Pakistan Journal of Social Sciences 5 (9): 853-855, 2008
ISSN: 1683-8831

Determinants of Human Impacts on the Coastal Area of the Niger Delta, Nigeria

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Abstract: The study determines, the dominant human activities and environmental attributes as a guide to coastal planning and management in the Niger Delta region of Nigeria. Data used for the analysis was collected within 3 years between 2002 and 2004. A total of 21 human and environmental variables were used for the study. Principal component analysis was carried out on the sets of data obtained. To determine the dominant human activity variables as well as the environmental components the 2 sets of data were correlated using stepwise multiple regressions. The result shows that agriculture (crop and fisheries), deforestation and human population are the major human activities impacting on the coastal environment with resultant pollution and environmental degradation. The study recommends that these activities be properly planned for and controlled in a well articulated integrated coastal planning and management framework to achieve a healthy balanced.

Key words: Human activities, coastal area planning, determinants, Nigeria

INTRODUCTION

One of the most pervasive and urgent problems, confronting coastal states in Nigeria today is how to achieve a healthy relationship between man's developmental needs and the stability that is essential for the preservation of natural environmental systems. The need to achieve this healthy balance has arisen from a number of intractable ecological problems created by both purposeful and inadvertent human activities. This has witnessed a rising tide of public concern for our deteriorating coastal environment as indicated by the recent surge in media publications on the issue (Oghifo, 2003). Niger Delta region which is situated on sandy terrain with copious rainfall is the most severely threatened ecosystem in the country.

These problems from various human activities especially wetland draining for oil exploration, expansion of infrastructural development, agriculture as well as urban growth extending outwards from the congested central areas of coastal old towns such as Ibeno, Mkpanak, Eket, Ikot Abasi, Bakassi, Calaber, Oron etc (Ekong, 2005). In these towns, very serious impacts had occurred resulting in mangrove forest clearance and environmental degradation. Others include major coastal erosion and loss of fishery resources in smaller villages Moses 2007 the multiplier effects of this development is the draining of mangrove which acted as a buffer against wave action and nursery area for fish/shell fish. Even with the construction of beach defense by Exxon Mobil and the state governments the story remains the same especially with the recent global climatic change and sea level rise (Akpan, 2004). On the whole, unemployment, social conflict and poverty are widespread, as fishing and crop farming, which are the mainstay of the coastal economy are no more lucrative. Also, the freshwater creeks, which supply drinking water to the coastal communities are drained, leaving them without a reliable source of drinking water. Boreholes and hand dug wells do not yield potable water because of high level of salinity and frequent oil spills.

These problems are as a result of insufficient information (data) on the correct mix of activities that could lead to a sustainable coastal environment. The objectives of this study, therefore, is first to determine the level of impact and provide information on these human activities that are impacting negatively on the coastal environment for a connect mix. This, it is believed, will assist in the sustainable planning and management of our coastal areas.

The study area: The study was conducted in Niger Delta, Nigeria. It has a coastline of 850 km and a land area of 117.396 km^2 (Okpara and Okpara, 2004) forming about 13% of Nigeria landmass of 923.768 km^2 and situates between the latitudes of 4° and 14'N and the longitudes of 3° and 9'E within the tropics. Since, this is a wide area to cover effectively, the study was conducted in Akwa Ibom State which was purposely selected among the nine states in the region; primarily for convenience of study. The state is bounded by Cross River in the East, Abia in the North, Rivers in the West and the Atlantic Ocean in the South. It has a population of 3 million people (NPC, 2006) a landmass of 6.187 km^2 and about 15% of the regions coastline.

The main occupation of the people is crop farming and fishing, the area is a coastal state with generally low lying landscape which exhibits considerable variety characterized by creeks, estuaries, headlands, coastal marshes and senic dune. More than 65% of its population lives within 20 km of the coastline. The state is made up of 31 local government areas of which 12 which are coastal areas were purposely selected for study. The local government areas include Ikot Abasi, Eastern Obolo, Mkpat Enin, Onna, Eket, Ibeno, Esit Eket Mbo, Oron, Udung Uko, Urue Offong Oruko, Nsit Ubium and Okobo.

MATERIALS AND METHODS

Data used for the analysis were obtained by using a set of well structured questionnaire administered to all house-hold heads in the twelve selected communities. The data was analysed using Principal Component Analysis (PCA). For the PCA data was collected on a total of 21 variables comprising human characteristics and environmental attributes within the study communities. The 21 variables of the human characteristics were later aggregated to give 11 variables. PCA was then carried out to show relationship between the 2 data sets. To determine the dominant human activity variables as well as the environmental component the 2 sets of data were later inter correlated using stepwise Multiple Regression Model. This was done to ascertain the significant proportion of environmental impacts contributed by the group of dominant human characteristics in the coastal region.

RESULTS

A total of 3 interpretable eigen values were extracted. Out of the 21 human characteristics variables used only 3 had eigen values of one and shown in Table 1. These 3 variables were extracted based on the criterion of those eigen values greater than unity. The sizes of eigen values represent the sizes of the components.

To investigate the effect of the human components against each of the environmental components a stepwise multiple regression was carried out.

These 3 components was interpreted and named as follows:

Factor 1: Agriculture and Urban development from the rotated matrix, this factor loaded highly on Agriculture (0.8527), community facilities (0.9542), Income (0.9578), waste (0.9212), NIPA palm (0.7310), mangrove clearance (0.7023) and Roads (0.6136). This factor alone holds 59.3% of the total variance in the data set.

Table 1: Eigen values for human characteristics

Components	Eigen values	Variation (%)	Cumulative (%)
Agriculture/Urban Dev.	5.9328	59.3	59.3
NTFPs /Water souce	1.7651	17.6	75.9
Population density	1.5075	15.0	90.9

Table 2: The human activity parameter

Components	Eigen values	Variation (%)	Cumulative (%)
Pollution-land and water	4.9242	49.2	49.2
Fisheries	1.8548	18.5	57.7
Mangrove forest	0.8382	8.4	66.1

Factor 2: Water source and NTFPs (gathering) as water source (0.9380) and gathering of NTFPs (0.8271) loaded highly and accounted for 19.17% of the total variance observed.

Factor 3: Population density (0.7576) and erosion (0.7497) showed significant loadings and accounted for 7.34% of the variances. This factor is named population density.

As with the human activity parameter, a total of 6 interpretable eigen values were extracted for environmental variables of which only 3 had load of .8 and above (Table 2). These four components accounted for 70.2% of the variation in the coastal environmental data and therefore, explain most of the variations in that environment.

The three components are:

Factor 1: Pollution (water and land) showed the following loads conductivity (0.7530), pH (0.9002); TDS (0.9024). TSS (0.7520); BS (0.8893) and EA (0.7273) and counted for 49.2% of the observed variance in the area.

Factor 2: Fisheries as cryfish (0.9417) and Demersal fishery (0.91317) accounted for 18.5% of the total variance in the data set.

Factor 1-3: Mangrove clearance loaded (0.8382) and hold 8.3% of the variance the data set.

Analysis of relationships between human characteristics and the environment: This relationship was investigated using the multiple correlation/regression analysis. A multiple correlation/regression of the 3 extracted dependent variables on each of the 3 extracted-independent variables defined the strength of association of the 2 sets of the variables as well as the causal relationship between the variables. The y-variable defined and named as pollution has a multiple correlation coefficient R = 0.67042 indicating that about 67% of this factor is contributed by the 3 extracted x-factors. The square of the multiple correlation coefficient $R^2 = 0.44947$

Table 3: The multiple correlation/regression analysis for the first y- factor

Multiple R	=	0.67042	
R^2	=	0.44947	
Adjusted R^2	=	0.41506	
Standard error	=	0.76481	
Analysis of variance	D/F	Sums of squares	Mean square
Regression	1	7.64098	7.64048
Residual	16	9.35902	0.58494

F = 13.06286, Significant F = 0.0023

Table 4: The analysis for the second factor

Multiple R	=	0.48996	
R^2	=	0.24006	
Adjusted R^2	=	0.19256	
Standard error	=	0.89858	
Analysis of variance	D/F	Sum of squares	Mean square
Regression	1	4.08095	4.08095
Residual	16	12.91905	0.50744

indicates the degree of predictability of the value of y and the entire x-factors as inputs, in this case about 45%. This result is significant at F = 0.0023.

The result of the multiple correlation/regression analysis is as follows for the first y-factor, which is pollution.

In the same way, the multiple correlation/regression analysis for the second y-factor named fisheries factor show a strength of association of 49% with a multiple correlation coefficient R = 0.48996. This means that about 49% of the factor can be predicted by the 3 extracted x-dependent variables. The square of the R^2 = 0.24086 showing 24% of predictability of change in y-components.

The result of the analysis for the second factor is as follows:

These 2 factors show (Table 3 and 4) a positive significant relationship and imply that these 2 human activities are actually impacting negatively on the environment.

CONCLUSION

Human induced impacts in order of importance include Agriculture (59.3%), pollution (49.2%), population density (15%) and depletion of natural resources (18.5%). This study has shown that the destruction of the mangroves vegetation for agriculture, fuel wood and construction is among the greatest problem posed by human use of the coastal areas under study and by implication the Niger Delta region. Another very important impact of man in the region is pollution. This comes in various forms while the most offensive include waste management (human and industrial). The main problem in waste management is in relation to human waste, gas flaring and frequent oil spills.

Another very important human impacts which shows a significant relationship with the environment is share human population density in the area. Currently, human population density is everywhere high ranging from 131 persons km^{-2} in fishing communities in Eastern Obolo and Mbo to 720.780 and 907 persons km^{-2} in Eket, Onna and Oron (Ekong, 2005), respectively. These can only be compared to the Nile Delta and Banglashesh where rural population reaches 500-1000 pasons km^{-2} (Liz, 2003).

The increasing human activities and densities have given rise to resource depletion and use conflicts. With increase in population and high population density, pressure to develop the coastal land for housing, agriculture, fisheries (including aquaculture), infrastructure, tourism and other activities will intensify these conflicts especially concerning the use of ocean space and the adjourning land and the development of an equitable balance of priorities. Physical planning policies and management programmes for the coastal areas should target these activities. These activities should be properly planned for and controlled to reduce future hazards in the area and must be properly integrated and co-ordinated through a framework known as regional integrated coastal area planning and management.

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