ISSN No:-2456-2165

The Need for Environmental Impact Assessment: An Insight into Nigerian Small Hydropower Plants (A Review)

Abisayo Ruth Adelaja[1*], Khalimat Ozichu AbdulKadir AbdulKadir [1]
National Centre for Hydropower Research and Development, Energy Commission of Nigeria.

Abstract:- Nigeria is blessed with so many human and natural resources but there is a vital need to harness these resources to serve its citizens. Renewable energy remains the cleanest and most reliable energy type and Nigeria is blessed with quite a number of these renewable energy resources. Small hydropower is among the most accessible types of renewable energy. By encouraging private investment in the energy sector through reforms, the Nigerian government has diversified its energy sources to support the development of renewable energy, but this may not be sufficient given that the nation still faces obstacles to the construction of Small Hydropower Plants (SHPs). One of such barriers is the lack of a proper Environmental Impact Assessment (EIA) to be carried out on the proposed SHPs in Nigeria. This review paper evaluates the need to conduct an environmental impact assessment on the small hydropower plants in Nigeria. It is concluded that for the hydropower plants to stand the test of time, for it to operate adequately and for the communities surrounding such plants not to be adversely affected by the construction of these plants, a proper EIA has to be carried out.

Keywords: *SHPs, EIA, Electricity, Nigeria.*

I. INTRODUCTION

Hydropower is the largest renewable resource used for electricity. It is vital in many parts of the world, with more than 150 countries producing hydroelectric generated electricity. Hydropower accounts for at least 50% of national energy output in 63 countries and 90% in 23 [1].About 10 countries acquire all their marketable electricity from hydropower, and these include Norway, several African nations, Paraguay and Bhutan. There is universally about 700 GW of hydro capacity sin operation, which generates about 2600 TWh/year [2]. Small, mini and micro hydro plants (usually defined as plants less than 10 MW, 2 MW and 100kW, respectively) also play a key role in many countries for rural electrification. In 2015, hydropower generated 16.6% of the world's total electricity and 70% of all renewable electricity [3]. This was expected to increase by about 3.1% each year for the next 25 years [4]. Nigeria has a strong hydro potential, and hydropower now contributes for around 32% of total installed commercial electric generating capacity. More than 11,000MW of large-scale potential which are exploitable exists [4]. Hydropower is an important energy source, primarily because of its low operating cost per unit of power generation. It also has relatively low CO_2 emissions per unit due to its renewable nature [5]. Despite these and other advantages of hydropower, there are issues regarding emissions and environmental impacts from hydropower generation. There has been a surge in global awareness of the environmental impact of hydropower plants such as depletion of natural resources, emissions, pollution, deforestation and soil degradation [6]. Large-scale dams can have a substantial impact on the regional environment. When the river is initially dammed, farmlands are sometimes flooded and entire populations of people and wildlife are displaced by the rising waters behind the dam. In some cases, the reservoir can overflow to hundreds or thousands of square kilometres [7]. The reduced flow downstream from the dam can also impact the downstream human and wildlife population. The dam can also act as a barricade to fish that need to travel upstream to spawn thereby making the aquatic organisms to be susceptible to being caught and killed in the penstock and the outtake pipes. Because of the large surface area of the reservoir, the local climate can change due to a large amount of evaporation occurring [8].

Environmental performance of products, services and processes has become one of the key issues in today's world that is more than ever more conscious of the problems of the environment and the consequential climate change [9]. It is important to examine ways in which these products, services and processes have negative impacts on the environment. One of the analytical tools that can be used for this purpose is the Environmental Impact Assessment (EIA)

EIA is an environmental decision-making tool that gives information on the anticipated implications of development projects to people who decide whether or not to approve the project [10]. The technical aspects, such as effect detection and prediction, as well as the evaluation, management, and presentation of information have led some to consider EIA as both an art and a science [11]. EIA is thus described as the systematic identification and assessment of potential impacts (effects) of proposed projects, plans, programmes, or legislative actions on the physical, chemical, biological, cultural, and socioeconomic components of the total environment [12]. In the context of EIA, "environment" refers to the physical, chemical, biological, geological, social, economic, and aesthetic

components, as well as their complex interconnections, which affect persons and communities and ultimately define their forms, character, interrelation, and survival [13].

The aim of this study is therefore to;

1. To enlighten interested people on the concept and practice of EIA as it relates to the construction and generation of hydropower.
2. To encourage the appropriate authorities concerned (private individuals, contractors and the government) about the need to conduct an EIA in proposed SHPs in Nigeria.

II. PURPOSE OF EIA IN PROPOSED SMALL HYDROPOWER PLANTS

The primary purpose of the EIA process is to encourage the consideration of the environmental issues in planning and decision-making and to ultimately arrive at actions which are more environmentally compatible [14]. This means that it determines the potential environmental, social, and health effects of a proposed SHP, so that those who make decisions in developing and authorising the project are aware of the likely consequences of their decisions before making them and are thus more accountable [15]. It is intended to enable knowledgeable and transparent decision-making while also trying to seek to avoid, reduce or mitigate probable adverse impacts through the contemplation of alternate options, sites or processes [16].

The goal of an EIA is to make the environmental impact of a development clear so that the environment is taken into account when making decisions, not to compel decision-makers to use the least environmentally damaging option. A technical tool, the EIA document itself identifies, anticipates, and analyses consequences on the physical environment as well as social, cultural, and health implications [16]. It can also reduce costs and time taken to decide by ensuring that subjectivity and duplication of effort are minimized, and also making sure that there is proper identification to attempt to estimate the primary and secondary consequences which might require introducing expensive pollution control equipment or compensation and other costs in future [17]. An application of EIA has the following aims in common:

a) provides decision-makers with complete and balanced information,
b) assesses intangible, immeasurable effects that are not addressed by other technical reports,
c) provides a source of information on a proposal to the public [18],
d) formalizes the consideration of alternatives to a proposal being considered, and
e) improves the design of the development and safeguards the environment through the application of mitigation and avoidance measures [19].

III. STAGES OF THE EIA PROCESS FOR A SMALL HYDROPOWER PLANT

The EIA process involves several procedures and stages:

1) **Screening:** Through this procedure, it is decided whether the hydroelectric facility justifies the creation of an EIA. The minimum standards for an EIA vary by country; some laws specify a list of the types of activities or projects that will require one, while others require one for any project that may have a significant impact on the environment or for projects that exceed a predetermined financial threshold [20]. In the case of small hydropower plants in Nigeria, it is required because of its potential impact on the environment and the monetary cost it would require to set up the pant and maintain it.
2) **Scoping**: The public and other interested parties participate in the scoping phase, which identifies the major environmental concerns that should be covered in an EIA [21]. One of the first opportunities for the public or NGOs to learn about a planned hydropower plant project and provide their opinions and suggestions is through scoping. Additionally, it can reveal parallel or related operations that might be taking place nearby a project, or it might point up issues that need to be resolved or that might lead to the hydropower plant project's cancellation [22].
3) **Baseline data collection** in this stage, all relevant information is collected on the current status of the environment which provides a baseline against which change due to the SHP can be measured [23].
4) **Impact prediction:** This is predicting the most likely environmental alterations that will take place as a result of the development of SHPs.
5) **Impact assessment:** To produce a conclusion that decision-makers can utilise to ultimately decide the fate of the project proposal, this calls for interpretation of the importance or significance of the consequences [24].
6) **Mitigation:** Mitigation includes taking appropriate steps to remove/reduce environmental impacts and it can be seen that the iterative nature of the EIA process is well demonstrated here [25]. A new screening exercise would disclose that there may not have been a need to do a formal EIA had the mitigating measures been incorporated from the beginning, for instance, if the mitigation measures were designed well, all significant impacts may be eliminated.
7) **Environment Impact Statement:** An Environmental Impact Statement (EIS) is the outcome of an EIA which is usually a formal document. It includes correct information about the development and details about all data gathering processes, including screening, scoping, baseline research, impact prediction and assessment, mitigation, and monitoring methods [26]. An EIS should also produce a non-technical summary for those who are not interested in reading the detailed documents. This is extremely necessary because EISs are public documents which are supposed to let the public know about the nature and possible consequences of development in time to comment and/or participate in the final project design to make necessary adjustments.

ISSN No:-2456-2165

8) **EIS Review:** The EIS is delivered to the appropriate authorities after the EIA is finished. This organisation has the power to approve or reject development application requests. Review can take many different forms. It can be a casual process in which decision-makers read and comment on the document; it can also be more formal, in which case an expert opinion is sought; [27] or it can be through the use of formal review methods designed specifically for the purpose. The review procedure should give the decision-maker the ability to assess the EIS's suitability (i.e., whether it is legally compliant), accuracy, and objectivity. If so, they will be able to use the EIS as information to decide whether or not the project should gain approval [28].
9) **EIA follow-up**: this refers to the phase after the EIA has been approved and would entail the monitoring of the impacts, continuous environmental management of the SHP project and impact auditing. Without any kind of follow-up, the EIA process would be linear rather than iterative, and an important step towards achieving environmental protection would have been wasted [24].The opportunity to control environmental influences and gain knowledge from the cause-and-effect linkages and process is provided by follow-up. By enabling more precise projections to be made, for example, the information generated by this approach can help to advance EIA procedures in the future.

IV. MISCONCEPTIONS ABOUT EIA

The introduction of EIA has met with resistance, especially with many of those who plan them and engineers, who overlook the intended role which is to improve the project planning process) and see it as a change that isn't needed in traditional practices [13].

EIA has been strictly disapproved as being inappropriate for application. Some of these criticisms include the following:

- EIA is too expensive.
- EIA delays projects [16].
- EIA is too complex.
- EIA doesn't produce useful results.
- EIA will be misused to stop development.
- We're too poor to afford an EIA [29].

V. IMPORTANCE OF EIA

The objective of the EIA process is to inform the public and decision-makers about the environmental effects of implementing a proposed SHP [30]. The application of EIA has numerous benefits to the development of a small hydropower plant. It is expected to:

- Help lower the cost of constructing and operating the SHP in the long term.
- Plan for and implement avoidance or remedial measures in time to minimize adverse impacts.
- Protect the environment [30].
- Provide an opportunity for the public to get involved and participate.
- Enhance public confidence.
- Foster good public relations.
- Reduce cost and time of project implementation.
- Increase project acceptance.
- Improve project performance [16].
- Propose designs that are modified to reduce environmental impacts.
- Identify viable alternatives.
- Predicts significant adverse impacts [31].
- Determine mitigation strategies to lessen, balance, or eliminate major impacts.
- Influence decision-making.

VI. DISADVANTAGES OF NOT CONDUCTING AN EIA IN SHPS IN NIGERIA

If EIA is not incorporated into the planning of SHP, the probability of several negative consequences increases. These include:

1. costly litigation, prosecution, expensive clean-ups, and the sudden burden of paying monetary compensation [32].,
2. expensive "surprises" such as closing down of the plant which can result in significant losses to developers and project proponents,
3. loss of trust in public and private institutions [33],
4. worsening environmental conditions leading to a deterioration in the natural resource base and a slowing of the economy, and
5. consumer and public backlash against the government institutions, ministries and contractors responsible for environmental disasters [29].

VII. PERSONNEL INVOLVED IN CARRYING OUT EIA ON AN HYDROPOWER PLANT

The responsibility for producing an EIA will be assigned to (1) the government agency or ministry, (2) the project proponent (3) the community [32]. A consultant can also be hired to prepare the EIA or manage particular EIA processes, like public involvement or technical studies.

Utilizing a consultant entails the possibility that the report will be skewed in favour of moving forward with the project [33]. If a consultant is hired for the proposed small hydropower plant, conflicts may arise if the consultant believes it will receive future work if the project is approved, or even indirect benefits from related activities [34]. Some regulations demand government registration or professional accreditation in EIA preparation for consultants. A consultant might occasionally be asked to submit a declaration outlining any financial or other stake in the project's success [35].

VIII. CONCLUSION

In other to minimize hazards during the construction stages and operational stages of a small hydropower plant caused by a lack of proper planning, an environmental impact assessment must be carried out.

ACKNOWLEDGEMENT

We want to acknowledge the encouragement, critical review, suggestions and editing of Dr. Olukayode Adelaja.

REFERENCES

[1]. Makoju, J.O. (2012). Small Hydro Power Construction: Techno-Economic Analysis, ECN/UNIDO Trainers Workshop on SHP Planning and Development, Owerri.
[2]. Oliver Paish, (2002). Small hydro power: Technology and current status. Renewable and Sustainable Energy Reviews, 6: 537–556.
[3]. Renewables (2s016). Global Status Report, page 25, Hydropower REN21, published 2011, accessed on 18th August, 2022
[4]. Renewables (2011).Global Status Report, page 25, Hydropower REN21, published 2011, accessed on 18th August, 2022
[5]. Mayor, B., Rodríguez-Muñoz, I.,Villarroya, F., Montero, E., López-Gunn, E. (2017). The role of large- and small-scale hydropower for energy and water security in the Spanish Duero Basin. Sustainability, 9, 1807.
[6]. Kibler, K.K., Tullos, D.D. (2013**).** Cumulative biophysical impact of small and large hydropower development in Nu River, China. Water Resour. Res. 49, 3104–3118.
[7]. Romanescu, G.,Miftode, D., Mihu-Pintilie, A.,Stoleriu, C.C., Sandu, I. (2016). Water quality analysis in mountain freshwater: Poiana Uzului reservoir in the eastern carpathians. Rev. Chim. 67, 2318–2326.
[8]. Ottmar Edenhofer (2012). Renewable Energy Sources and Climate Change Mitigation, Technical Support Unit Working Group III, Potsdam Institute for Climate Impact Research (PIK).
[9]. Hennig, T., Wang, W., Magee, D., He, D. (2016). Yunnan's fast-paced large hydropower development: A powershed-based approach to critically assessing generation and consumption paradigms. Water. 8, 476.
[10]. Greenberg, M. (2012). The environmental impact statement after two generations. Abingdon: Routledge.
[11]. Scrase, J and Sheate, W. (2002). Integration and integrated approaches to assessment: what do they mean for the environment? Journal of Environmental Policy and Planning 4 (4), 276–94.
[12]. Ferreira, J.H.I., Camacho, J.R.,Malagoli, J.A., Camargo Guimarães, S., Jr.(2016). Assessment of the potential of small hydropower development in Brazil. Renew. Sustain. Energy Rev. 56, 380–387.
[13]. Shah, A.,Salimullah, K., Sha, M.H.,Razaulkah, K., Jan, I.F. (2010). Environmental impact assessment (EIA) of infrastructure development projects in developing countries. Int. J. Sustain. Dev. 1, 47–54.
[14]. Ioja, I.C. (2013). Analysis and Evaluation of the Environmental Situation; EdituraEconomica: Bucuresti, Romania; p. 183.
[15]. Leknes, E. (2001). The role of EIA in the decision-making process. Environmental Impact Assessment Review 21, 309–03.
[16]. Noble, B.F. (2010). Introduction to Environmental Impact Assessment: A Guide to Principles and Practice. Oxford University Press, Oxford
[17]. Therivel, R. (2010). Strategic environmental assessment in action, 2nd edn. London: Earthscan.
[18]. EIA Study SHPPs Hrcavka, projekt Banja Luka, 2013
[19]. Bilgin, A. (2015). Analysis of the Environmental Impact Assessment (EIA) Directive and the EIA decision in Turkey, Environmental Impact Assessment Review 53, 40-51.
[20]. Pavlíˇcková, K.,Kozová, M.,Miklošoviˇcová, A.,Zarnoviˇcan, H.,Barancok, P.,Luciak, M. (2009). Environmental impact assessment. In Textbook for Students of Master's Studies, 1st ed.; Comenius University in Bratislava: Bratislava, Slovakia.
[21]. Bobat, A. (2014). The problems in environmental impact assessment of hydropower projects, 12th Conference on Protection and Restoration of the Environment, Proceedings, 804-810, Mykonos-Greece.
[22]. Coskun, A.A and Turker, O. (2011). Analysis of environmental impact assessment (EIA) system in Turkey, Environ. Monit. Assess.,175, 213– 226.
[23]. Bilgin, G. (2013) Regulating Hydropower in Turkey: An Evaluation of the Environmental Impact Assessment Regulation. Master Thesis, University of Oslo.
[24]. Kentel, E., Alp, E. (2013). Hydropower in Turkey: Economical, social and environmental aspects and legal challenges, Environmental Science and Policy 31, 34-43.
[25]. EIA Study HPP Vrilo, Ecoplan Mostar, 2013
[26]. Hennig, T., Wang,W., Feng, Y.,Ou, X., He, D. (2013). Review of Yunnan's hydropower development. Comparing small and large hydropower projects regarding their environmental implications and socio-economic consequences. Renew. Sustain. Energy Rev. 27, 585–595.
[27]. Environmental Assessment Guideline For Hydropower Projects, National Environment Commission Royal Government of Bhutan, Phama Printers & Publishers, 2012
[28]. International Association for Impact Assessment (2014). Public Participation, International Best Practice Principles, http://www.iaia.org/publicdocuments /specialpublications.

[29]. Toro, J., Requena, I., Duarte, O., Zamorano, M.A. (2013). A qualitative method proposal to improve environmental impact assessment. Environ. Impact Assess. Rev. 43, 9-20.
[30]. Tekayak, D. (2014). An overview of environmental impact assessment in Turkey: Issues and recommendations, Ankara AvrupaÇalışmalarıDergisi 13(2),133-151.
[31]. Yilmaz, G.(2013). Do EIA reports really assess environmental impact? Perspectives 4, 25- 28.
[32]. International Energy Agency (IEA) (2012). Measuring progress towards energy for all: power to the people? In: World energy outlook. Paris, France: Organization for Economic Co-operation and Development.
[33]. Zvijáková, L.; Zele ˇnáková, M. Risk Analysis in the Process of Environmental Impact Assessment of Flood Protection Objects; Leges: Prague, Czech Republic, 2015; p. 255.
[34]. Turkish Official Gazette (2014). Environmental impact assessment regulation, Official Gazette No : 29186, November, 2014(in Turkish)
[35]. U.S. Department of Energy (2010). Guide to Purchasing Green Power, DOE/EE- 0307.