

# Assessment of the Implementation of the Environmental Management Plan of the Gurara Multi-Purpose Dam in Kaduna State Nigeria

Ahmed Yero Bello, T. A Ogah, Magaji JI, Abugu N.A

**Abstract**— Despite the credibility of EIA in predicting and mitigating environmental impact of development projects like dam, Gurara dam has continues to cause environmental degradation. This study assessed the implementation of the Environmental Management Plan (EMP) of the Gurara Dam in Kaduna State Nigeria. The objectives of the study are to assess the implementation of mitigation measures for: air quality deterioration; noise and vibration and changes in hydrological patterns and water quality. To achieve the objectives, the EIA report of Gurara Multipurpose Dam Project was reviewed to identify the predicted impact and mitigation measures in the EIA report. Then field survey was conducted to evaluate the implementation using questionnaire survey, observation, interview, and focus group discussion. This study selected five hundred (500) respondents for household questionnaire administration and twenty-three participants for Focused Group Discussion and interview using purposive, systematic and panel sampling techniques. Data collected were analysed using descriptive statistics frequency distribution tables, percentage, mean standard deviation and Coefficient of Variation. Results showed that three hundred and twenty-nine (329) respondents representing 65.8% agreed that the enlisted mitigation measures to prevent air pollution were implemented; two hundred and eight respondents representing 41.65% agreed that the enlisted mitigation measures to prevent noise and vibration were implemented and that one hundred and seventy-six respondents representing 35.1% agreed that the enlisted mitigation measures to prevent changes in hydrological patterns and water quality were implemented. It was concluded that the implementation of the outlined mitigation measures in the Gurara dam EIA report fall short of the arrangement in the Environmental Management Plan. It was recommended among other things that stakeholders should play their roles properly to ensure that mitigation measures in the Gurara are well implemented.

**Index Terms**— EIA, Environmental Management Plan, Mitigation Measures, implementation, Gurara Dam.

## I. INTRODUCTION

Development has for a long time focused on whether the initiative was economically and technically feasible. Thus, development projects increased pressure on the environment due to their lack of concern for the environment. However,

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development and environment are no longer separate concepts due to the continued rise of interest in sustainable development of land and its valuable resources. This thought was brought first time in the Brundtland report by the World Commission on Environment and Development. In the report efforts were made to integrate the environmental aspects with the developmental issues (Bruhn and Eklund, 2002), so to bring environment and development together new legislative and technical tool called EIA (Environmental Impact Assessment) was introduced at national and international levels. Environmental Impact Assessment (EIA) provides assistance to make the decisions for sustainable development. In this approach information about environmental impacts of a proposed project is assessed and consideration will be made by the decision makers (stakeholders) to determine whether the project should proceed or not. The environmental impacts are seen in a very systematic way of different steps such as screening, scoping, consideration of alternatives, description of environmental baselines, identification, prediction and evaluation of impacts, public consultation, mitigation and monitoring of impacts, presentation, documentation and review and decision-making.

An essential part of EIA report is the Environmental Management Plan (EMP). Republic of Serbia FERP (2015) stated that the main purpose of EMP is to serve as a valuable tool for identifying possible key environmental and social impacts that will result from the project and proposing mitigation measures to address the most significant impacts. The EMP also provides the responsibilities of different parties involved in the project implementation. Similarly, Morgan (2012) explained that an Environmental Management Plan (EMP) is a living document that must consider predicted impacts to the environment, monitoring data and programs, and means for compliance (present and future) to applicable guidelines and regulations.

Once construction and operations commence, monitoring is an integral part of evaluating the effectiveness of the plan and planning process. Monitoring and analysis of monitoring results then allows for adaptive management of the site and adjustment of management plans or mitigation measures to reduce or eliminate potential impacts.

The objective of the EMP is to set out clearly the as key components of environmental and social management for the project. The EMP includes measures for waste management and disposal, noise abatement, maintenance, emergency

response planning as well as monitoring and informing public on the environmental and safety impacts of the project. The purpose of environmental management planning is to consider and develop proper measures and controls to decrease the potential for environmental degradation during all phases of the Project, and to provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety.

Mitigation measures to be incorporated in the project execution for the effective management of water resources include but not limited to minimum disturbance of the top soil including the vegetation and consolidation of the disturbed earth to original undisturbed state (Habibullah and Andre, 2012)). 'Environmental Management Plan (EMP) is a key component of Environmental Impact Statement (EIS) where identified potential environmental and social impacts of a proposed project and their proposed remedies are documented'

This scientific tool (EIA) has been applied for comprehensive development projects such as dams in Nigeria and the Gurara Dam in particular. However, the performance of Environmental Impact Assessment (EIA) has become a common feature in environmental management debates among scholars, practitioners, Non-Governmental Organizations (NGOs) and the government agencies in Nigeria. EIA is globally recognized and credit as sustainable approach that predict and mitigate development impact. Despite the credibility of EIA in predicting and mitigating environmental impact of development projects like dam, the country continues to experience monumental environmental degradation (Agbazue and Ehiemobi, 2016). Construction activities, including the diversion of the river through a tunnel, have continued to cause adverse impacts on the aquatic ecosystem and the general water quality.

This prompted Alhmed (2016) to evaluate the impact of Gurara dam on soil and water quality within the catchment which found a significant difference in soil quality in terms of nitrate, sulphate, phosphate, chloride and organic matter between the study soil samples and EIA baseline data. And all surface water quality parameters vary between the EIA and the study surface water quality. As a result, Ahmed (2016) concluded that dam have significant negative impacts on soil and water quality as some soil and water quality parameters had been altered significantly after dam construction. Thus, the study recommended among other things the implementation of the environmental management plan listed in the EIA. Therefore, the present study emanated from the findings and recommendation of Ahmed (2016), as it proposed to assess the implementation of the Environmental Management Plan of the Gurara Multi-Purpose Dam in Kaduna State Nigeria.

Moreover, several researches have been carried on Nigeria EIA Act of 1992 and its performance as a tool for sustainable development and findings has been made. The origin, objectives process of EIA in Nigeria is well documented (Federal Ministry of Solid Mineral Development, 2004;

Nwafor, 2006, Agbazue and Ehiemobi, 2016).

Nwoko (2013) observed that prior to the enactment of the EIA Act 86 of 1992 in Nigeria, project appraisals were limited predominantly to feasibility studies and economic cost benefit analysis and that most of the appraisals did not take environmental costs, public opinion, social and environmental impacts of development into consideration. Similarly, Ortolano and Shepherd (2012) observed that the appetites of large infrastructure agencies in charge of water resources projects, highways and energy facilities appeared to be unquenchable and the mission statements of those agencies did not force them to account for the adverse environmental impacts of their actions. Though, recognition and application is on the increase, the status of EIA implementation in dam projects in particular makes it difficult to evaluate the EIA implementation and its improvement. Agbazue and Ehiemobi (2016) doubted the functionality of EIA in Nigeria when they stated that "it has been over 20 years since the EIA Act was promulgated in Nigeria but one wonders if EIA process has become more effective than the period prior to 1992". EIA has been noted to have many challenges and shortcomings, Agbazue and Ehiemobi (2016) stated that the challenges of EIA are assessed based on compliance, responsiveness and the efficiency of the process. It starts with the extent to which developmental activities that require EIA's are actually subjected to this process before their commencement.

Caucasus Environmental NGO Network (CENN, 2004) Noted that co-ordination between the parties to the EIA process in Azerbaijan is the weakest point of EIA practice in the country, to which there are a number of possible reasons. Thus, not all the potential participants of EIAs are systematically involved in this process, partly due to the lack of information made available during the public information campaigns held in each particular case. Co-ordination with investors is sometimes difficult due to the low levels of their activities with regard to participation in EIAs, and donor organisations are also viewed as often having low interest in financing EIAs and relevant activities, despite their often active participation in increasing public awareness of the EIA process.

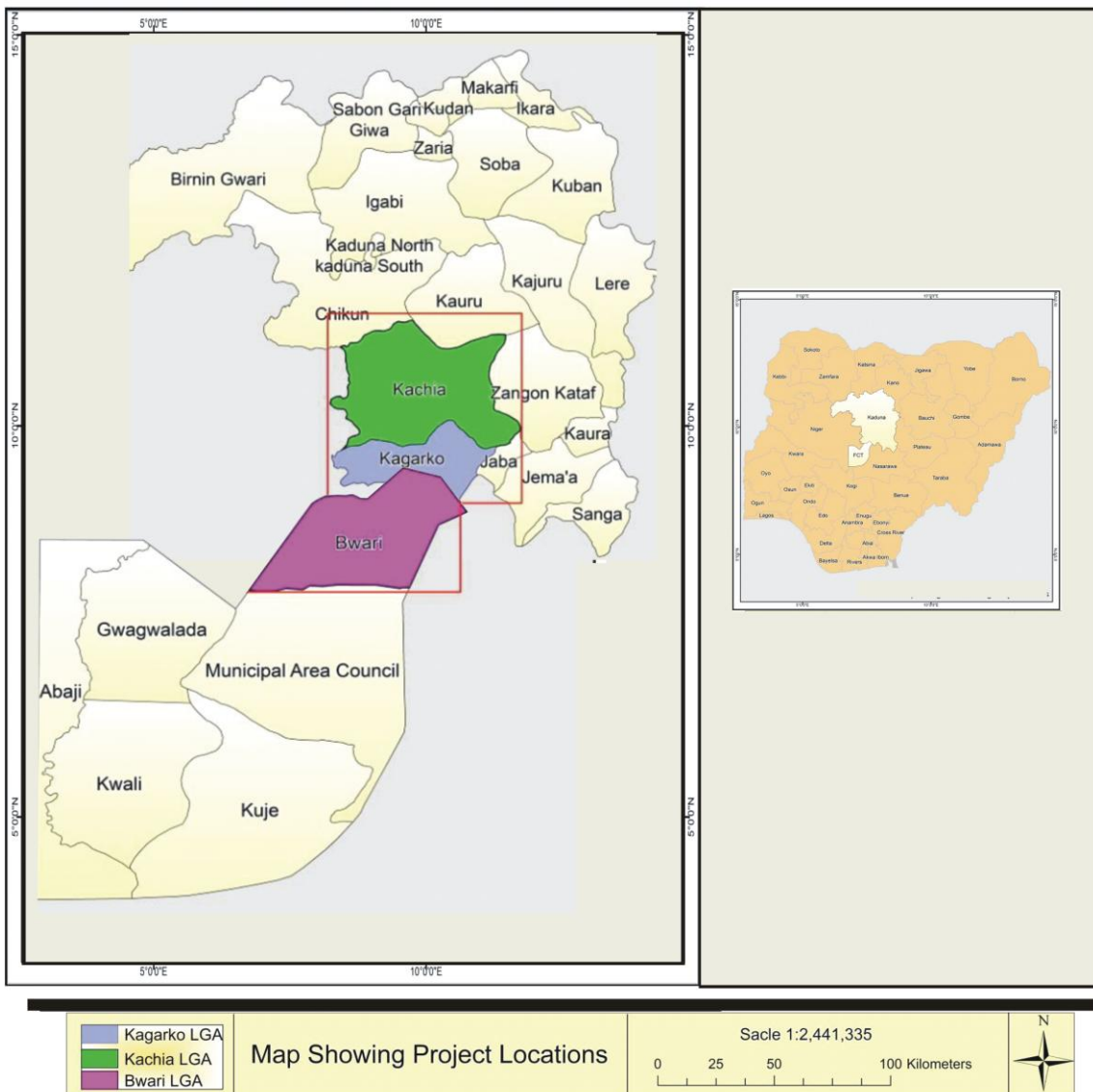
Olubunmi and Olufemi (2013) identified shortcomings of EIA to include (i) delay in the execution of EIA in Nigeria due to the inadequacies and misinterpretation of various regulatory statutes (ii) There is duplication of functions and overlapping responsibilities in processes and procedures guiding the execution of the various impact assessment tasks due to too many regulatory bodies (FME NESREA, NOSDRA, DPR, states EBP) and (iii) Absence of effective Sanctions.

Among the factors that are believed to be significantly influencing the effectiveness of EIA are weak institutional framework, inadequate legislative framework, omission of stages in the EIA process, quality of EIA reports as well as the ineffectiveness of implementation and follow-up of EIA

recommendations (Sileshi, 2016). Although, Nwafor (2006) has lamented that EIA is poorly conducted and its environmental management plan is usually not well implemented to reduce the impact. However, 'no research' has been conducted on the implementation of environmental management plan of the Gurara Multi-Purpose Dam. This study in bite to bridge this gap, promote EIA as a tool for sustainable development, intends to assess the implementation of Environmental Management Plan of the Gurara Multi-Purpose Dam in Kaduna State Nigeria. The objectives of the study are to assess the implementation of mitigation measures for: air quality deterioration; noise and vibration and changes in hydrological patterns and water quality.

The area under study is Gurara Dam Project, the entire project area cuts across Kachia and Kagarko Local Government Areas (LGAs) in Kaduna State and Bwari Area Council of Nigeria's FCT, of approximately 150 km<sup>2</sup> with the pipeline route inclusive ( Figure 1).The Gurara dam, and 2000 hectares irrigation pilot perimeters fall within Latitude 090:32'N to 090:48'N and Longitude 070:29'E and 070:49'E. The Pipeline takes its route from the upper Gurara dam in Kachia Local Government Area (LGA) of Kaduna State, traverses Kagarko LGA of Kaduna State and Bwari Area Council of FCT to Lower Usama Dam with a corridor 60m wide and 75km in length (Environmental Impact Assessment (EIA) Report of the Gurara Multipurpose Dam Project, 2004).

**1. Methodology**



**Figure 3.1: Project Location**

**Source: Gurara Water Management Agency- Federal Ministry of Water Resources**

The main project area falls within the same climatic conditions as Kaduna State. The area experiences a typical tropical continental climate with distinct seasonal regimes, oscillating between cool to hot dry and humid to wet. These two seasons reflect the influences of tropical continental and equatorial maritime air masses which sweep over the entire country. The mean annual temperature is about 35.4 °C

(NIMET).Total annual rainfall for the project area over the 15 year period ranges between 849 mm to 1564 mm with a duration of rainy season spanning over five to seven months, from April – October. The dry season sets in from early November till March with no trace of rainfall at all. The mean monthly relative humidity is highest in August with 82%, corresponding to the same period of highest

rainfall. EIA Report of the Gurara Multipurpose Dam Project shows that the main hydrological system in this area is the Gurara River system. The major tributary of the Gurara River is the River Usuma which together with its tributaries drains the FCT into the Gurara River.

This study used a combination of methods: literature review; reviewing the EIA reports of Gurara Multipurpose Dam Project and other relevant documents; the EIA report of Gurara Multipurpose Dam Project was reviewed to identify both the impact mitigation measures, in the environmental management plan in the EIA report. Then field survey was conducted to evaluate the level of their implementation using questionnaire survey, observation, interview, and focus group discussion. Environmental mitigation measures in the Gurara Dam EIA Report were used as checklist to evaluate its implementation.

This study selected five hundred (500) respondents for household questionnaire administration and twenty-three participants for Focused Group Discussion using purposive, systematic and panel sampling techniques. Purposive sampling technique was used to select

ten (10) affected communities namely: Kadah, Akama, Igo, Doka, Peyi Jigo, Yelwa, Doupe, Pena and New Akwana for household survey. The selection of these ten (10) communities out of twenty-six (26) affected communities in Kagarko and Kachia Local Government of Kaduna State were based on degree of impact in the communities. For representativeness, sampling considered the household spatiality. Thus, systematic sampling technique a probability sampling method was used to select households sampled. As a result, three household intervals was use in household selection. Panel sampling technique was employed to select participants for Focus Group Discussion. The panel selection relied on the EIA attendance list as a guide to consult representative of stakeholders. Data was analysed using frequency distribution tables, percentage, mean and standard deviation and Coefficient of Variation.

**Result**

**Implementation of Mitigation Measures for Air Quality Deterioration**

Table 1 presents the implementation of mitigation measures for air quality deterioration.

**Table 1: Implementation of Mitigation Measures for Air Quality Deterioration**

Question	Which of the following mitigation measures were implemented?	Freq uency	%
	Irrigate soil surface before commencing land preparation activities	97	19.4
	Ensure adequate maintenance of equipment, machineries and vehicles	423	84.6
	Train workers on proper operation and use of machineries	343	68.6
	Emissions from generators shall pass through exhausts allow aerial dispersion	453	90.6
	<b>Mean</b>	<b>329</b>	<b>65.8</b>
	<b>Standard Deviation</b>	<b>139.8</b>	
	<b>Coefficient of Variation</b>	<b>4</b>	<b>98</b>

Table 1 presents the scores on the implementation of mitigation measures to prevent air quality deterioration due to dam construction and operation. It shows that on average three hundred and twenty-nine (329) respondents representing 65.8% agreed that the enlisted mitigation measures to prevent air pollution were implemented. This reveals fair implementation of measures to prevent air pollution. However, the standard deviation and coefficient of variation being  $\pm 139.84$  and 98% respectively shows disparity in the implementation. Thus, some mitigation measures were implemented more than others. For examples mitigation measure such as ‘irrigate soil surface before commencing land preparation activities’ had only 97 frequencies (19.4%) while mitigation measure such as

‘emissions from generators shall pass through exhausts allow to aerial dispersion’ had 453 frequencies (90.6%).

At the course of focus group discussion, participant agreed that measure to mitigate air pollution were well implemented. However, possible air pollution was largely attributed to the economic activities and increase transportation in the areas. Participant also agreed that the dam project has the potential to negatively impact air quality through the release of greenhouse gases from aerobic and anaerobic decomposition of biomass, organic matter of the drainage basin, phytoplankton life and use of fossil fuels.

**Implementation of Mitigation Measures for Noise and Vibration**

Table 2 present the implementation of mitigation measures for noise and vibration



**Table 2: Implementation of Mitigation Measures for Noise and Vibration**

Question	Which of the following mitigation measures for noise and vibration were implemented?	Freq.	%
	Fit equipment and machineries with adequate sound insulation	67	13.4
	Use of the quietest practical type of vehicles and equipment	55	11
	Restriction of all noise generating activities to working hours	312	62.4
	Ensure adequate maintenance of equipment, machineries and vehicles	399	79.8
	<b>Mean</b>	208	41.65
	<b>Standard Deviation</b>	150.49	
	<b>Coefficient of Variation</b>	97	

Table 2 presents the frequency of respondents that agreed on the implementation of mitigation measures to prevent noise and vibration due to dam construction and operation. It shows that on average, two hundred and eight respondents representing 41.65% agreed that the enlisted mitigation measures to prevent noise and vibration were implemented. However, the standard deviation and coefficient of variation being  $\pm 150.49$  and 97% respectively indicate that some measures were implemented more than others. For instance, 67 respondents representing (13.4%) and 55 respondents (11%) respectively ticked that mitigation measures ‘fit equipment and machineries with adequate sound insulation’ and ‘use of the quietest practical type of vehicles and equipment’ were implemented. Whereas, mitigation measures such as Restriction of all noise generating activities to working hours and ‘ensure adequate maintenance of equipment, machineries and vehicles’ were ticked by 312 respondents (62.4%) and 399 respondents (79.8%) respectively.

During focus group discussion with dam management

board, participants explained that noise and vibration were reduced to the highest minimal during construction and operation. The proponent representative explained that dam construction and operation is impossible with generating noise and vibration. Participants pointed out that many that were resettled to avoid the effects of such unavoidable impacts relocated back to the buffered zone, thereby, exposing themselves to the adverse effects of the dam operation. In this vein, the local community members explained that majority of the new settlers within the buffer zone are strangers attracted by some infrastructural development facilities like road, hospital, telecommunication and borehole that followed the dam.

**Implementation of Mitigation Measures for Changes in Hydrological Patterns and Water Quality.**

Table 3 presents the implementation of mitigation measures for changes in hydrological patterns and water quality.

**Table 3: Implementation of Mitigation Measures for Changes in Hydrological Patterns and Water Quality**

Which of the following Mitigation Measures for Changes in Hydrological Patterns and Water Quality were implemented?	Frequency	%
Prepare and implement water release management plan	287	57.4
Prepare and implement watershed management plan	123	24.6
Protection of natural vegetation in the watershed	88	17.6
Carry out occasional draw down of reservoir water level	134	26.8
Collaborate with farmers on effective use of agro-chemicals and erosion	287	57.4
Ensure periodic safety inspections of all pipes	134	26.8
<b>Mean</b>	176	35.1
<b>Standard Deviation</b>	80.33	
<b>Coefficient of Variation</b>	67	

Table 3 presents the affirmations of options by respondents on the implementation of mitigation measures to prevent

changes in hydrological patterns and water quality due to dam construction and operation. It shows that on average, one hundred and seventy-six respondents representing 35.1%

agreed that the enlisted mitigation measures to prevent changes in hydrological patterns and water quality were implemented. However, the standard deviation and coefficient of variation being  $\pm 80.33$  and 67% respectively indicate that some measures were implemented more than others.

The low percentage of respondents that agreed on the implementation of the enlisted mitigation measures to prevent changes in hydrological patterns and water quality may be due to obvious alteration of hydrological patterns and water quality. Ahmed (2014) found a significant difference between the water quality of EIA base line data and water samples collected at the same spots in the year 2014.

Focus group discussion with the dam management board shows that mainly engineering aspects were implemented. Example 'prepares and implement water release management plan'. Participants explained that 'the Dam design includes the addition of a 1km ogee spillway and a bottom outlet designed to primarily manage the river and in particular to assure the safety of the project in the occurrence of the river floods. The dam is also designed to release water to downstream river to prevent water shortage and drought especially for down river water users through the spillway and bottom outlet. In addition, the design is such that the water used to turn the turbines for hydropower generation is released into the downstream river to ensure constant and all year round water release downstream'.

### Conclusion/Recommendations

The implementation of the outlined mitigation measures in the Gurara dam EIA report is not in tune with the arrangement in the Environmental Management Plan. These have given room to adverse environmental and social impacts. The data from the survey showed that three hundred and twenty-nine (329) respondents representing 65.8% agreed that the enlisted mitigation measures to prevent air pollution were implemented; two hundred and eight respondents representing 41.65% agreed that the enlisted mitigation measures to prevent noise and vibration were implemented and that one hundred and seventy-six respondents representing 35.1% agreed that the enlisted mitigation measures to prevent changes in hydrological patterns and water quality were implemented. Thus, the implementation of Environmental Management Plan of Gurara Multi -purpose Dam is poor to moderate.

The study recommended based on the findings as follows:

- i. The dam stakeholders should carry out post impact assessment of the Gurara dam project.
- ii. All measures outlined to mitigate the negative impacts of the dam project should be implemented by the dam management board.
- iii. Monitoring of the of implementation should be consistent and any shortcoming of agencies responsible for implementation should be punished adequately.
- iv. Project Affected Persons should have access to and good knowledge of the EIA and its management plan to be able report defaulters properly.

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