ENVIRONMENTAL PROTECTION AND MANAGEMENT: THE SURVEYOR'S ROLE

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ABSTRACT

Since the existence of man, man has been concerned with the development of his environment in order to improve his way of life. The achievement of sustainable and equitable development remains the greatest challenge facing the human race.

Although, the desirability of development is universally recognized, recent years have witnessed rising concern about whether environmental constraints will limit development and whether development will cause serious environmental damage- in turn impairing the quality of life of this and future generations.

A number of environmental problems are already serious and require urgent attention. Humanity's stake in environmental protection is enormous, and environmental values have been neglected too often in the past resulting in serious disasters. Without adequate environmental protection, development will be undermined; without development, environmental protection will fail.

This paper considers the Surveyor's role in using modern technology to protect the environment and to manage it. Survey activities related to the environmental protection of land (e.g. land fill and contaminated land) and environmental monitoring are considered. Also, the paper discusses exploring Space Technology and Geographic Information Systems (GIS) in environmental management, and enforcement of environmental policies. Environmental Impact Assessment (EIA) is also briefly discussed.

Surveyors who are the custodians of geospatial technology should wake up from their slumber and seize this golden opportunity to make their indispensable role on environmental protection and management known to all the concerned authorities as one of the survival strategies for the Nigerian Surveyor in the next millennium.

1.0 INTRODUCTION

The term "Environment" has a variety of definitions depending on the perspective and professional background of those who attempted to define it. For example, environment could be defined as the sum of all external conditions influencing the growth and development of (an organism) a population, or it could be broadly defined as the whole complex of physical, social, cultural, economic and aesthetic factors which affect individuals, communities and ultimately determine their form, character, relationship and survival.

Environment can be categorized into three:

- Physical environment.
- Social environment.
- Economic environment.

In summary environment consists of – the natural environment (e.g. air, water, trees, flora and fauna), and the man-made or built environment (e.g. a room, street, town or city).

Environmental considerations are usually in terms of: air and water quality, land use planning, erosion generation and control, natural hazards, site selection and design, subdivision development, conservation of flora and fauna, urban congestion, overcrowding, displacement and relocation resulting from public or private action or natural disaster, urban sprawl, urban design and the quality of the built environment, urban growth policy, impact of the environment on people's values, aspirations and activities.

The achievement of sustainable and equitable development remains the greatest challenge facing the human race. Despite good progress over the last generation, world record has shown that more than one-billion people still live in acute poverty and suffer gross inadequate access to the resources – education, health services, infrastructure, land, and credit- required to give them a chance for a better life

Although the desirability of development is universally recognized, recent years have witnessed rising concern about whether environmental constraints will limit development and whether development will cause serious environmental damage – in turn impairing quality of life of this and future generations.

It is clear that current events and interplay of forces regionally and globally have proved beyond any reasonable doubt that the present and future calamities in the world will come not only from warfare, but also from the flagrant abuse of the environment, unsustainable use of natural resources, poverty, diseases and over-population. All these will put so much pressure on the environment and subsequently lead to its degradation. Hence, there is need to protect and manage our environment now.

A number of environmental problems are already very serious and require urgent attention. Humanity's stake in environmental protection is enormous, and environmental values have been neglected too often in the past.

The cost of environmental damage to humans- which may be bone immediately or at some point in the future- are principally losses in health (or life), productivity, and amenity.

For example, the Nigerian Guardian on Thursday 17th 2000 carried a photograph of flood victims from Jenisville informal settlement showing a damaged riverbank where 6 shacks slid into Jukstei River claiming 34 lives and rendering hundreds homeless in Johannesburg, South Africa. We have several flood and erosion cases in Nigeria where lives were lost and properties worth several millions of naira has been destroyed.

It is true that the costs of protecting and improving the environment are high in absolute terms, but they are modest in comparison with their benefits and with the potential gains from economic growth.

The protection of the environment is an essential part of

development. Without adequate environmental protection, development is undermined; without development, resources will be inadequate for needed investments, and environmental protection will fail.

The environmental problems that countries face vary with their stage of development, the structure of their economies, and their environmental policies. Some problems are associated with the lack of economic development; inadequate sanitation and clean water, indoor air pollution from biomass burning, and many types of land degradation in developing countries have poverty as their root cause.

The environmental mistakes of the past do not have to be repeated. Today, countries have more choices- they can choose policies and investments that encourage more efficient use of resources, substitution away from scarce resources, and the adoption of technologies and practices that do less environmental harm. Such changes will ensure that the improvements in human welfare which development brings are lasting.

This paper highlights the roles of Modern Surveyors or better stills Geoinformaticians in using modern technology to contribute their quota in protecting the environment and to manage it. The paper itemizes detailed survey activities related to twelve different problems. These include- environmental protection of land (e.g. landfill, erosion, dredging, mining and contaminated land) and environmental monitoring (e.g. change detection). Also, it explores Space Technology and the use of Geographic Information Systems (GIS) in environmental management (e.g. forestry management), and enforcement of environmental policies. Environmental Impact Assessment is also briefly discussed.

2.0 ENVIRONMENTAL DEGRADATION AND SURVEYOR'S ROLE

This section emphasizes on the effects of environmental degradation under the following headings (even though the list is endless), and also the importance of Surveyor's (or Geoinformatician's) role:

A. EROSION:

Without doubt, soil erosion is the best known among the components of environmental degradation in Nigeria, as virtually all segments of the country are subject to erosion. In the south three-quarter are eroded by rainfall, while in the north a quarter is eroded principally by the wind. There are four major types of erosion, namely, sheet erosion, rill erosion, gully erosion, and bank erosion. The last named one only affects the Atlantic coastal regions and major waterways and has by far the least spatial coverage, but the most harmful of them all is the gully erosion.

Rainfall and wind are the most important causes of soil erosion, however, many other causes can be attributed to the following: (1) Desertification, (2) Bush burning, (3) Overgrazing, (4) Mining, (5) Construction activities, (6) Poor drainage, (7) Improper planning of the cities, and (8) Wrong disposal of waste products.

The impact of soil erosion has wide dimensions. They range from the truncation of roads to the collapse of buildings, from the loss of wildlife habitats to the diminution of range land and farmland, from damage to electricity installations to disruption of waterworks, from reduction of soil fertility and recreational potential to loss of livestock and human life, and cutting away of villages, communities and towns.

It is apparent that soil erosion problems have received very little financial attention over the years relative to the magnitude of the problems and the projected cost to the nation annually as contained in the World Bank Report. For example, only ₦22.50 million was allocated to erosion and flood control programmes of the River Basin Development Authority in the 1990-92 plan.

The most awesome and the most spectacular, gully erosion is the most expensive to control. There have been occurrence of thousands of gullies in Africa including the single largest gully erosion i.e. the Agulu-Nanka erosion in Anambra State.

In order to control these type of erosion the Geoinformaticians have significant roles to play in the following areas:

(a) Digging Catch-Pits (CPTs) of different sizes and direct water into them,
(b) Constructing a Top-Side Gully Drains (TGDs)- a way of checking and stabilizing gully erosion,
(c) Sandbagging which can also be used to control beach overflooding, and
(d) Construction of reclamation dams.

B. MINING AND MINERAL EXPLORATION:

For more than 60 years ago mining and quarrying have been a source of income to Nigerians, even though, before the advent of the colonial rule it was being exploited in the crude way and at small scale.

During the colonial regime, colonial geologic surveys revealed widespread occurrence of coal and lignite, tin ore on the Jos Plateau, columbite, gold, iron ore, clays, crude oil, sands, and so on. Since that time most of the minerals have been consistently exploited at large scale.

From the mid-sixties, oil exploration emerged as the leading mineral resources sector and also as the foremost of the Nigerians economy. From 1958 when oil was first drilled in commercial quantity in the Delta area of Nigeria till date, there has been a rapid increase in output, from 100,000 – 200, 000 barrels per day in the early 1960s to a peak of 2.3 million barrels per day in 1979.

With respect to crude oil exploitation, aggressive exploration has led, over the past 60 years, to the discovery of new oil fields. The captivity has since the last 35 years spread to more locations like Rivers, Akwa Ibom, Cross River, Imo, Ondo, Edo and Delta.

Studies of the ecological impacts of the petroleum industry abound in the literatures (e.g. Izeogu, 1986). Between 1970 and 1982, Nigeria recorded 1,581 incidents of oil spillage which caused considerable ecological and physical damage to environmental resources: land/soil, water, and vegetation.

Crude petroleum is toxic to most species of flora and fauna, and when it spills and contaminates the environment, it affects the health and general living condition of affected communities e.g. Warri, Bonny, Escravos, etc. In the worst affected areas, the oil can penetrate into the soil up to 0.65m thus destroying farm crops

and interfering with plant growth.

Also, the landscape features of the mined areas are by no means uniform, and the degree of landscape disruption depends entirely on the methods employed in winning the ores, which are in turn controlled by the depth below ground surface. Surveyors can assist in sandfilling these degraded areas.

C. ARCHEOLOGICAL SITES:

In Nigeria, concern for the impact of development projects on the cultural environment has been very little. Much of what has been considered before now are the physical impacts and economic viability of projects. B.W. Andah and A.L. Okpoko in Nigeria in Maps listed about 84 archeological sites in Nigeria.

Modern Surveyors (or Geoinformaticians) could play a significant role by creating the necessary database for archeological sites. The database will contain such information as- site location, nature of site, type of soil, size of site, weather conditions, value of site, and so on.

Similarly, map layers can be created to show the various sites and other relevant information. These layers can be overlaid on the national map in order to give graphical perspective of the sites, also the areas where extraction of archeological materials have taken place should be refilled in order to avoid future disaster to the inhabitants of the area.

D. DREDGING:

Since erosion always erode a lot of soil particles from one place and eventually deposit it in the rivers, seas and oceans, therefore, there will always be a decrease in the depth of the rivers, seas and oceans on yearly basis and if this is not quickly checked it will definitely lead to overflowing of such bodies of water. Houses, properties and lives will be lost.

The Geoinformaticians have an indispensable role to play in this aspect of environmental management because the relevant dredging data- location, depth, area of coverage, and so on are best laid out by them than any other professional.

E. IRRIGATION AND WATER RESOURCE POTENTIAL: In order to solve drought problems and lack of sustainable quality water during the dry season, our agricultural crops need to be properly irrigated. Irrigation of any area depends on the quantity of water available in the area i.e. there is need to know the water resource potential in the area.

The United Nations Food and Agriculture Organization (FAO) contracted ESRI some few years ago to develop a spatial database and resulting output products for estimating irrigation potentials for the African continent.

Modern Surveyors (or Geoinformaticians) have the following parts to play:

1. Create a database that will include data on:
   - Countries in Africa, cities and towns;
   - Water availability and irrigation potential data
   - Water requirement for irrigation in each country and each watershed (to be determined from soil, slope, and texture factors)
   - Estimated data on water resources (surface- and ground-water).
2. The final map to be produced by a Geoinformatician is a GIS package that will show graphically the following:
   - Areas of irrigable soils
   - Areas where rainfall makes irrigation unnecessary
   - Areas with a water surplus.

These maps will be studied along with tabular listings of water volume and area of irrigable soils, stratified by country and watershed, to provide an approximation of water supply versus needs. The final products will include maps of high cartographic quality as well as numerical tables produced by a Geoinformatician.

F. DISPOSAL OF HAZARDOUS MATERIALS:

Apart from the tremendous quantities of organic and inorganic wastes generated by Nigeria's industries in both urban and rural areas, the amount of wastes produce in other land use contexts is equally enormous.

In residential zones, commercial areas such as markets and eating houses, transportation routes and centres like motor parks, offices and educational establishments, and numerous other locations, wastes are produced. For instance, as much as 20kg or more of solid wastes is generated per capita every year in Nigeria.

Solid wastes clog up drains, deface the land surface, and constitute a major health hazard, as they harbour all sorts of pathogenic microorganisms and vermin like rats and cockroaches.

To determine the best waste site, Geoinformaticians can carry out a GIS land-capability analysis. This can be done by identifying the relevant constraints on locating a disposal facility. The constraints are usually based on regulations as well as on the transportation infrastructure required to support a waste disposal site.

Criteria for citing a waste disposal facility should include:

1. Site must be at a specific height (e.g. 100m)
2. Site must be at a specific distance from wetland (e.g. 160m)
3. Site must be more than a specific distance from sensitive areas (e.g. endangered speciesHabitats or recharge zones of aquifers – say 160m)
4. Site must be within certain distance (e.g. 300m) of a major road.

After determining these specific constraints, the needed environmental and cultural data are gathered. Then the required thematic layers will be created and these include:

(a) locations of existing waste production facilities;
(b) locations of existing waste disposal sites;
(c) spatial extent of wetland land-cover types;
(d) spatial extent of upland land-cover types;
(e) infrastructure (the transportation network, including primary and secondary roads and railroads, plus the utilities);
(f) locations of known sensitivities areas (environmental reserves, endangered species habitats, archaeological sites); and
(g) elevation from a digital terrain model

Many of these datasets can be derived from aerial photographs and satellite imageries. A multiple-theme analysis of the datasets

is then used to derive a new land potential theme, indicating areas that meet all the necessary criteria. The final map, indicating those areas in which it is feasible to locate a waste repository, can then be used to narrow the search for an appropriate property.

G. LAND FILL:

As there is always a risk of contaminating surface and groundwater, landfill sites need particular care in their engineering and design. The position and elevation of plants and installations must be determined before work commences.

Background data should be collected from boreholes regarding groundwater levels surrounding and outside the extent of the site, to compare with ongoing monitoring of readings from those boreholes during and after operations. Furthermore, periodic measurement of airspace is a continuing requirement, the full base topographic survey provides the initial comparison with the final projected landform as well as the gross capacity of the site.

When landfilling operations are completed, the proof of physical stability would require that the filled mass ceased to show any settlement or surface deformation due to degrading processes of the buried wastes. Such processes may well take several decades to reach a stable condition. A full site record history would be required, the rate of fill (i.e. level of fill), the effects on local groundwater, the projected and actual rates of settlement and the monitoring of the final completed surface all require a planned programme of regular survey input, an essential element of any engineering assessment of the completeness of the whole project.

Sandfilling of swampy sites is another aspect of environmental protection that Surveyors must be fully involved.

H. CONTAMINATED LAND:

Is any land that is polluted with any material or substance that adversely affect the natural environment. The keeping of an accurate and up-to-date record or register of contaminated land in a country, state or local government as Federal Government deemed fit is very essential.

The land value will definitely depreciate, but as Geoinformaticians the spatial recording of all contaminated lands is an essential tool. The size of the land, type of contamination, depth of contamination, height of waste above ground level, time of contamination and so on are data that will be required in the database, and graphical display of these lands against State lands can be visually displayed.

Exempt Sites are sites where certain types of waste are permitted within specific limits of quantity. Exceeding them by any licensed authority could lead to prosecution; the need for spatial quantification to prove compliance or otherwise is therefore necessary. Unfortunately, the waste management professions always refer to quantities of materials by weight, even when the fundamental essential is a spatial extent. A significant and effective part of the evidence can be provided by the surveyor quantifying and describing deposited materials. This can then be used as a basis for calculating clear-up costs in time, lorry loads to cart away and dispose of lawfully and restoration of the affected area.

The Expert Witness statement would contain the complete account of their involvement, including relevant exhibits such as plans, photographs, calculations, reference texts, hardcopy printout, etc. leading to the giving of evidence and questioning.

Various CAD, mapping and GIS packages are used in relation to the described areas of work-GMSL, MapInfo, DeskMapper and AutoCAD together with linked databases. Survey information (in form of layers) is overlaid on the digital Cadastral map of the State.

I. NATURAL RESOURCES MANAGEMENT

Natural resources and the physical environment are productive assets which support economic development and sustain human populations. Nigeria exploits and utilizes the resources of her environment to achieve the present levels of social and economic development which are reflected in the key indicators of social, economic, and environmental conditions in the country.

This section of the paper considers the use of GIS in these natural resources management using *forestry management* as a case study.

In the pre-colonial and early years of colonial presence in Nigeria, the natural forest vegetation was subjected to a systematic exploitation for the purpose of deriving a number of products which were vital to the sustenance of both the local population and the colonial administration.

Wood was the most important of these forest products which is commonly used for fuel and timber.

The need to convert some forest lands to agricultural and residential land use also enhanced the speed with which forests disappeared particularly in the areas with rapidly increasing population.

Nigeria was a major producer of timber especially for exportation purposes, unrestrained exploitation of timber over the years have resulted in an output which stood at 99.0 million cubic metres in 1988. The FAO stated that Nigeria's closed forests were deforested at an average of 4.0 % per year (about 300,000 ha annually) through removals of wood.

Despite the current desire among governmental and non-governmental organizations (NGOs) to preserve as much of the natural climax vegetation of the country as possible, the wood resources of the country have consistently depreciated in recent decades. The decline is attributable to indiscriminate felling of trees and forest clearance for agricultural production, as well as the harvesting of timber for construction purposes and overgrazing. Consequently the forests are disappearing at an alarming rate resulting in derived savanna woodland, erosion, soil losses and other forms of environmental degradation.

The Geoinformaticians role is to produce natural resource models that can be used to manage the forest. The main computer model will be designed in such a way that it will be possible to integrate the results (suitability maps) derived from a set of other six submodels, each of which will be directed toward a specific forest management objective. The submodels are:

1. a submodel that will evaluate visual quality, explores the manner in which a user will visually experienced the features of a study site, and determines the visual importance of each

area in a study site to a user;

2. the landscape ecology submodel which analysis the structure, function, and interrelationships of ecosystems to optimize the spatial allocation of a site's natural resources (Forman and Godron, 1986).
3. the potential natural vegetation submodel examines the environmental characteristics of a site (e.g. soil type, slope, etc) determines the optimal vegetation species for each area in a site.
4. the fire management submodel identifies the areas where fires are most likely to occur the areas to which fires would spread most rapidly, and determines the relative potential intensity of a fire within each area of the site.
5. the wind management submodel through investigation of the types of vegetation found on a site, as well as their locations and the attributes of their locations, areas of a site that are most susceptible to windthrow damage can be determined.
6. the production and economics land use submodel- this ascertains how profitable each area of a site will be for logging.

In summary, the database to be created includes topography, soils, glacial deposits, vegetation, windthrow affected areas, spruce-budworm affected areas, forest crown closure, forest development stage, deeryards, water, and roads.

From series of spatial analysis, scenarios of areas that will meet different needs can be selected e.g. fire affected areas, logged areas that need to be replanted, and so on.

J. CHANGE DETECTION

Since there are numerous environmental problems ranging from natural causes to man-made causes. The natural ones include earthquakes, desertification, drought, flood, erosion, and so on while the man-made ones include everyday human activities such as construction activities, poor planning of towns, poor drainage, wrong disposal of solid wastes, and so on.

All these causes if not well and adequately monitored could lead to disaster- loss of lives and properties.

Modern technology has made it possible for Geoinformaticians to use ***change detection*** technique in monitoring the environment. The use of standard methods of change detection for imageries (e.g. panchromatic) extended with raster to vector polygon conversion of change regions and statistical pixel analysis of regions using polygon making will display the new changes in the environment.

The major two basic steps to be taken are:

1. Identification of change areas using rationing, and
2. Tracing of man-made features in the changed areas using statistics. Also filtering technique must be applied for the purpose of smoothing and removal of distortions.

K. POOR CITY PLANNING AND MAINTENANCE

Most of our urban cities in Nigeria dated back to the 12th century, these cities have expanded rapidly due to the mass urban migration syndrome, but these cities have witnessed little or no planning control. These cities are poorly planned and maintained. Their roads are narrow with poor drainage facilities and the recreational centres and facilities are too small and old for the populations.

For example, a major bridge in Lagos Island was abandoned due to some sign of dilapidation, also the National Theatre was noticed to be moving, these structures and some other ones need to be monitored in order to maintain them.

Until recently, the urban centres are the locations of the major industries. There has been little or no concern for the proper siting of the industries within the urban centres; the industries are characterized by haphazard location in the cities and mixed up with other unrelated forms of land use.

The effects of poor drainage, shortage of facilities, wrong locations of industries, and so on, do cause environmental nuisance and damage. But a proper planning with the Surveyor's input will ensure a well planned, beautiful environment that has aesthetic look and can easily be managed. A municipal GIS could be created to assist in managing our cities.

L. UTILITY MANAGEMENT

The population of cities and countries throughout the world is increasing thus leading to further development of our towns and cities. For any meaningful development and better living there is need to provide and improve in the utilities provided. They include water, gas, oil, and electricity supplies.

The utility mapping systems are concerned with the description lines and the associated facilities that ensure their effective performance. They are also concerned with the provision of spatially referenced information used in the management of these very complex networks that extend over large areas e.g. water pipe network (State Water Cooperations), electric cable network (NEPA), telephone cable network (NITEL), and so on.

Cadastre, as a multipurpose inventory of basic information on topography, construction, size and shape of landed properties, soil type, land use, land cover, age, type and state of maintenance of structures on land, provides a powerful tool for managing utility services through digital mapping technology. Only the Modern Surveyor or Geoinformatician that can create these information in map layers and carry out any necessary spatial analysis.

3.0 THE ENVIRONMENTAL AND INSTITUTIONAL ISSUES

The effect of poorly managed environment cannot be quantified, but we have seen that development as a result of economic growth without careful planning often has its adverse effect on the environment.

However, events have proved to the world that there is need for a strategy of sustainable development which will involve the articulation of environmental and other elements of human needs and rights with the economic growth and development objectives. The principles of sound environmental policies always complement and reinforce development.

Over several centuries ago and till now a lot of policies and guidelines have been instituted by various governments all over

the world, still environmental pollution and degradation have not seized instead they have been on the increase especially in the developing countries like ours. Most of these policies are often met by stiff oppositions.

World Commission on Environment and Development (WCED) has stated that "it is mismanagement or no management at all of the environmental and natural resources that is undermining Africa's economic security and plunging the continent into a crisis" (Tolba, 1988).

In Nigeria, environmental problems have been blamed on poor sanitation, and the poor environmental situation in the country can be attributed to:

(a) Low priority given to environmental issues by the different levels of government,
(b) Political instability,
(c) Lack of integrating economic planning with environmental planning, and
(d) Jurisdictional overlap between the three-tiers of government and even sometimes within the central government itself e.g. transportation issues.

Environmental problems can be categorized into two levels:
(1) Primarily, the one attributable to poverty, underdevelopment, and poor living conditions, and
(2) Secondly, the other generated by the process of development.

Solving the above environmental problems in Nigeria became a national issue when Radioactive Toxic Waste from Italy was dumped at Koko Port former Bendel State in 1987 without the Federal Government awareness, thus putting an end to the somewhat nonchalant attitude of the government.

Since that time some policies and agencies established to coordinate environmental issues include:

(i) National Committee on Ecological Problems (NCEP) established in 1982,
(ii) Decree 58 of 1988 establishing Federal Environmental Protection Agency (NEPA) and State's Environmental Protection Agencies,
(iii) Natural Resources Conservation Council (NRCC) established in 1989,
(iv) The National Environmental Policy launched on 27th November, 1989,
(v) Nigeria's Environmental Impact Assessment Decree No. 86 of 1992, and
(vi) Vision 2010 sub-committee on Ecology and Environmental Protection established in 1996.

Their purpose and duties are as contained in the relevant legal documents.

FEPA was established primarily to plan, implement, monitor and control all new major projects in the country, and to evaluate their environmental consequences. To achieve these objectives there is need for Environmental Inventory (EI) of the proposed site- this is one of the initial steps in environmental Impact Assessment (EIA).

There is no clear cut definition of EIA, but it can be seen as the evaluation of the various aspects of the environmental effects, both adverse and beneficial of a proposed development, including the identification of measures for mitigating the adverse effects.

To accomplish an environmental assessment, the following essential interrelated stages must be covered:
(1) Purpose and Need, (2) Proposed Action/Alternatives,
(3) Description of Environmental Setting,
(3) Impact Prediction and Assessment, (5) Selection of Proposed Action, (6) Preparation of the Draft
(7) Environmental Impact Statement, (8) Review Process and Comments, and (9) Final EIA.

RECOMMENDATIONS

The following are some important steps to be taken in order to have a meaningful development that will have minimal or no adverse effect on the environment:

1. Popular participation of various professionals including Surveyors in making environmental policy e.g. FEPA,
2. The actual implementation of the policies must include Surveyors or Geoinformaticians since the environment is a spatial entity,
3. Review of National Policy on Surveying and Mapping – making it a must for all survey content of any construction to be awarded separately,
4. Adequate funding of Environmental Management/Monitoring and Protection Programmes,
5. Carry out ***As-Built Survey*** of all new projects constructed,
6. Carry out utility mapping throughout the country,
7. Regular mapping of the entire country, the states and local governments,
8. Create National Data Bank
9. Enforcing all the environmental policies,
10. Educate and involve the local communities in taking part in planning and execution of disposing of their wastes,
11. Close the gap between poverty and environmental problems by introducing poverty alleviating programmes for the masses, and
12. Introduce less-polluting technologies and learn from successes and failures of industrial countries' environmental policies

CONCLUSION

From the various highlighted environmental problems it is clear that policies, reforms and institutional changes cannot bring the so much desired accelerated development and better environmental management. Similarly, the growing recognition of the importance of environmental concerns, the rapid introduction of economic reform programmes, and the trend toward democratization and participation in the development process will not solve environmental problems unless all the necessary professionals including Surveyors are involved.

It is high time for the Surveyors (i.e. Geoinformaticians) to take the bull by the horn and prove their mettle in this area of human life, without which other professionals may make an easy inroad into our noble profession. It will also serve as a way of

keeping Surveyors afloat financially, and in agreement with the current trend of the world becoming a Global Village.

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