Environmental Impact Assessment of Ala-River Akure, Ondo State Nigeria

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Abstract—With an increase in urbanization, there is a need for a constant assessment and monitoring of environmental features. Environmental Impact Assessment (EIA) as been used in this research was to assess the impacts of Ala River in Akure on the environment using Geographical Information System (GIS) techniques. Data collection involved the use of Questionnaires and the design was based on four criteria: socio-cultural, climatic, economic, Health and Safety Impact factors. Using Arc Map, Buffer Analysis was performed around the River to get those features most susceptible to the impact of Ala River and also to guide the expance where opinion survey was carried out at different locations around the river. Analysis of Variance (ANOVA) was used to analyze the data acquired and the Hypothesis tested was used to generate the outcome set for each of the criteria. From the results of the study, it was discovered that the River has impacts on the Social-Cultural state of the environments (P<0.05), Climate of the environment (P<0.05) and Health and Safety state of the environment including the people around it (P<0.05), but the River does not have major impacts on the Economic factors (P>0.05). The research recommends that additional efforts need to be put in place on all fronts if the results acquired from environmental assessment is to be put to good use.

Index Terms—Environment, Ala River Akure, Flooding, ANOVA, Climate.

I. INTRODUCTION

Everything within Earth sums up to makes up the environment. Physical, natural, biological and socio economic features have effects on the environment. Water, an element of physical environment is arguably an alternative name for life. A constant increase in population on the earth surface causes a rapid and astronomic increase in the request for water and in turn increases the amount of activities around earthly water bodies. One very vital life supporting system available in nature is the fresh water ecosystems, where rivers play significant role in the land and water ecological system. Reasonably, water is a rich and profuse resource readily available by nature and it is essential for the upkeep in all the facets of life [12]. In developing countries, water, a prized resource is used for the provision of goods, household consumption, and commercial healthy drinking water and irrigation purposes [15]. A very important and basic issue in advanced nations is the production of tremendous quantity of toxic waste by different anthropogenic exercises and its inappropriate disposal into surrounding water bodies particularly freshwater supplies. For example; in 1988, an Italian businessman illegally deposited more than 2000 containers of sack and drums of hazardous waste in Koko a small fishing community in Southern Nigeria [13]. Also, human activities gotten from industrial, agricultural and residential exercises have frequently rendered these natural assets inadmissible for essential or potentially optional uses [9]. Subsequently, water bodies which are significant containers of treated and untreated or somewhat treated industrial wastes have turned out to be exceptionally contaminated. The resultant impacts of this on general wellbeing and on the environment are normally extraordinary. The rapid emergence and spread of water-borne diseases like cholera, hepatitis, gastro-enteritis, and so on, are conceivable wellbeing impacts of contaminated water [1], [11], and [7]. Sadly, although improvements are being made recently in most of the state of the federation to combat open defecation though the support of United Nation [16]. However, common approach of stable solid waste disposal in many cities in Nigeria nonetheless remain open dumping, land-filling in unlined sterile landfill destinations, open burning, incineration [2]. This study aimed at assessing the Environmental Impact Analysis (EIA) of Ala River in Akure using Geospatial technique with a view to solving major rising issues about Ala river within Akure city and how to manage the dynamic environment constantly. Also, Akure as a city experiences environmental hazards and occurrences occasioned by Ala River which is an extensive water body that supports and impacts the environment around it. These impacts could be positive or negative, and can be costly to manage if proper measures are not put in place while the occurrences could be partly or majorly erupted by the activities of settlements around the river. From findings, there have not been any Environmental Impact Analysis solely carried out on Ala River and this influenced the need for this research to assess the Environmental Impact of Ala River. This research was used to give GIS a methodical leverage and incorporated methodology for the accumulation of environmental data which lies at the core of a decent EIA.

II. STUDY AREA

This Ala River is located in Akure, the capital of Ondo State. It lies on latitude 7.25°N and longitude 5.19°E (Fig. 1). Akure is situated about 282 Km away from Abuja, the capital city of Nigeria and 312km from Lagos, the business hub of Nigeria. Akure is also the headquarters of Akure South Local Government Area. The city is located 396 meters above sea level. The current estimated population of

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Akure is over 495,000. The increase in the annual growth of the city’s population could be attributed to her role as an administrative and economic nerve centre of the state. Also, Ala River is one of the major tributaries of River Ogbese in South-western Nigeria. The river has a total length of about 58 km, out of which about 14.8 km is within Akure Township [4]. It took its source from the North western part of Akure town and flows toward the South-eastern part of the town. Akure township dominates upstream of River Ala while rural towns such as Ilado, Ehinala, Ajegunle, Owode Aiyetoro and Araromi are located downstream. High temperatures and high humidity with two distinct seasons characterize the climate of Akure, namely wet and dry seasons. The annual rainfall is about 1524mm while annual temperature ranges between 28°C and 31°C with a mean annual relative humidity of about 80%. Often, with high amount of rainfall, the volume of the water body increases therefore creating the need for this research on the impacts of the river on the environment.

![Map showing Ala River course Akure, Ondo State Nigeria.](image)

**Fig. 1. Map of the study area**

III. METHODOLOGY

Both primary and secondary data were used in this research. The Primary data was obtained from the target population using Survey Questionnaires which aimed at acquiring information on the impacts of the river on the population. Also, differential Global Positioning System (GPS) instrument was used to acquire geographic coordinates of some fish farms and ponds within the 30m buffer zone and some other notable features along River Ala. Notably too, the secondary data included Satellite Imagery of Akure downloaded from Google Earth Satellite imagery. The satellite images were opened in the Arc Map 10.2 GIS environment. The imageries were enhanced, filtered, georectified and resampled using digital image processing techniques.

The coverage universe in this study is the population of people residing around the study area. They were selected because they have businesses, structures (buildings inclusive) and farms (fish ponds, vegetable farm etc.) within the 30meters radius buffer from either side of the River. The projected population of the study area is 55,944 based on 7 persons per family (ppf) and 4 Households per Building (hpb) [8]. The sampling frames for this study are the Ondo State Ministry of Physical Planning and Urban Development and Akure South Local Government Area Town Planning Office. These are the Government organs responsible for building standards as well as granting of permission to construct permanent and temporal shed in the study area. Exploratory research design was adopted and it was used to assess the impact of Ala River on the socio-cultural, climatic, economic, Health and Safety of life of the residents in the study area. It was conducted based on survey – ‘individual interview through questionnaire administration – i.e. structured interview method’ in line with [13] and [10].

The sample size was chosen in such a way that they represent the total population as good as possible and it represented the number of households or person selected for the survey. With an estimated population of 55,944 and building population of 1998, a 5% of the building population gives an approximate sample size of 100. This proportion is realistic and sufficiently comfortable considering the homogeneity characterizing the study site and is in line with [14] who considered sample size of 5% to be fair and reliable for a study of this nature. Significantly, a household head who is an adult male or female was selected based on simple random sampling techniques and where there is more than one household head in a building, the most senior household head was interviewed in accordance with [3].

The research instrument for this study was based on interview schedule and the design of the questionnaire was done using Likert scale of five points (Strongly agreed, agreed, neutral, disagreed and strongly disagreed) which was used to obtain responses from the respondents with regards to acceptance to each question.

The major variable measured in this study originated from social survey and it includes explanatory variables (- i.e. biological-data of respondents) and criterion variables (- i.e. the impacts of Ala river on the environment and the actions taken by the respondents) respectively. Specifically, the EIA process provides levers to select the criteria variables for the evaluation of the Socio-Cultural, Climatic, Economic, Health and Safety impacts of Ala River on the environment. The selected criteria were four as follows: firstly, finding the Socio-cultural effects and impacts of Ala River; secondly, determining the Climatic impacts of the river and then its impact on the environment; thirdly, evaluating the economic implications of the river, while the fourth aimed at getting information on the health and safety impacts of the River on the environment as well as on the inhabitants around it.

A total of 100 structures within the buffer zone (Fig. 2) were sampled. They were selected at Random to get a proper sample data and remove bias. The questionnaire was read and interpreted by trained Field Assistants (FAs) to the household heads in their homes. Correct options to the various questions were ticked off by the FAs. According to [5] and [6], a response rate from these respondents was considered to be very good as a 96% response to all the questionnaires was achieved.
IV. RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents are as shown in Fig. 3. Significantly, it displays the age distribution of the respondents residing beside Ala River. From the distribution, it is observed that respondents below the age of 30 constitute the majority (51%) while respondents age between 41 - 45years were the least (7%). Most of the respondents residing in the study area have lived in the study area between 5 to 6 years and there were at least 5 to 10 persons occupying a building while fishing is the main occupation followed by farming.

A. Socio-cultural factors of the Residents

The data derived from the questionnaire on socio-cultural factors are presented in Fig. 4. There are religious activities carried out around Ala River as there are a combined 48% of respondents agreeing to that as against 35% who disagreed. However, 68% of the respondents refuted the statement that “Ala River serves as a spot for festival activities” so there was no major known festival activity information we could acquire from the respondents. Also there are no recreational spots around Ala River as there are a combined 74% of respondents agreeing to that but centers that showcase this feature dotted Akure landscape. Similarly, 38% of the respondents agreed to Ala River being a tourist attraction site as against 50% who did not agree. However, Tourism is a good socio-economic feature which if harnessed well can add a lot to the environment and the people at large, so opening up of new areas with access roads and developing a tourist attraction site can go a long way in improving the status of the environment around Ala River.

The Analysis of Variance (ANOVA) used to test the null hypothesis whether Ala River has influence on Socio-cultural factors at 5% confidence level was accepted since the P Value = 0.044843, P < 0.05, and FCal=Ftab = 2.965686 as indicated in Table I. This means that, statistically, Ala River has influence on Socio-Cultural state and environment.

TABLE I: ANALYSIS OF VARIANCE ON SOCIO-CULTURAL FACTORS

| Source of Variation | SS   | df | MS  | F    | P-Value | F crit |
|---------------------|------|----|-----|------|---------|--------|
| Between Groups      | 532.4| 4  | 133.1| 2.965686 | 0.044843 | 2.866081 |
| Within Groups       | 897.6| 20 | 44.88|      |         |        |
| Total               | 1430 | 24 |     |      |         |        |

B. Climatic Impact on the environment

The questionnaire analysis on climatic impact of Ala river on the environment (Fig. 5) reveals that the displacement of people in the study area is an occurrence that happens annually (plate 1) and has been identified by 79% of the respondents as a result of Ala river overflowing its boundary, thereby causing a negative impact and hardship on the public. Also, 80% of the respondents strongly agreed to confirm the statement that “Lands around Ala River experience flood” thereby causing a huge loss of agricultural and vegetated land which has serious financial loss implication on the farmers around. In the same vein, 79% of the respondents agreed that rainfall around the River is always very high and this has a positive impact. Rain harvesting is a good source of clean water, more especially as there is abundance of rainfall in the area during the wet season. The communities around Ala River satisfy their water needs from hand-dug wells, boreholes as well as from Ala River as witnessed during the field work. The hand dug wells and boreholes supply drinking water, while water for other purposes is mostly scooped directly from the river.

Plate 1. Building within the buffer zone partially submerged in water.
However, from the results of the vectorizing of structures within the study area, plate 1 is one of the 1998 other structures that fall within the buffer zone and this was also confirmed from the questionnaire analysis which reveals that flooding impact on the environment and inhabitants around the River. 61% of the respondents also strongly agreed to the statement that lands around Ala River often experience erosion but flooding is a major menace the settlements close to Ala River are facing. This is partly caused by the sand mining activities attested to during the field work and also non adherence to the setback rule of 30m from the river. Houses erected closer to the river often experience submergence as a staggering 60% of the respondents attested to that while 50% also agreed that flooding around Ala River is manageable.

C. Economic Impact

Chart corresponding to the responses on economic impact of Ala River on the environment is shown Fig. 6. From the survey data, fishing is regarded as a major commercial activity that the Ala River is known for with 67% of the respondents attesting to that. Responses acquired from the survey with the statement “There is no presence of mineral resources in the Ala River” reveal that 33% of the respondents were neutral, while 31% strongly disagreed with the assertion. Also, we can infer that the Ala River is not really used for transportation as about 48% of the people attested to that. Another economic importance the Ala River poses to its environment is in Sand mining. Sand Mining is marketable for building and construction purposes but also has its own disadvantages to the overall wellbeing of the environment. Ala River supports cultivation of crops; therefore, farming is also an economic activity practiced around Ala River. However, the major cultivation is seasonal as a result of flood disturbance when the water level of the River is high and this is a serious discouraging factor to the farmers.

The P value is greater than the significance level when the Null Hypothesis: ‘Ala River has influence on Economic Impact factors’ was tested at $\alpha = 5\%$ (Table III). The alternative hypothesis was accepted and it was concluded that statistically, Ala River has no influence on Economic Impact factors.

From the hypothesis result, it was concluded that Ala River does not have major economic influence and impact on the environment. From the study, we can infer that the main economic occupation of the inhabitants of the settlements around the river was trading at different levels such as fishing, farm products and other small business owners. Agriculture in the area is basically that of arable cultivation and fish farming.

D. Health and Safety

The health and safety of the residents within the Ala river envirom was equally analyzed. From the bar chart (Fig. 7), it reveals that ‘strongly agree’ was the most selected option across the 8 questions posed to the respondents. For instance, over 60% respondents strongly agreed that solid waste is often deposited around or in the River while over 50% respondents also strongly agreed that Open defecation is practiced around or in Ala River thereby making the River quite unsafe for some domestic use. The washing of large number of carpets, rugs, engines and vehicles by many car wash owners reduces the water quality by contaminants. 48% of the respondents claim the River does not serve as a source of drinking water for them. Some hazardous physical and chemical impurities were discovered in the samples collected from Ala River which were above the acceptable limits which pose a health risk to several rural communities who rely heavily on the Ala River primarily as their source of domestic water and even for livestock production. Significantly, there are not so many activities been reported around Ala River however, the issue of noise pollution has been noticed. With 38% of the respondents strongly agreeing to the fact that noise pollution is a challenge posed by the Ala River. The presence of many Cement Block Industries around the River contributes to this.
The Null Hypothesis: ‘Ala River has an influence on Health and safety factors’ was accepted at α= 5% because the P value is less than the significance level (Table IV). This means that, statistically, Ala River has influence on Health and safety factors.

| TABLE IV: ANALYSIS OF VARIANCE ON HEALTH AND SAFETY FACTOR |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Source of Variatio n | SS | df | MS | F | P-Value | F crit |
|-------------------|-----|----|----|---|--------|-------|
| Between Groups | 5525.2 | 5 | 1105.04 | 16.6437 | 0.00000009 | 2.64146 |
| Within Groups | 2904.7 | 3 | 968.23 | 82.9928 | 96 | 5 |
| Total | 8430 | 8 | 1113.27 | 952.63 | 96 | 5 |

V. CONCLUSION

The research shows that a lot of people have not followed the setback rule which have been set by the government and so had negative impacts on the Ala River. There is no proper monitoring of how the land around Ala River is been used. It was also revealed in the study that Ala River cuts across the developed part of Akure and it plays a vital role in impacting the environment and in turn the inhabitants of Akure. The research also reveals that Ala River has influence on the Socio-cultural factors, Climate factors, and Health and safety while the river has no influence on Economic Impact factors.

The applications of GIS in Environmental Impact Assessment cannot be overemphasized, however much work lies in the hands of the EIA monitoring experts to ensure that important steps are put in place to mitigate the negative impact of the River on the environment and also stop the negative impact man’s activities has on the environment.

The research recommends that, the act of indiscriminate waste disposal poses a risk to the river and to the environment as there are hazardous physical and chemical impurities discovered in the river. Also the issue of flooding discovered in this research has to be handled seriously because it is a serious problem the residents within the river environment are facing. It was also discovered that most residents cannot use the water for drinking, and neither for cooking but very few people use the water for other purposes and so the quality of the water needs to be checked before people are allowed to consume it so as to prevent the outbreak of epidemics. Laws guiding the environment can be enforced to checkmate open defecation, dumping of waste especially by cement block industries, mechanics, car wash, and laundry businesses that litter the river course.

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