal behaviour of different physiological units. The history of SLAR application in environmental monitoring in Nigeria dates back to the 1978 Land Use and Vegetation Cover Mapping sponsored by the FAO. Those maps formed the basis for the World Bank-assisted Environmental Management Project (EMP) in 1993 using Land Sat and SPOT Imageries as the Remote Sensing database with which the 1976 Land Use and Vegetation Maps were brought up to date. The outstanding results of this project formed the hardcopy and GIS digital environmental database of the Federal Ministry of Environment.

Soil Degradation Assessment

The application of Landsat imagery to soil degradation mapping was advocated by FAO. It was found that mapping enhancement can be better achieved using 1:500,000 scale and optical enlargement especially in areas with less dense cover. Despite the limitations of Landsat in the area of poor relative poor resolution, insufficient overpass intervals and weather dependence, it is still recognized and used as a powerful and reputable tool in monitoring sediment deposition, especially in irrigated areas and stream channels as well as water reservoirs. In a more recent study of the impact of dam construction on Fadama cultivation in the downstream parts of Jakara Dam in Kano State, some authors have applied the use of SPOT and aerial photographs to assess changes in soil moisture status at pre-dam and post-dam periods. The study concludes that there was a serious fall in the soil moisture during the post-dam period resulting to a change in Land use (from Fadama to predominantly rain

fed). Both SPOT and aerial photographs have proved to be useful tools complementing each other and providing a means of cross-checking data entry and reliability.

Drought Hazard Assessment

Large areas are affected by drought hazard notably in Northern Nigeria, thus forecasting emergencies has become a vital issue. Monitoring anomalies of cloud and rainfall patterns and the related vegetation cover changes caused by fluctuation of the seasonal displacement of the Intertropical Convergence Zone (ITCZ) over the years, using low-resolution satellite data is common practice nowadays. The ARTEMIS drought monitoring system of FAO and regional centers such as CILSS (Centre Intergovernmental pour la Lutte centre la Sccheresse en Sohel) and IGADR (Inter Governmental Agency on Drought and Development) play an essential part in the research and use of aerospace technology.

Flood Hazard Assessment

Distinction should be made of coastal flooding, plain flooding and river floods since these types of emergencies require different approaches. Use of early warnings based on monitoring eddies tracks using space-borne, air-borne and ground radar systems and building of Refuge structures/platforms in appropriate locations and awareness creation among the population is essential. In case of river floods, early warnings are usually based on the gauging stations upstream. Aerospace imagery serves to monitor the fluvial dynamics such as lateral sapping, etc and for flood hazard zoning and management. One should realize, however, that land classification focused on flood susceptibility in densely populated river plains does not necessarily result in effective land-use planning, because population pressure will cause farmers to settle in endangered areas. Nevertheless, such classification may be vital for planning infrastructure and urban extension.

Recommendations

The following recommendations are hereby made to alleviate the land degradation problems in Nigeria:

- Effective and reliable measures must be put in place by the Federal Government to make alternative fuel such as gas, kerosine and diesel more readily available and affordable so that less pressure will be put on forestry resources for use as fuel.
- Environmental education must be promoted at all levels of education and in the rural areas as well as industries to raise the consciousness of the populace towards the issue of environmental protection.
- Fanners should be assisted by agricultural extension agents to practice sustainable agricultural practices such as crop rotation, use of organic farming and mixed cropping and farming.

The Federal Government should appropriate more funds to help in data management using remote sensing and most especially for the execution of the proposals for the application of Landsat, SLAR, SPOT and other data gathering and monitoring devices including the The ARTEMIS drought monitoring system of FAO mentioned earlier. In addition, the Remote Sensing data from Nigeria Sat-1 should be vigorously pursued and encouraged to complement all above stated programmes.

Conclusion

Aerospace technology plays an important role in providing adequate and reliable data in managing Nigeria's environmental degradation problems. The appropriate type/configuration varies with the degradation type. It should be well selected and combined with other means of surveying and monitoring. From the examples put forward in this paper, it may be pointed out that world wide, remote sensing application in the mapping, assessment and monitoring as well as forecasting environmental degradation is modernizing, simplifying and easing the exercises which "would otherwise be executed through conventional methods. Furthermore, recent pressure on environment arising from rapid population increase and competing uses, the need for improved mapping and monitoring systems become imperative.

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