A Cost and Benefit Analysis of Kashimbilla Multipurpose Dam Project in Takum, Taraba State, Nigeria

James T. Ihum[1] and Fabian Stephen[2]

[1]*Former Postgraduate Student, Department of Economics, LUBS, University of Leeds, UK*
[2]*Center for Energy, Petroleum and Mineral Law and Policy, School of Social Sciences, University of Dundee, UK*

***Abstract*:-This paper has investigated the viability of constructing Kashimbilla Multipurpose Dam in Taraba State Nigeria using Cost and Benefit Analysis (CBA) under two different scenarios. It particularly varied interest rate, project costs and benefits. The analysis has demonstrated that Kashimbilla Dam is a worthwhile project. While the result from the computation of the CBA suggests that the project is viable, other social benefits such as improved crop yields resulting from irrigation services, improved water availability, full benefits from flood control (value of human life), increased access to water resources, creation of employment and tourism indicate also that the project is a worthy public undertaking.**

Keywords: **economic, environmental, costs and benefits, Kashimbilla Dam, net-present value**

I. INTRODUCTION

The impacts of dams on economic growth of nations have been a topic for discussion in recent times. Several studies (Kenyon, 1997; Watermeyer, 2000; World Commission on Dams, 2000 and Garden, 2012) have laid credence to the fact that dam projects play significant roles in sustainable economic growth and other benefits to the society in which they are sited. Kenyon (1997) argues that dam and other water infrastructure projects generate employment opportunities, inject additional capital into a nation's economy and boost population. He (Kenyon) further stresses that most dam infrastructure have a recreational component. This, in turn, increases employment, creates income as well as tourism. The World Commission on Dams (2000) noted that dams are mostly constructed for irrigation and thus largely contribute to food production. ICID (2000) and Altinbilek (2002) in their separate studies added that multipurpose dams generate electricity, serve domestic and industrial water supply, control flood, provide platform for recreation among others. It is therefore not surprising why dam construction is one of the most funded public infrastructures in developing countries including Nigeria.

It is no exaggeration that inadequate power supply, low access to portable water, flood among others are part of national life in Nigeria. Majority of rural communities in the country have been without access to the national grid (Muhammad, 2016). Currently, the country produces about 4,000 MW trailing behind South Africa with over 43,000MW. The provision of electricity most especially in the rural areas could facilitate the growth of SMEs and hence the nation's economy. This is one of the reasons for the establishment of the Kashimbilla Dam Project.

Kashimbilla Dam Project is a multipurpose dam constructed to serve as buffer against possible flood. Apart from generating electricity, the Dam serves as an irrigation scheme supplying water to the host community (Takum) and other neighbouring communities. The Dam has the potential to generate 40MW of hydropower and Irrigation (2000ha). On a broader scale, the Dam is designed to tackle weather changes as well as shared concept of integrated water resources management. This paper therefore, seeks to examine the viability of constructing the Kashimbilla Multipurpose Dam using Cost and Benefit Approach (CBA). The paper is subdivided into four sections. After the introductory section, the second section discusses some fundamentals of Kashimbilla multipurpose dam project and the location. Methods and assumptions are contained in the third section. The fourth section presents results and discussion while the final section concludes and recommends.

II. LITERATURE REVIEW

2.1 Basic Information about Kashimbilla Dam Project

Kashimbilla Multipurpose Dam Project is situated in Kashimbilla a locality in Takum Local Government area of Taraba State Nigeria. The Dam is located close to river Katsina-Ala the flows from Cameroun down to Makurdi and makes a confluence with river Niger in Lokoja, the Kogi State capital. Kashimbilla district is about 50km South-West of the Takum town. The Dam is said to be a multi-purpose one due to the fact that it has different proposed dimensions of needs it is expected to serve. As it is the expectation just like other dams across the globe, Kashimbilla dam certainly has both socio-economic costs (negative consequences arising from the dam) and benefits (positive impact the dam brings on to its immediate communities) for instance, there is likely danger if the dam collapses. Dams of the sorts of the Kashimbilla also have some advantages in terms of say, they make available some basic needs of the society. The resultant impact is

raising standards of livings. The Kashimbilla Dam is mainly for protection of lives and properties against incessant flood disasters arising from Lake Nyo in Cameroun. Despite assurance by the Nigerian government that the project will be completed by the end of year 2011, the project is yet to be completed and is still in progress.

Other details of its specifications as contained in Abayomi et al (2015) include a power component which comprises Hydropower Generation (40MW capacity), Generators (4×12,100KVA), Turbines (4×10MW), Turbine Type (Kaplan), Transformer (8×15MVA). Oruonye (2013) notes that the dam originally has capacity to generate more than 40MW of electricity but had to be limited due to its closeness to the border with the Republic of Cameroon. A generation higher than this according to Abayomi et al (2015) could result in the submergence of much land in the Republic of Cameroon and this could result in international problem.

Kashimbilla dam has been projected to contribute several benefits. In addition to electricity generation, the dam presents a couple of desirable impacts. According to Nigeria's Minister of Water Resources, Sarah Ochekpe (2014), the dam is expected to mitigate the environmental disaster that could occur in Taraba and the four neighbouring states to Taraba which usually affects more than 6 million people. Mrs Ochekpe said the project serves as a preventive measure to cushion the likely eventual breakage of Lake Nyos in Cameroun. Accordingly, Ochekpe concluded by noting that in addition to the primary goal of providing electricity, there would also be a water treatment plant with a capacity of 60,000m3 /day that will help to provide water for about 400,000 people in the immediate environment. Another important aspect in the Kashimbilla dam project is the inclusion of an irrigation component designed to utilize 86,400m^3/day to irrigate about 2000 hectares of farmland.

Regarding the duration of the project, The Minister of Water Resources, Mrs Sarah Ochekpe stated that Kashimbilla Dam was awarded in May 2007 and estimated for a completion period of 36 months. This was no longer feasible when other needs were factored in, thus, the completion period was revised to March, 2015. The development of Kashimbilla hydropower has been highly dependent on public budgetary funding. On the financial implications of the project, Mrs Ochekpe stated that N42 billion (or $332.5 million USD) was the first project investment sum. However, with new needs factored in, the project sum was revised to N60 billion and later to N104 billion. This amount represents $823,436,262.9 US dollars. It means that the project sum has been revised upward by at least 147.62%.

Notwithstanding the fact that Kashimbilla dam project investment cost has been up by more than double its original cost, available reports indicate that the project has not been fully completed as at the end of 2016. As a result, the various components are not yet fully operational. Abayomi et al, (2015) notes that, the dam is now 95% completed and the hydropower component is about 80% completed. It is however envisaged that, with continued support and funding from the government of Nigeria, the project would be completed by the end of 2017 or the first quarter of 2018.

2.2 Socio-Economic Issues of Dams Development in Nigeria

Nigeria has considerable hydro potential sources exemplified by her large rivers, small rivers and stream. In an effort to harness the hydropower potentials, the country is embarking on the construction of several large and small dams. As with the Kashimbilla hydropower dam, a number of dam construction projects currently on-going across the country include Mambila (2600MW), Zungeru (950MW), Gembu (130MW), Beji (240MW) and Gurara Dam (30MW). The country is also investing in the development of various river basins and a number of thermal plants. Notwithstanding the country's enormous hydro potentials, empirical records indicate that the contribution of hydro power to national power generation has remained under exploited. As at 2016, hydro power contributes about 20% of power generation in Nigeria Olaoye et al (2016). Undoubtedly, this level of output has contributed to Nigeria's underperformance in overall energy generation when compared with South Africa, Egypt and several other developing economies.

In an effort to improve the power situation, various governments have invested towards the construction of dams. The process of dam construction in Nigeria has over the years been confronted by challenges. These challenges are multi-faceted and range from administrative (or political), environmental, cultural and social issues. Some of the visible problems to the development of dams include forceful resettlement, loss of means of livelihood such as farmlands, economic trees, engendered ecological changes which are harmful to the hosting communities, decline in fishing yield, drying up of arable agricultural land and general developmental neglect. This section identifies some of the socio-economic issues of dams' construction in Nigeria as follows:

Administrative Issues: Despite the efforts by governments of Nigeria to establish dams and develop the hydropower sector over the years, there seems to be a lack of political will to harness dam resources and develop the hydropower as Nigerians continue to suffer insufficient power supply following the untapped hydropower potential. In addition to the percentage contribution of hydropower to total national output, Nigeria's overall per capita consumption per kilo watts remains low. A study conducted by Ekpo (2012) puts the average annual power consumption at 0.03 (KW). The performance lagged far below South Africa with per capita consumption of 1.015 (KW) during the same period.

Forceful Resettlement: It has been argued that the development of dams and their related infrastructure such as power stations and irrigation canals in Nigeria often comes with forceful resettlement of residents. Worst still is that the forceful displacements are not usually accompanied by proper compensations for the displaced residents (Babagana et al

2015). Following the construction of dams, those who once lived in their houses are either forced to relocate to other areas or take shelter in rented houses. Displacements as a result of dam and hydropower projects in Nigeria are usually predictable and in most cases, the displaced become economically, culturally and psychologically devastated. This has caused a decline in public acceptance and support which is essential for the equitable and sustainable development of water and energy resources generally.

Environmental Issues: The environmental problems associated with the establishment of dams in Nigeria are numerous but mainly occur in the forms of de-grade of human ecology, the physical environment including the water (aquatic)and land (terrestrial) resources. One significant environmental challenge associated with dam construction is the distortion of upstream from a free-flowing river ecosystem to an artificial reservoir habitat. This transformation most times results in changes in temperature, chemical composition and general quality of water. The water finally available for use is often not suitable to the aquatic plants and animals that originally evolved with the river system. Dams in Nigeria have led to the extinction of many other aquatic species, loss of forest, distortion of wetland and farmland and many other environmental impacts. Idris (2008) asserts that as a result of diversions from dams, irrigation activities and drought, one of Nigeria's wetlands, the Hadejia-Nguru Wetlands, have contracted by as much as two-thirds in the past 30-40 years adversely impacting fishing, wildlife and general agricultural activities in the area.

Loss of Means of Livelihood: Following the environmental problems already stated, the livelihood of many people and societies has been negatively affected. Indigenous farmers and local residents who have depended on the aquatic system for survival suffer disproportionately as they either get displaced to other areas or suffer as a result of the distorted habitat. Forceful resettlements also have an immediate implication in the form of a loss of means of livelihood. As people who have lived in a region or along a river for a long time are forced to leave their homes for a totally different society, they suffer a loss of their basic livelihood. They also lose economic and agricultural activities among other benefits to start life all over in new and unfamiliar terrains.

Ecological Changes: According to the World Commission on Dams (2000), 60% of the World Rivers have been affected by dams and diversions. These acts of diversions have ecological implications. In the case of Nigeria, river-related ecological changes have occurred following an alteration in the natural course of rivers, distortion of aquatic habitat and displacement of economic trees due to construction. These according to Bruijnzeel (1990) cited in Uyigue (2006) result in decrease in water quality and variable changes in the seasonal timing of water yield. Although dams in Nigeria may not have been proven to significantly contribute to greenhouse gas emission, empirical works indicate likelihood as Bruijnzeel (1990) notes that most reservoirs, especially those in the tropics are described as significant contributors to greenhouse gas emissions.

III. METHODS AND ASSUMPTIONS

To examine the economic impact of the Kashimbilla dam project, the study utilizes cost-benefit analysis (CBA). CBA is a widely employed analytical tool in investment decision making. It aims at estimating direct and indirect costs of a specific project in relation to its benefits (Browne and Ryan, 2011). In other words, Cost-Benefit Analysis estimates and sums up the monetary values that are expected from projects with a view to establishing their viability.

There are several methods of carrying out cost-benefit analysis of a project. These include, the Net Present Value (NPV), Internal Rate of Return (IRR), Payback period (PBP), profitability index among others. The NPV (which is the technique adopted in this study) takes into account the stream of expected cash flow of a project less the cost of the project. The present values of the cash flows are calculated by using a discount rate. This implies that Net Present Value can be seen as a formula for benefits (revenues) less costs. If the value of NPV is positive, it suggests that the value of the project measured in terms of the cash flows is greater than the costs or cash outflows. The reverse is the case when revenues are less than the costs. When the NPV is zero, there is breakeven with regards to the project returns.

The formula for computing the NPV is shown below:

$$\text{NPV} = \frac{R1}{(1+i)^1} + \frac{R2}{(1+i)^2} + \frac{R3}{(1+i)^3} + \ldots + \frac{Rt}{(1+i)^t} \qquad NPV = \sum_{t=0}^{t} \frac{B_t - C_t}{(1+i)^t}$$

Where:

Rt = Bt – Ct (The Cash flows or revenues from investment over the lifespan of the project or investment from time period in years t = 0, 1, 2,…).
Bt = the Benefits derived from the project or investment.
Ct = the Costs incurred from the project of investment.
i = Interest Rate or Discount rate
t = time period in years.

The discount multiplier is usually given as $Dt = \frac{1}{(1+i)^t}$

The cost-benefit analysis depends on arriving at a discount rate as well as cash flow from investment.

3.1 Inputs and Variables

This section focuses on determination of costs and benefits of the Kashimbilla dam project. Using the Net Present Value (NPV), the study examines the viability of the project. In order to take into account the costs and benefits analysis (CBA) of the project, the study accounted for socio-economic and environmental costs and benefits from the construction of the dam. The paper relies heavily on publicly available information and economic reasoning to determine model's inputs. Data source is mainly from the Federal Ministry of Water Resources Nigeria. Other Data sources are the Central

Bank of Nigeria (CBN) where interest rate is collected, the Nigerian Electricity Regulatory Commission (NERC) where cost of electricity is collected and other public sources like journals and News Media.

Economic Costs and Benefits

The economic costs and benefits are the direct financial costs incurred as a result of constructing and operating the Kashimbilla dam within the projected time period of 60yrs. These include:

i. *Cost of constructing the dam* – this is the total cost of the project as at the time of contract award. As noted earlier, the sum for the project was revised to N104 billion (Nigerian Naira) from N42 billion. This is equivalent to $823,436,262.9USD (at the prevailing exchange rate of N126.3 per US dollar at the time the project was awarded). This capital cost is to cover the construction of the dam itself, construction of water treatment plant, construction of access road to the site, construction of hydropower plant that will generate 40MW of electricity, construction of an airstrip, construction of irrigation channels to provide irrigation on 2000ha, resettlement and compensation costs and construction of staff housing unit.

ii. *Cost of operating the dam when completed:* This covers average dam operation and maintenance cost. According to the International Renewable Energy Agency (IRENA, 2012, 2015), the average global operation and maintenance cost for a small hydropower (SHP) per annum ranges between 1% and 6% of project investment cost. IRENA also notes that EREC/Greenpeace, (2010) and Krewitt (2009) estimate operation and maintenance cost for a small hydropower at 4 percent per annum. In this regard, this study uses the upper band of 6 percent of IRENA operation and maintenance costs per annum. This is for two main reasons, firstly it is considered that this is a multipurpose dam, and secondly, staff or personnel cost is also factored into the annual operation and maintenance cost of the dam. This gives the operation and maintenance cost (O&M cost) at N62.4 billion per annum or $49,406,175.77 US dollars. It implies that apart from other O&M costs, the dam should employ directly at least 40 persons. By 2067, about N3.0576 trillion or $2,420,902,613 would have been spent on operation and maintenance of the dam. They are presented in Table 4.1 below

Table 3.1: Summary of Personnel Salary

O&M cost (including personnel costs)	Annual O&M Cost	Number of Years	Total O&M Costs by 2067
6 percent of project investment cost	$49, 406, 175.77	49 years (2018-2067)	$2,420,902,613

Source: Authors' Computation

iii. *Benefits from Sales of Power:* the Kashimbilla dam has the capacity to generate about 40MW of electricity. This is projected to an average annual output of 350,400MWh. The Dam will distribute its energy to Kashimbilla, Gamovo, Takum, Katsina-Ala and to the coast areas. In assessing benefits from sales of electricity, the study adopts the prevailing energy price of N24.30 per kwh (NERC 2016) in the country. This amounted N24,300/MWh. At this price, the annual revenue derivable from sale of power generated by the dam will equal N8, 514,720,000 or $67,416,627.08. This is shown in Table 4.2

Table 3.2: Summary of Revenues derivable from sales of Power

Total Installed Capacity	**Projected Annual Output**	**Energy Price**	**Annual Revenue**	**Total Revenue by 2067**
40MW	350,400MWh	$192.399/MWh	$67,416,627.08	$3,303,414,727

Source: Authors' Computation

iv. *Benefits from saved cost of flood:* The Kashimbilla dam will be saving both government and Nigerians money that would otherwise be used to repair houses and provide relief materials to flood victims. According to Nwodim (2016), the estimates of damages during 2012 flood from Cameroun stood N2.29 trillion. This is an equivalent of $14,707,771,355 per annum. It is important to note here, certain costs like the loss of lives during the flood cannot be monetized, lose of comfort, life expectancy etc could not be monetarily quantified. In the presence of the Kshimbilla dam, Nigerians would for next 60 years, have saved the country N137.4 trillion or $832,727,272,727.27

Environmental cost and benefits

Just as with socio-economic costs, the construction of Kashimbilla dam has both environmental costs and benefits. On one hand, construction of the dam could have adverse impacts on the host communities. This includes Ecosystem disturbance among others. The benefits on the other hand could arise from lower usage of generators following the supply of electricity on completion among others. It is pertinent to state here that apart from the fact some of costs and benefits are not quantifiable, other basic data on Kashimbilla dam project are not available for the public even from Federal Ministry of Water Resources and Rural Development. Therefore, the CBA model in this study is calculated under a range of assumptions. The analysis covers a span of 60years (2007-2067). The choice of the base year is necessitated by the fact that it coincided with the year the project was awarded. It is assumed in this study that the

project will be completed in 2018. Therefore, the benefits are assumed to be zero, from 2007 to 2018.

Environmental Benefits

Here, the study uses the cost of alternative energy sources, in the manner of Ekirman et al, (2015) which are mainly generators and other traditional means. According to Omar, (2015) the average monthly expenditure of Nigerians on electricity bills is N3, 374 (or $17 USD). In most cases power generation and supply is grossly inadequate, thus making Nigerians to seek alternative power sources in generators. Omar also report that on this note Nigerians' average monthly expenditure on generators is N9,529 ($48 USD). This is approximately three times the mount spent on electricity bills. In so doing, this study estimates the cost of an alternative to the 40MW electricity to be three times more. Based on this assumption, it is estimated in this study that alternative will cost N24.3 multiply by three which is N72.9 per kWh or N72, 900 per MWh. This assumption is support in Wong (2013) who also estimated the opportunity cost of hydropower dams using data from Massachusetts Institute of Technology (MIT) Centre of Energy and Environmental Policy Research. Greenstone and Looney (2012) also notes hydropower is still cheaper 2.2cents per kWh compared to alternatives 6.4cents per kWh.

Table 3.3: Alternative Power sources (e.g. Generators)

Total Installed Capacity	Projected Annual Output	Energy Price	Annual Revenue	Total Revenue by 2067
40MW	350,400 MWh	$577.197 per MWh	$202,249,881.24	$9,910,244,180.8

Source: Authors' Computation

Sensitivity Analysis Data

Here, the study assumes a number of factors such as interest rate variation, cost overrun, loss in power generation and supply and seasonal variations in water levels. The study uses 10.42% interest rate which is the average interest rate between 2007 and 2017 (see CBN 2017).

Cost Overrun

The study assumes that cost overrun will be more than double of the total project costs (see Wong, 2013 and WWF, 2003). This may be the result of time overrun of the project which is about 150%, corruption and exchange rate deteriorations. The project was awarded in 2007 and designed for completion in 2011, but is yet to be completed as at today. The World Wide Fund for Nature (WWF) (2003) formerly World Wildlife Fund, cites McCully (1996) who found cost overrun for Dams to be between 17% and 2900%. This way this study adopts the time overrun rate of 150% to measure cost overrun. The new project cost is therefore $2, 058,590,657.2 that is $823,436,262.9 multiply (1+150/100).

Operating Below Capacity

The study also assumes in the order of Brimmo et al (2016) a 20% loss in power generation and supply and another 30% seasonal variation and fluctuation in water levels. This way the operating capacity is put at just 50% and the annual power generation and supply is halved to 175,200 MWh. This gives the new annual revenue at $33, 708,304.80. With these new figures the Net Present Value is re-estimated.

IV. RESULTS AND DISCUSSION

This section presents results of the Cost and Benefit Approach (CBA) model conducted with a view to testing the viability of constructing the Kashimbilla Multipurpose Dam. Before estimating this model (CBA), the paper demonstrates how all the benefits as well as the costs of the project were estimated. Since the Kashimbilla dam is expected to go be completed in 2018, the benefits will thus begin from 2018 to year 2067. The NPV was calculated using the prevailing interest rate (9.125%) as at the time the project was awarded in 2007. After which sensitivity analysis was done using average monetary policy rate (MPR) (interest rate) between 2007 and 2017. This stands at 10.42%.

Table 4.1 Computation of Net Present Value of Kashimbilla Multipurpose Dam

Input	Amount	Total by 2067
BASIC INFORMATION: Discount Rate Exchange Rate	9.125% PA N126.3 per US dollar	
BENEFITS: Sales of Power Alternative sources savings Flood control **Total Benefits**	$67,416,627.08 PA $202,249,881,.24 PA $14,707,771,355.00 PA	$3,370,831,354.00 $10,112,494062.00 $735,388,567,750.00 **$748,871,893,166.00**
Costs: Project Investment O&M Costs **Total Costs** **Bt – Ct**	$823,436,262.90 (once) $49,406,175.77 PA	$2,470,308,788.50 **$3,293,745,051.40** **$745,578,148,114.60**
NPV		**$66,625,710,160.10**

Source: Authors' Computation, raw data sourced from public sources

Table 4.1 shows summary results from the CBA. The costs of the project as well as benefits derivable from it are in constant value dollars. This is based on the assumption that there was no price change included in the analysis. As noted earlier, the NPV (Net Present Value) of the streams of benefits discounted at the Central Bank of Nigeria's prevailing interest rate 2007. As shown in the table, the NPV value for the 60-year period is positive ($66,625,710,160.10). This indicates that the the Kashimbilla Multipurpose Dam project is worthwhile since CBA considers a project to be viable if its value is positive. The study concludes based on these results that the Kashimbilla Multipurpose Dam is viable under this criterion.

Sensitivity Analysis

As explained in section 3.0, sensitivity analysis was done assuming that MPR is 10.42%, under capacity utilization is 20% and 30% seasonal fluctuations in water level. It was also assumed that cost overrun is 150% of the project investment since time overrun is 150%.

Table 4.2 Sensitivity Analysis of Kashimbilla Multipurpose Dam

Input	Amount	Total by 2067
BASIC INFORMATION:		
Discount Rate	10.42%	
Exchange Rate	N126.3 per US dollar	
BENEFITS:		
Sales of Power	$33,708,304.80 PA	$1,685,415,240.00
Alternative sources savings	$202,249,881,.24 PA	$10,112,494,062.00
Flood control	$14,707,771,355.00 PA	$735,388,567,750.00
Total Benefits		**$747,186,477,052.00**
COSTS:		
Project Investment	$2,058,590,657.20 (once)	
O&M Costs	$49,406,175.77 PA	$2,470,308,788.50
Total Cost		**$4,528,899,445.70**
Bt – Ct		**$744,241,868,753.46**
NPV		**$50,705,050,229.04**

Source: Authors' Computation, raw data source from public sources

Sensitivity results also show that the project is viable under the new assumptions. Even when costs is more than doubled and the benefits downplayed, the NPV value over the sixty-year project life span remains positive.

It is pertinent to emphasize that the main objective of public investment is to increase social benefits but not necessarily monetary benefits as contained in the computation of NPV. On this basis, other forms of benefits must be considered in ascertaining the viability of this project. These are discussed as follow:

1. **Flood Control**: As with most dams, the Kashimbilla dam would reduce normal flooding in the area. The dam is projected to serve as buffer to people in the five states likely to be affected should Lake Nyos breaks down. Flood control dams such as the Kashimbilla project generally impound flood waters and thereafter either release them under control to the river below the dam, store or divert the water for other uses.
2. **Provision of electric energy**: There are no doubts the Kashimbilla dam would in line with its objective for establishment increase the amount of electricity available to the area. The dam holds a power component of 40MW capacity Hydropower Generation. This method also offers an advantage of a relatively low operations and maintenance cost. Although this is monetized in the CBA calculation, it remains that the CBA cannot be 100% accurate in its assumption. Several assumptions were made and some variables were assumed constant.
3. **Provision of water**: The Kashimbilla dam plan is an irrigation component designed to utilize 86,400m3/day to irrigate about 2000 hectares of farmland. The dam is also projected make water for domestic available to about 400,000 people per day. Most rural inhabitants are directly dependent on surface water - rivers, wetlands, springs and lakes - for their water supply. They witness scarcity during dry season and sometimes, pass through so much stress getting water. These challenges are addressed as the construction of dams usually involves riverbed deepening for tens or even hundreds of kilometers below the reservoir. As a result, the dam would store water for irrigation in summer seasons and dry months. The Kashimbilla dams would positively affect water quality and quantity for millions of downstream. The direct benefits of this service could not be captured in the project.
4. **Environmental preservation**: Hydropower usually produces fewer greenhouse gases than many other energy sources and so also the Kashimbilla dam. In view of its proven technology and storage capacity, hydropower in Nigeria is also currently deemed more reliable, affordable and feasible than large-scale wind and solar projects.
5. **Opportunities in both the agricultural and fisheries sectors**: The Kashimbilla dam provides opportunities in plantation agriculture and fishing. The dam presents opportunity which could positively affect the downstream river-dependent population whose livelihoods, particularly farming and fishing revolve around the seasonal pattern of rainfall in Nigeria.
6. **Employment Generation**: In a study to assess the socio-economic impact of the Kashimbilla dam, Oruonye (2015) noted that the project as at 2015 provided employment opportunity to 1,500 people in the area. The number was expected to increase to 2,000 after completion. The Project Manager remarked the community is fast developing with so many construction works springing up in the neighbourhood of the dam. The Kashimbilla dam is also designed to accommodate tourism and by that way, create jobs.

In summary, many costs and benefits could not be quantified in monetary terms under the input variables considered in the study. Apart from some environmental benefits and costs mentioned above, the construction of Kashimbilla Dam is primarily aimed to protect lives and properties. Economists are yet to determine the monetary value of human life. The outbreak of flood from Lake Nyo constitutes danger to human life which does not have monetary value. A public project of this sort would therefore not be aimed towards breaking even.

V. CONCLUSION

Cost and Benefit analysis (CBA) remains a very important analytical tool in economics and related disciplines as it is helpful in ascertaining the viability or otherwise of investments choices. This paper has investigated the viability of constructing Kashimbilla Multipurpose Dam under two different scenarios. It particularly varied interest rate, project costs and benefits. The analysis has demonstrated that the viability of the project is in general worthwhile. While the result from the computation of the CBA suggests that the project is viable, other social benefits such as improved crop yields from irrigation services, improved water availability, full benefits from flood control (value of human life), increased access to water resources, creation of employment and tourism indicate that the project is a worthy public undertaking. A CBA cannot be conveniently applied if certain assumptions are not made. In this work, interest rate, exchange rate, relative product prices etc. were assumed to remain unchanged over the 60-year period. Despite these assumptions which might seem to be limitations of the study, the project of Kashimbilla Dam can still be said to be worthwhile especially when the main objective of its construction was to protect human lives and other means of livelihood.

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