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## **ANALYSIS OF SOCIOECONOMIC BENEFITS OF KASHIMBILLA BUFFER MULTI-PURPOSE DAM IN TAKUM LOCAL GOVERNMENT AREA, TARABA STATE, NIGERIA**

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### **ABSTRACT**

*A dam is a barrier constructed across a stream or river to impound water and raise its level for various purposes such as generating electricity; direct water from rivers into canals and irrigation and water supply systems; increase river depths for navigational purposes; to control water flow during times of flood and droughts; create artificial lakes for fisheries and recreational use. This paper assesses the benefits and challenges of Kashimbilla Multi-purpose dam project in Takum Local Government area of Taraba State. Data were sourced from both Primary and secondary sources for this study. The primary sources involved the use of questionnaire survey which involves the administration, completion and collation of data from the respondents while interviews and the researchers' direct observations were also conducted to ensure an in-depth understanding to verify some information provided by respondents from the field. The secondary sources of data collected were information from text-books, journals, internet and documentaries on dams. A four point scale was used for the formulation of the instrument (Questionnaire). A total of one hundred and fifty (150) questionnaires were administered but only one hundred and forty five (145) questionnaires were retrieved and used for this study. Results shows that the benefits of the dam include among others: flood control, hydroelectric power supply, tourism, portable water supply, irrigation farming and job creation. Some of the challenges include funding, lack of adequate capacity and marketability. The study therefore recommended that adequate budgetary allocation should be made available by the concerned authorities.*

**KEYWORDS:** *Kashimbilla, Dam, Benefits, Challenges, Takum*

## INTRODUCTION

A dam is a barrier constructed across a stream or river to impound water and raise its level for various purposes such as generating electricity, direct water from rivers into canals and irrigation and water supply systems, increase river depths for navigational purposes, to control water flow during times of flood and droughts, create artificial lakes for fisheries and recreational use. Many dams are multipurpose and fulfill several of these reasons (Eyigue, 2006). Nigeria has witnessed an upsurge in dam construction in the past three decades. Over 323 dams have been constructed in Nigeria and many more are under construction in different parts of the country. Between 1970 and 1995, 246 dams were constructed in Nigeria (Wikipedia, 2013). The effect of the sahelian drought of 1972 – 1975 aggr Department of Hospitality and Tourism Management, Federal University Wukari, Taraba State, Nigeria<sup>1</sup>

avated the food shortage in the country prompting the various levels of government to embark on a rigorous policy to increase food production. To achieve this, impoundment of river basins was seen as inevitable to provide sufficient water for year-round irrigation which led to the construction of over 246 dams (Imevbore et al, 1986).

One thing is clear, that in the process of using surface waters for development, man has interfered so much with streams, rivers and lakes that now they can hardly be described as natural. It is also no doubt that dams have contributed to the economic growth of many nations. The numerous dams built round the world have played important role in helping communities and economies harness water resources for several uses. An estimated 30-40% of irrigated land worldwide now relies on dams and that dams generate 19% of world electricity (World Commission on Dams, 2000). However, these services are being provided not without a cost being paid for them. Kashimbilla multipurpose dam was proposed principally to check threat of flood from the structurally weak volcanic Lake Nyos, (see plate1) located upstream along the Cameroon line of volcanic activity to generate 40MW of Hydro electric power. Lake Nyos basin is located in the Republic of Cameroun. It has a maximum length of 2.0km with a maximum width of 1.2km and a surface area of 1.58km<sup>2</sup> with an average depth of 208meters. Other benefits of the project include; Ecological Flood Control; Water Supply to 400,000 people. The project is to generate 40MW of hydropower; Irrigation (2000ha); Fisheries; Airstrip; Tourism; Poverty Alleviation and job creation etc. On a broader scale, the project is to address global changes as well as shared concept of integrated water resources

management requirements. Kashimbilla Multipurpose Buffer Dam Project is located between the towns of Kashimbilla and Gamovo on River Katsina-Ala in Takum Local Government Area of Taraba State, North East Nigeria (see fig. 1). The dam is principally intended to check the threat of flood from the structurally weak volcanic Lake Nyos, located in the high Bamenda Plateau (300m above sea level) upstream along the Cameroun line of volcanic activity (see plate 1). This disaster, if allowed to occur, will affect the States of Taraba, Benue, Cross River, Kogi and Delta.

The Kashimbilla Multipurpose Buffer Dam is on River Katsina-Ala in Takum Local Government Area of Taraba State, Nigeria. The project would mitigate against the environmental disaster that would occur in several states of Taraba, Benue, Cross River, Kogi and Delta and affecting more than 6 million people. The dam is 95% completed and the hydropower component is 80% completed to date. The power component comprises Hydropower Generation (40MW capacity), Generators (4×12,100KVA), Turbines (4×10MW), Turbine Type (Kaplan), Transformer (8×15MVA). The Power Evacuation Component includes: The erection of Kashimbilla – Takum (132kV Double Circuit Line – 65km), Takum – Wukari (132kV Double Circuit Line – 75km), 132kV Switchyard at Kashimbilla, 2×7.5MVA 33/11kV Substations at Donga and Rafin Kada with associated distribution network facilities, 2×7.5MVA 33kV Substation at Kashimbilla Switchyard and 33kV distribution network to Kashimbilla town and Township Distribution Network (TDN)].

The dam area is in a rich agricultural area, and envisaged that the efficient use of the power generated from the 40MW power plant will go a long way to facilitate the realization of agricultural value chain development in places such as Kashimbilla, Takum, Donga, etc in Taraba State and environs, with extension to Benue, Adamawa, and Plateau States. This is in line with present economic diversification drive from oil sector to agricultural sector which in turn would help in reducing the current food scarcity in the country. The completion of this project will also improve power supply nationwide as well as address the environmental challenges in the area.

The aim of this paper is to appraise the benefits and challenges of dams with particular reference to the Kashimbilla multipurpose Dam in Takum Local Government Area of Taraba State, Nigeria. In order to achieve the above aim, the following objectives are put forward:

- i. To assess the benefits of Kashimbilla multipurpose dam project to the host community and the nation at large.

- ii. To assess the envisage challenges of Kashimbilla multipurpose dam project.
- iii. To recommend measures that will solve the identified problems

### STUDY AREA

Takum Local Government Area was created in 1976 by the then late Gen. Murtala Mohammed. Takum derives its name from Kuteb word '*Tekum*' meaning "we come to settle". Takum was created from the former Wukari Native Authority in 1976. It is roughly located between latitude 6°22'N to 7°30'N and longitude 9°40'E to 10°20'E. It is bordered to the North by Donga and Wukari LGAs, to the West and South West by Benue State, to the East by Ussa LGA and to the East and South East by the Republic of Cameroon (see Fig. 2, Map of Taraba State showing Takum, the study area). Takum LGA with a landmass of 2,542km<sup>2</sup> has a population of 135,349 (68,863 male and 66,486 female) people according to the 2006 National Census (Federal Republic of Nigeria Official Gazette, 2009). Takum LGA has 11 political wards and 3 districts; Chanchanji, Kashimbilla and Takum districts.

The Kashimbilla dam is located in Kashimbilla district, 50km South-West of Takum town in Taraba State. The dam is a 40 mega watts capacity. It could actually generate more electricity than this but has to be limited to this, because of its closeness to the border with the Republic of Cameroon. If it is made to generate more than this, it could result in the submergence of much land in the Republic of Cameroon and this could result in international conflicts (Oruonye, E. D. (2012). The Kashimbilla dam is a buffer dam which is meant to protect and save the citizens of the state from destruction as a result of flooding from possible collapse of Lake Nyos (see

plate 1). The decision came after warning by the United Nations to the Nigerian Government in 2005 on the need to create a buffer dam to contain the water of Lake Nyos in Cameroon as a result of breakage in 5-10 years. The lake was said to have been formed 400 years ago as a result of volcanic eruptions. Presently, it has started breaking. When it breaks, water from the lake will wash away villages, farm lands and settlements along the River Benue in Taraba, Benue and Kogi States, and will lead to the death of thousands of people. The Kashimbilla dam is a unique dam. Its Uniqueness can be seen from the design and construction of the dam (see plate 2).

The Kashimbilla dam has been designed for an operating life span of 150 years. The dam is 35m high. The sections include the spillway, flood directing structure, power generating plant and sensors to measure seepages. There are 8 openings of the water intake to prevent big fishes from entering the turbine. There is also a machine for clearing the clogs. The speed of the river is 4meter per seconds. The river was diverted and an embankment was constructed across the main river. The whole idea of a buffer dam is to control the flow of water through the spillway. A generator seats on top of a turbine.

The multibillion Naira contract for the construction of the Kashimbilla multi-purpose dam project was awarded to Messrs Setraco Company limited on May 11, 2007. The contract was awarded in 2006 at the sum of 42 billion naira, but only 1 billion naira was released to the contractor. The contractor was mobilized to site in July 2008. The project was expected to be completed in 3 years (2011), but owing to politics and bureaucratic bottleneck, it is yet to be completed.

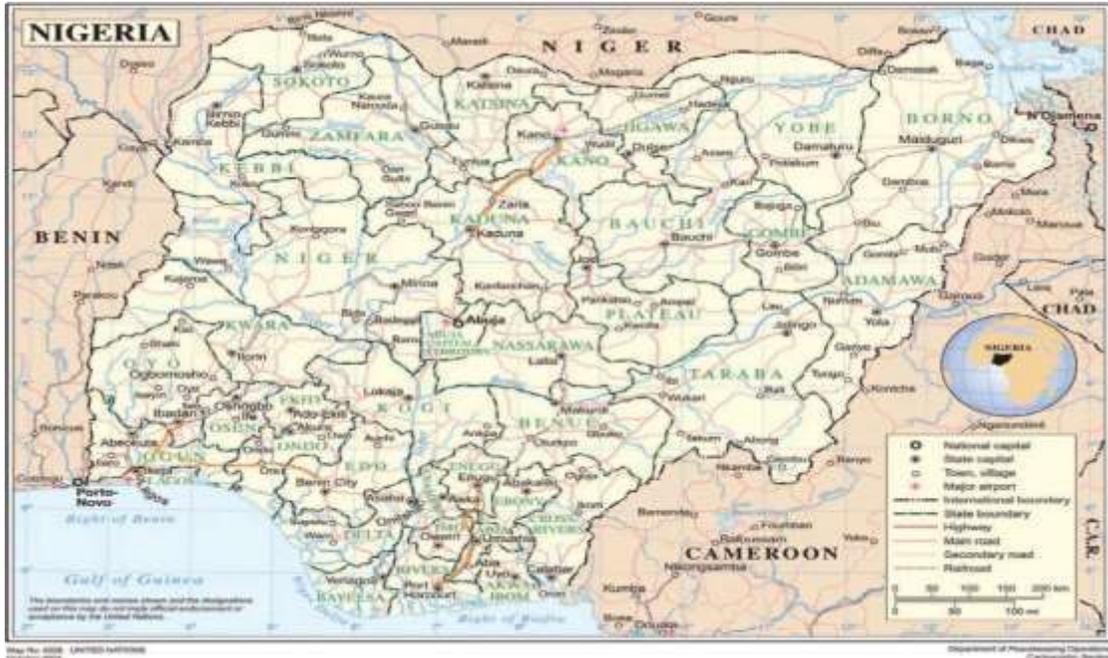


Figure 1: Map of Nigeria Showing Location of Kashimbilla Dam

Source: Abayomi A, Reginald, Imo E. E, Ali-D. A, (2015)



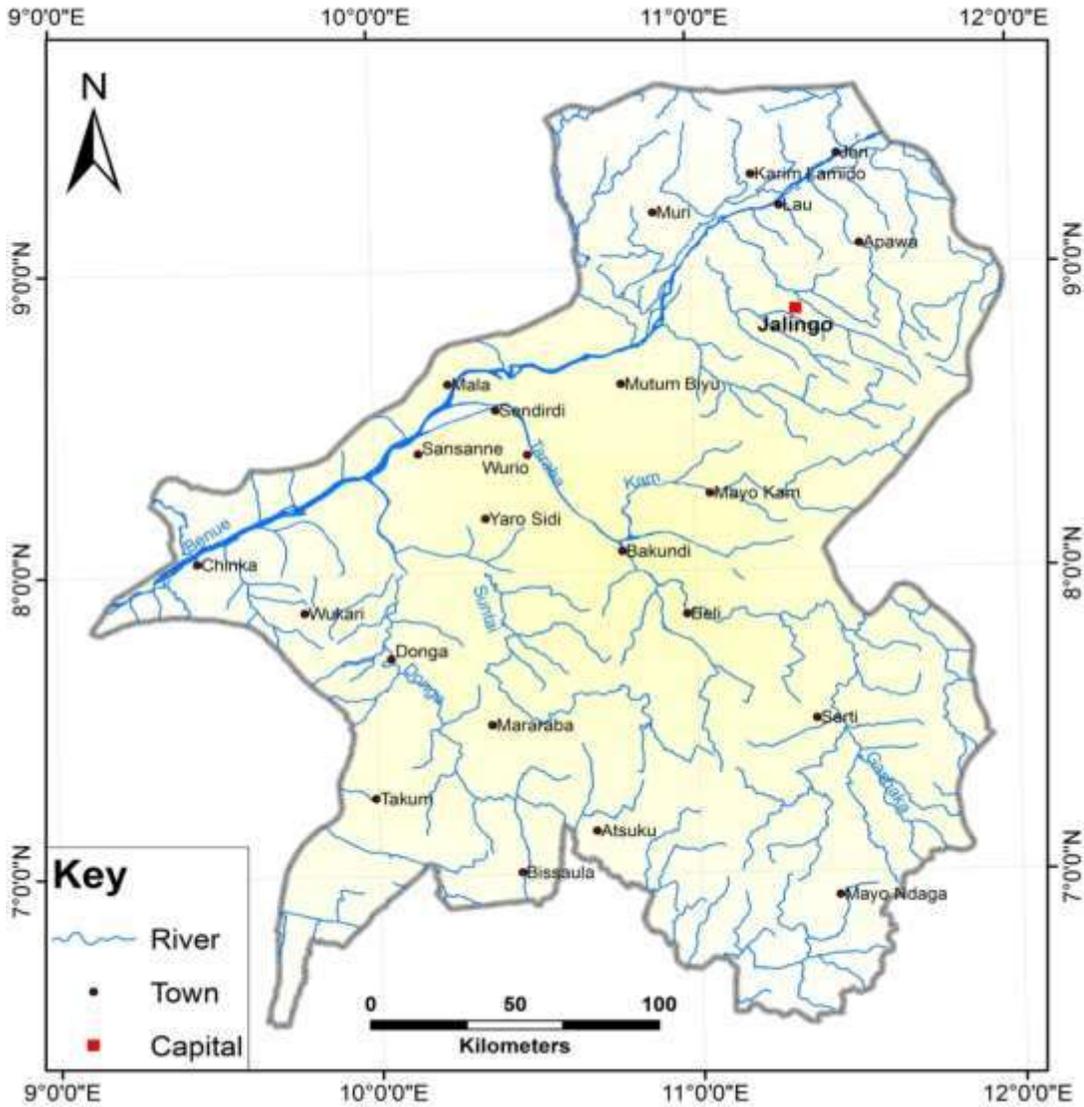
Fig. 2: Map of Taraba State Showing Takum LGA

Source: Shenpam (2016)

**Drainage**

The existing water resources in Taraba State (Kashimbilla dam inclusive) is capable of improving agricultural production using irrigation facilities to boost dry season farming in order to guarantee food sufficiency. Also, the area has the potentials of fish

production as the available water bodies transverse many communities. The available water bodies (streams, rivers) is use for dry season farming, thereby boosting food sufficiency and generating cash income to the farmers, who resides mostly at the rural areas (see Fig. 3).



**Fig. 3: Drainage of Map Taraba State**

Source: Shenpam (2016)

**SCOPE OF WORK AND TECHNICAL SPECIFICATIONS OF KASHIMBILLA DAM**

To date, remarkable progress has been achieved in all the various components of the project, with overall percentage completion of about 95% of the civil engineering works of the actual dam construction.

The works include: Access Road, Staff Housing Unit, and Construction of the Dam,

Pipeline for Water Conveyance to Takum and Jato Aka towns and environs, Air Strip, Water Treatment Plant and Hydropower (to generate 40 MW Capacity).

Plate 1: Lake Nyos

Source: Abayomi A, Reginald I, Imo E. E, Ali-D. A, (2015)

### Lake Nyos Data

Basin Country: Cameroun

Max. Length: 2.0km

Max. Width: 1.2km

Surface Area: 1.58km<sup>2</sup>

Average Depth: 208m



**Plate 2: General overview of Kashimbilla dam site**

Source: Abayomi , Reginald. I, Imo E. E, Ali-D. A, (2015)

### Dimension of Kashimbilla Dam

- Dam height 35m
- Dam length 1,585m
- Dam Width 150m
- Reservoir Capacity 500MCM
- Dam Level 200m asl
- Full Supply Level 192m asl
- Minimum Operational Level 184.30m asl
- Tail Water Level 159.82m asl
- Irrigation Area 2000ha
- Water Treatment Plant: 60,000 m<sup>3</sup>/ Day
- Water Supply 400,000 people
- Access Road 1km
- Air Strip 2.5km

## Methodology

**State 1:** Primary and secondary sources of data were employed to obtain data for this study. The primary sources were the use of questionnaire survey which involves the administration, completion and collation of data from the respondents while interviews and the researchers' direct observations were also conducted to ensure an in-depth understanding to verify some information provided by respondents from the field.

**Stage 2: Desk study:** The secondary sources of data collected involved information from text-books, journals, internet and documentaries on dams. A four point scale was used for the formulation of the instrument (Questionnaire). The following width were

assigned to each statement item: strongly agree (4); Agree (3), Disagree (2), and Strongly disagreed (1).

A total of one hundred and fifty (150) questionnaires were administered but only one hundred and forty five (145) questionnaires were retrieved and used for this study.

## RESULTS AND DISCUSSION

The Table below shows the results of the benefits and challenges of Kashimbilla Multi-Purpose dam project in Takum Local Government Area of Taraba State. Information was obtained from the administration of questionnaire to the target population of the study area (Table 1).

**TABLE 1. RESPONDENTS VIEWS ON BENEFITS AND CHALLENGES OF KASHIMBILLA DAM**

SNO	ITEM: BENEFITS OF KMD	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
1	FLOOD CONTROL	40(28%)	67(46%)	30(21%)	08(6%)
2	HYDROPOWER SUPPLY	53(37%)	51(35%)	23(16%)	18(12%)
3	FISHING	61(42%)	73(50%)	11(08%)	00(00%)
4	TOURISM	45(31%)	62(43%)	28(19%)	10(07%)
5	WATER SUPPLY	38(26%)	72(50%)	15(10%)	20(14%)
6	IRRIGATION FARMING	43(30%)	81(56%)	11(08%)	10(07%)
7	JOB CREATION	40(28%)	69(48%)	18(12%)	18(12%)
8	ECONOMIC BENEFITS	51(35%)	74(51%)	12(08%)	08(06%)
9	TRANSPORTATION	46(32%)	70(48%)	10(07%)	19(13%)
10	DEVELOPMENT OF HOUSING	60(41%)	49(34%)	16(11%)	19(13%)
RESPONDENT'S VIEW ON THE CHALLENGES OF KASHIMBILLA MULTIPURPOSE DAM PROJECT					
1	MARKETIBILITY	55(38%)	61(42%)	19(13%)	10(07%)
2	FUNDING	51(35%)	45(31%)	16(11%)	33(23%)
3	IMPLEMENTATION	69(48%)	74(51%)	02(01%)	00(00%)
4	SUSTENANCE STRATEGY	46(32%)	59(41%)	25(17%)	15(10%)
5	LACK OF CAPACITY	63(43%)	48(33%)	14(10%)	20(14%)
6	IMPROPER EIA	39(27%)	84(58%)	13(09%)	09(06%)

Source: Authors' Field Work, 2016

## DISCUSSION

### Flood Control:

Flooding is one of the most common environmental hazards that regularly claims over 20,000 lives per year and adversely affects around 75 million people world-wide (Smith, 1996). Across the globe, floods have posed tremendous danger to people's lives and properties. Floods cause about one third of all deaths, one third of all injuries and one third of all damage from natural disasters (Askew, 1999). From the above Table therefore, forty respondents representing 28% said they strongly agreed that Kashimbilla multipurpose dam project when completed will check the problem of flood from Lake Nyos. Sixty seven respondents representing 46% agree with the

opinion, thirty respondents representing 21% disagreed, while eight respondents representing 6% strongly disagreed with the view. This goes to show that flood control is one of the benefits of a dam hence, 28% and 46% of the sampled population strongly agreed and agreed with the option. Cases of floodings are on the increase in Nigeria in particular and the world in general. This concurs with the work of Oruonye (2012) which opined that, floods generally cause enormous damages worldwide every year. This could be economic damages, damage to the natural environment and damage to national heritage sites. Although different parts of Jalingo LGA is exposed to flood almost every year, the 2005 and 2011 floods break all records of the past (Oruonye, 2012). The 2011 flood devastated three North Eastern states of

Borno, Bauchi and Taraba, washing away over 4000 farms and destroying over 5000 houses (Timothy, 2011). In Taraba state alone, the flood destroyed over 2,068 farms, 363 houses and partially affected 1,562 houses. Over 6,213 persons were internally displaced and 1,420 families affected by the flood in 4 LGAs, Jalingo, Lau, Ardo Kola and Yorro (Timothy, 2011). It therefore becomes necessary to investigate the socioeconomic impacts of flash flood in the study area so as to find a lasting solution to the negative effect resulting from it.

### **Hydropower Electricity Supply:**

As seen in the Table above, Fifty three respondents representing 37% said they strongly agreed that Kashimbilla multipurpose dam project when completed will provide reliable and adequate electric power that will reduce the costs and losses currently suffered from inadequate power supply, and increase productivity, effectiveness and the quality of output, reduce hardships, inconveniences and disrupted services due to power interruptions, and reduce the expenditures made by businesses and households to compensate for inadequate power. Since Nigeria is facing power shortage during the peak hours, this additional capacity will help in improving the voltage in the distribution network. Fifty one respondents representing 35% agreed with the assertion, twenty three respondents representing 16% disagreed, while eighteen respondents representing 12% strongly disagreed with the view. This shows that hydro-electric power supply is one of the benefits that could be derived from the construction of dams in Nigeria in general and the study area in particular.

### **Increased Fish production**

Sixty one respondents representing 42% said they strongly agreed that Kashimbilla multipurpose dam project when completed will provide an increase in fisheries production to the host community and the nation at large. Seventy three respondents representing 50% agreed, eleven respondents representing 8% disagreed, while zero respondents representing 0.00% strongly disagreed with the opinion. This shows that fishing could be one of the benefits derivable from a construction of dams. People derive a major source of protein from consumption of fish. This can also provide a source income to the local community thereby alleviating their poverty level.

### **Tourism**

Forty five respondents representing 31% strongly agreed that Kashimbilla multipurpose dam project when completed will increase tourism potentials by attracting people from local and international tourists. Sixty two respondents representing 43% agreed, twenty eight respondents representing 19% disagreed, while ten respondents

representing 7% strongly disagreed as seen from Table 1 above. From the above analysis therefore, it shows that tourism is a benefit of dam construction to kashimbilla community. It can also bring about economic development of the area.

Plate 5: An airstrip constructed at Kashimbilla Dam site.

### **Potable Water Supply**

Water is life, but most importantly, portable water is a necessity to human life. It is common knowledge that water is a colourless, tasteless and odourless substance that is essential to all forms of life. Human beings consume water which has quality compatible with human body. Water quality is a term used to describe the chemical, physical, and biological characteristics of water (Yuncong and Kati, 2011) that make it useable for certain activities. The chemical, physical, and biological attributes of water affect suitability of water for human use (drinking, irrigation, industrial use) and ecosystem health. From the above Table, thirty respondents representing 26% strongly agree that Kashimbilla multipurpose dam project when completed will provide improve quality drinking water to the host community and its environs. Seventy two respondents representing 50% agreed, fifteen respondents representing 10% disagreed, while twenty respondents representing 14% strongly disagreed with the opinion.

### **Irrigation Farming**

Before the construction of the dam, rain-fed agriculture was a dominant form of agriculture but with the dam, irrigation farming can be fully practice by the farmers thereby making farming all year round activity. This will lead to greater productivity thereby reducing poverty level of the people. From the above Table, forty three respondents representing 30% of the sampled population strongly agreed that Kashimbilla multipurpose dam project when completed will boost irrigation farming as the community hitherto depends on rain fed agriculture. This is in line with Federal Government drive to diversify from mono economy (that is oil economy) to agriculture. Eighty one respondents representing 56% agreed, eleven respondents representing 08% disagreed, while ten respondents representing 7% strongly disagreed with the view. This goes to show that irrigation farming is a benefit that could be derived from the dam when completed.

### **Job Creation**

According to Ngabea, etal(2013), the construction of dam results in creating employment to so many people in Kashimbilla area. A lot of people were employed during the construction of the dam, though there are changes in the employment and production systems starting before the construction of

the dam including expropriation of the land, employment of construction workers and the transport of construction materials with the machines to the site. Unskilled labour was employed from the site; however the technicians and experts came from other places. From the result of our study, forty respondents representing 28% said they strongly agreed that Kashimbilla multipurpose dam project when completed will create a lot of jobs in the area. This is in agreement with the fact that Poverty is clearly linked to unemployment. The lack of stable electricity is an important constraint that works against employment, generating economic growth and contributes to the under utilization of human and natural resources, resulting in wide spread unemployment and poverty.

Although the unskilled generally have difficulty securing new jobs in the industrial and manufacturing sectors, they can benefit from the multiplier effects of economic growth, such as new construction and increased expenditure in the informal sector. These types of unskilled jobs, however, tend to be low-paid, temporary and/or insecure. This has been demonstrated from experiences, where income from the Gulf countries facilitated the increase of wage rates, not only in the construction sector, but also in agriculture, because of linkages in the labour market. The availability of power would also enhance public services and infrastructure facilities such as communications, which are necessary for the growth of industries and activities in the service sector. Sixty nine respondents representing 48% agreed with the view, eighteen respondents representing 12% disagreed, while eighteen respondents representing 12% strongly disagreed with the opinion.

### **Economic Benefits**

From the above Table, fifty one respondents representing 35% strongly agreed that Kashimbilla multipurpose dam project when completed will boost economic activities in the area. There are historical and empirical evidences that there is positive relationship in Nigeria between power availability and industrial

and economic development, shown in the decline or stagnation of the manufacturing sector in Nigeria after the late 1980s. A faster pace of industrial development is expected when IPP begin producing and supplying additional cheap power. Normally 40% of power generated goes to industrial development. In rural areas, agro based SME are most likely to develop. Nearly 200,000 employees get direct employment and the same number gets indirect employment. Similarly converting the SHP sites for tourism development and fish farming can create employment opportunity making more people to benefit from this project. Seventy four respondents representing 51% agreed, twelve respondents representing 08% disagreed while eight respondents representing 06% strongly disagreed that economic benefit could accrue from dam.

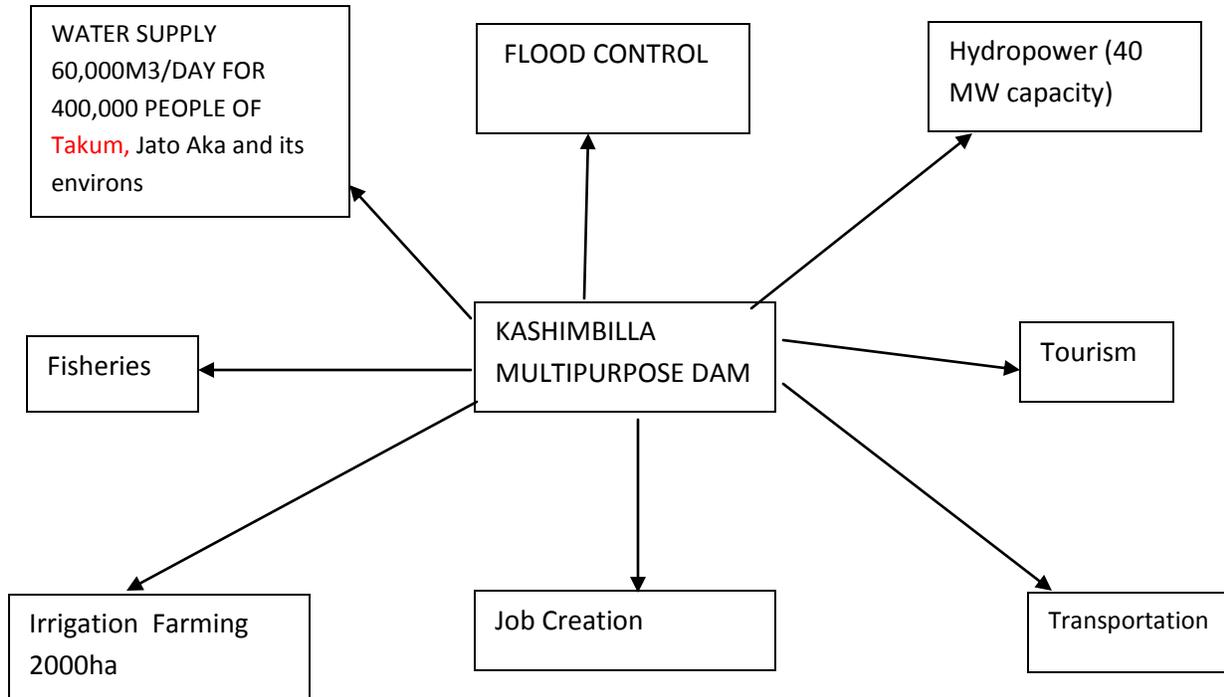
### **Transportation**

Transportation is seen as the movement of people, goods and services from one geographical area to another. From the above Table, forty six respondents representing 32% strongly agreed that Kashimbilla multipurpose dam project when completed will improve greatly the transportation network linking the host community and its environs to other parts of the country. Seventy respondents representing 48% agreed, ten respondents representing 07% disagreed, while nineteen respondents representing 13% strongly disagreed with the view. This shows that transportation is one of the economic benefits of the dam and this in turn will bring about development of the area as transportation brings along with it development.

### **Development of Housing**

Sixty respondents representing 41% strongly agreed that Kashimbilla multipurpose dam project when completed will bring about development of housing in the area, forty Nine respondents representing 34% agreed, sixteen respondents representing 11% disagreed, while twenty respondents representing 14% strongly disagreed with the assertion.

**A Chart showing the multiplier benefits of Kashimbilla dam Project.**



**Challenges**

Having identified the benefits accruable to Kashimbilla multi-purpose dam, it has become imperative to highlight some of the anticipated challenges of the dam. This includes marketability, funding, implementation, strategy and lack of adequate capacity.

**Marketability**

- Absence of hydropower resource assessment tool for the country for hydropower prospecting and feasibility analysis
- Limited hydropower studies of key locations with potentials
- Complexities due to lack of proper definition of stakeholders' roles in the industry
- Lack of requisite knowledge by investors on licensing and registration in Nigeria

**Funding**

- Absence of dedicated fund by the banking sector for hydropower development
- Over dependence on public budgetary funding for implementation
- Lack of information on other funding options

**Implementation Strategy**

- Absence of targets and milestones to encourage the pace of deployment in the sector
- Implementation predicated on technical viability alone without financial viability considerations

**Lack of Adequate Capacity**

- Limited access to ever evolving Energy Technology which has expanded to include plug-and-play models
- Lack of adequate expertise.

**CONCLUSION**

Kashimbilla multipurpose dam was proposed principally to check threat of flood from the structurally weak volcanic Lake Nyos, which is located upstream along the Cameroon line of volcanic activity to generate 40MW of Hydro electric power. Other benefits of the project include: Ecological Flood Control, Water Supply to 400,000 people, Irrigation farming, Fisheries, Airstrip, Tourism, Poverty Alleviation and job creation etc. On a broader scale, the project is to address global changes as well as shared concept of integrated water resources management requirements.

## Recommendations

- i. Adequate funding: There should be adequate funding by way of budgetary allocation by government. Government should fund any dam project to its fullest realizing the huge economic benefits that is accrued to dams in Nigeria. This will help in boosting the Nigerian economy thereby fulfilling the present economic diversification drive from mono economy (oil sector) to multi-economy (such as agricultural sector) which in turn will help in reducing the current food scarcity in the country.
- ii. Community enlightenment: The community should be enlightened on the benefits that will be derived from the dam most especially the agricultural sector. They should be enlightened on the importance of irrigation farming as this would help in reducing poverty among the local community. As a result of present economic recession in Nigeria and fall in global oil prices, they people should be encouraged into agricultural sector of the economy. One of the major reasons for sitting dams in Nigeria is for agricultural purposes. This can only be achieved if the people of Kashimbilla and its environs are fully enlightened on the importance of irrigation farming. This can be done by the provision of extension services through extension workers by the Government to the local communities. An estimated 30-40% of irrigated land worldwide now relies on dams (World Commission on Dams, 2000).
- iii. Private Sector Participation: Nigerian power sector reform should encourage private sector to invest in dam projects in Nigeria. Private individuals should be encouraged to own their private dams for full commercial purposes. They can generate their own private hydroelectric power supply which can be distributed to companies and individuals. It can also help in promoting agricultural sector, tourism and portable water supply among other benefits to the teeming population. Dams generate 19% of world electricity (World Commission on Dams, 2000).

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