



Spatial Analysis of the Impacts of Kainji Hydropower Dam on the Down Stream Communities

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Abstract

The effect of human interference with the natural river course at the upper, middle or lower course has always been negative on the bordering ecosystem including human settlements. This is exactly the case of the River Niger right from its source in Futa-Jalon Highlands (Sierra Leone) down to its delta in Nigeria. This paper examined the spatial transformation of the downstream sector of Kainji Dam and its effect on those communities within two and half kilometers away from the river course using satellite image (Landsat 7 MSS), Topographical maps and field survey. The image analysis shows that Primary vegetation has given way to secondary vegetal cover due to the change in the primary occupation of the people (from fishing to farming) and over grazing. And this has direct negative impact on the Burgu and Zugruma sectors of the Forest and Game Reserve. Socio-economic life of the people has worsen than when the dam was newly constructed since they still lack basic infrastructural facilities except for towns like New Bussa. The paper recommended that a re-evaluation of the dam be carried out as contained in the Environmental Management Plan (EMP).

Keywords

Dam; Downstream; Ecosystem; Human settlements; Socio-economic

Introduction

The need to re-evaluate and assess the effect of Kainji Dam cannot be over emphasized as in the episode of September 14, 1999 when the National Electric Power Authority (NEPA) (PHCL), Kainji Regional Headquarters sent an urgent message of warning to communities and establishments around Jebba, downstream of the possible flooding of River Niger with damaging consequences. Inhabitants were warned rather too late to safeguard lives and properties. The dam has overflowed its banks as authorities of NEPA (PHCL) decided to open dams letting out torrents of water which in all overran many communities, killing over 1000 people, submerged 1,500 houses. 52 primary schools were rendered inhabitable, rendering thousands jobless and homeless in Niger, Kwara and Kogi States [1].

Large dams in Africa are donor-driven projects, as there seems not to be clear government policy on dams, African Development Bank (ADB, 1995) [2]. Also, the general goals of the national energy policy are not in tune with the philosophy of the pilot program, which emphasizes serving the needs of the local population. Also it

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Received: March 07, 2013 Accepted: June 20, 2013 Published: June 30, 2013

is traditional on the part of the governments to send relief materials to flood victims since the establishment of National Emergency Management agency (NEMA) at both federal and states level. But it is more of an eye service and bonus for the implementing agents as most flood victims hardly get the meagre relief if it ever comes. According to Atakpu (1999) [3] in his study of this same area, a flood victim has this to say:

“most of these relief materials don’t get to us. I remember last year (1998) when they brought food items to our village in bags, they told villagers to surround the food items, and they took our picture with the items and as soon as this was done, the food stuffs were packed into vehicles and were taken away, that was the last time we saw it.”

Since 1999, the focus of the advocacy group, which is now embraced by other communities in the dam areas covering five states, has grown into what is now called Hydropower Producing Areas Development Commission (HYPADEC). These and many more calls for a project like this to re-examine the effects of Kainji Lake on the surrounding communities as being canvassed for by the people of the lower Niger Basin.

Aim and objective of the study

The aim of this project is to assess the spatial characteristics of Kainji hydropower dam downstream and its effect on the socio-economic life of the communities through the following objectives.

- i. Identify and map out the spatial delineation of the dam and the downstream settlements
- ii. Carry out a post dam land use/land cover analysis of the downstream areas of the dam
- iii. Examine the socio-economic life of the displaced people presently in relation to their
- iv. Past life and
- v. Suggest ways of mitigating the socio-economic and the environmental problems observed in the study if any.

Methodological approach of the study

This work is generally based on both direct primary field data collection and secondary remotely sensed image over the study area. For the primary field survey, a total of nine (9) villages were sampled at the downstream of the dam. Hundred (100) questionnaires were administered to these villages based on their population. The targeted respondents are the household heads which were randomly selected in each of the villages. The population figures are based on the data given by the village heads since this is not made available by the State National Population Commission (NPC). See Table 1 for those villages that were sampled.

The secondary sources of data wholly depend on Satellite Image and Topographical maps covering the study area. Two topographical maps used for this study are Kainji sheet No. 160 NW and sheet No. 160 SW. For the satellite image, Landsat 7 (MSS) of 2006 was used. The image used is windowed from the original scene covering the entire dam area. To enhance the major features of interest in image, series

of colour composite was carried out before the supervised spectral classification of features using IDRISI Andes (G.I.S) software. Other complementary secondary data include books, periodicals, journals and site photographs. Detail of the characteristics of the secondary data sources are shown in Table 2.

The Study Area

Geographically, Kainji hydroelectric dam is located in New Bussa town now headquarter of Borgu local government area of Niger State, Nigeria. The lake created behind the dam span between latitude 9° 8' to 10° 7' and between longitude 4° 5' to 4° 7' E with reference point 9.54 N and 4.38 E northwest of the Federal Capital Territory (FCT, Abuja); see Figure 1 for the dam location on the Niger River. The lake is about 139 kilometres long, 24 kilometres wide in its widest point and about 1280 square kilometres in area [4].

Table 1: Distribution of questionnaires among villages.

S/N	Settlements	No. questionnaires	Remark
1	New Komi	11	Resettled
2	Fakun	15	Not resettled
3	Old Awuru	10	Old site
4	New Awuru	12	Resettled
5	Leaba	10	Old site
6	Yankede	10	Old site
7	Lubararu	12	Old site
8	Farin dutse	10	Old site
9	Kere	10	Old site
Total		100	

Table 2: Data sources and their characteristics.

Data Type	Date	Scale	Identification	Acquisition source
Landsat 7 (MSS), Enhance.	2006		L71191053_05 320011022	Geography Department, Federal University of Technology, Minna.
Topographical map sheet 160	1968/69	1:50,000	Kainji N.W	Federal surveys Lagos, Nigeria
Topographical map sheet 160	1968/69	1:50,000	Kainji S.W	Federal survey Lagos, Nigeria.

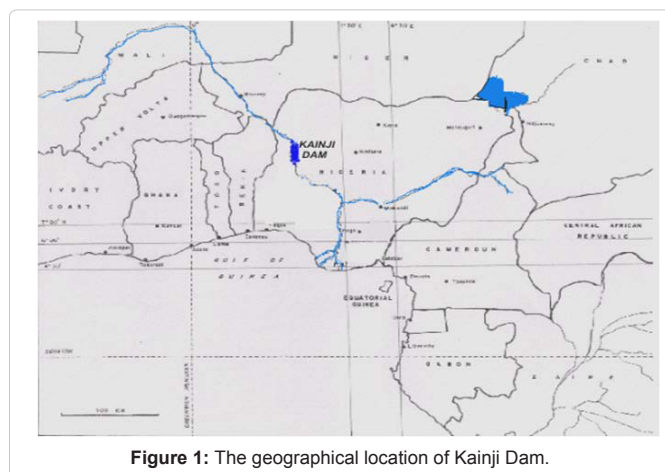


Figure 1: The geographical location of Kainji Dam.

The historical background of the area

The origin of Borgu emirate within which Kainji dam is located can be traced to the tenth (10th) century of the settlement of war-like people. Bussa town was coined from the Bussa language ‘Ma Bussa’ meaning ‘I am tired’. The major occupation of the indigenes are farming, fishing and hunting. Generally, settlements are made up of scattered compounds of less than ten (10) people per family size and a total population estimate of 44,500 people. The major ethnic groups in the area are: Gunguwa (46.5%), Kamberi (14.6%), Lopawa (9.6%), Hausawa (6.7%), Shangawa (2.9%), Bussawa (1.7%) and others (18.0%) [5,6].

The Niger River

The principal river of West Africa, the Niger is the third longest on the continent after the Nile and Congo Rivers. It is about 2,600 miles (4,200 kilometres) long; rising in Guinea 150 miles (240 kilometres) [7]. Of the many long rivers in West Africa like the Nile, the Volta, and the Senegal, which rise from the interior highlands and flows to the sea, World Commission on Dams [8]. It rises in the Guinea Highlands; collect its main headwaters, the Milo and Tinkisso, in Guinea, and flows through the arid country of Mali and it finally crosses Nigeria from northwest to south where it collects its main tributary, the Benue, and enters the Atlantic by a delta.

The multi-seasonal and the construction of the kainji hydroelectric dam

Due to the international nature of the river, two major types of flooding activities are identified in the flow of Niger (the white and black flood). The white flood which originates majorly from Sokoto-rima basins owing to heavy rainfall in the Sokoto and Kainji areas begins in mid-August while the black flood begins in November and peaks in December/January.

The Kainji dam has a main dam and a saddle dam. The main dam is constructed of concrete and rock fills while the saddle dam is rock filled which protects the main dam during flooding. There are four spillways with hydraulic operated gates of 50 ft by 50 ft, which could be opened to control flood and also to release water for use at the Jebba hydropower dam downstream. The lake has a total capacity of 15 billion cubic meters covering an area of 1,270 sq. Kilometres. It has a power plant with initial six generating units and six turbines at the site [9]. See the Layout plan and the general view of the dam site in Figure 2.

Data Presentation and Analysis

The analysis of the questionnaire administered reveals that 75% of the people depend on the river for fishing activities as primary occupation, while farming is secondary as revealed in Table 3 and Figure 3. 65% of the respondents had only quranic education while few of the teenagers attend modern schools. In fact, some headmasters use to beg parents to allow their children to stay in the school, although some of their youths can communicate in English fairly. On the issue of early warning signal information from the Dam Management, 65% of them acknowledged that they received the information through the various sources as indicated in Figure 4, but that it’s always too late to adjust. The question on the level of satisfaction on compensation from the government, the study reveals that 78% of the respondents applauded government efforts, but that the aspect of their livelihood is not well addressed in the old resettlement schemes like that of New Awuru.

On the spatial analysis and the mapping of the settlement distribution, figure 5 is the original composite image that was windowed from the image full scenes.

Analysis of developmental activities in the area

The major land use/land cover categories investigated comprises of the following:

- a) Settlements; b) Downstream rivers/ tributaries; c) Reservoir (Lake); c) Roads; d) Air strip runway; e) Inundated areas; f) Vegetal-cover (primary and secondary); and g) Rock outcrop.

The supervised image classification of Landsat 7(MSS) of the area reveals that apart from New Bussa, one of the major towns that were resettled, most village settlements downstream primarily depend on the Niger River for their livelihoods. Primary vegetation has given

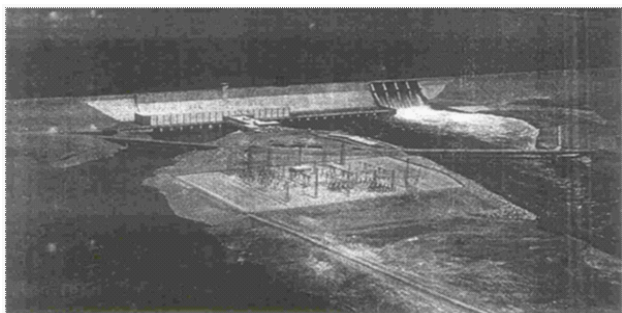


Figure 2: General view of Kainji Lake Dam, Nigeria.

Table 3: Occupational Distribution of the people.

Settlements	Farming (%)	Fishing (%)	Civil Servant (%)	Trading (%)
New Komi	35	25	17	15
Fakun	37	54	7	2
Old Awuru	21	61	3	15
New Awuru	38	22	14	26
Leaba	53	36	4	7
Yankede	42	51	3	4
Lubararu	43	37	4	16
Farin dutse	54	29	3	14
Kere	48	42	3	7

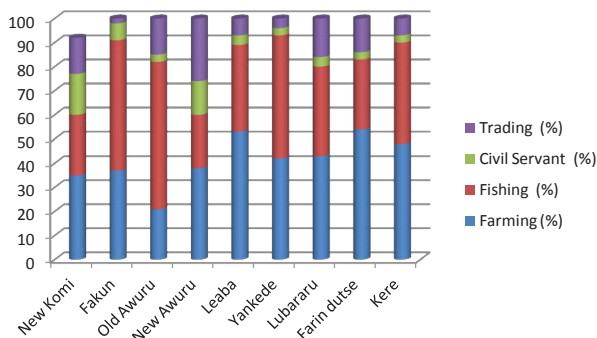


Figure 3: Sources of Early warning Information to the communities.

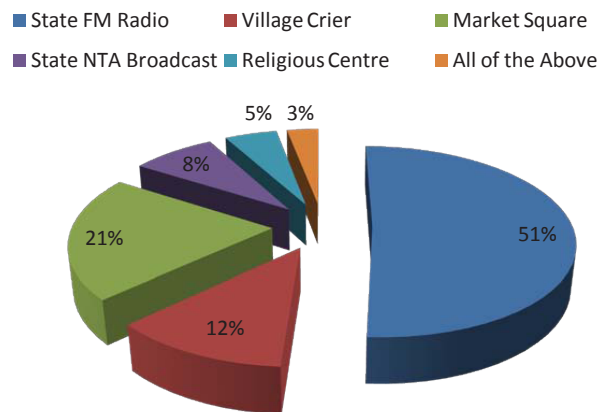


Figure 4: Methods of Early Warning Information Receptivity by the communities.



Figure 5: Original composite image sub-set of Kainji Dam area in 2006 (band 2, 4, 5).

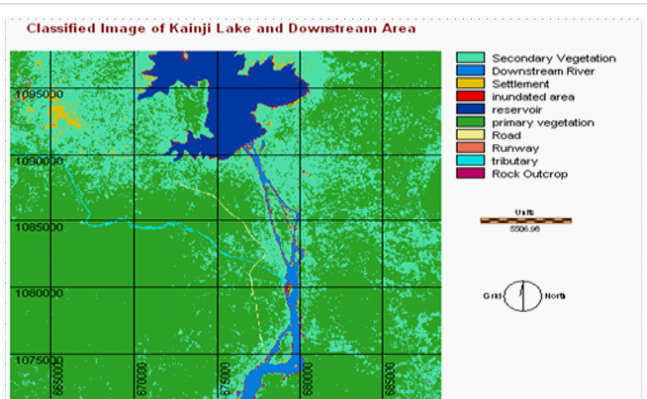


Figure 6: Supervised image classification of kainji Dam downstream as at 2001.

way to secondary vegetal cover due to the change in the primary occupation of the people and over grazing, this has direct negative impact on the Burgu and Zugruma sectors of the National park. Also worthy of note is the periodic inundation of the settlement and the farmlands bordering the river course which has been causing untold hardship on the people and economy set back on the state. Figure 6 is the classified image of Kainji Lake and downstream areas, while Figure 7 is the spatial distribution of those settlements.

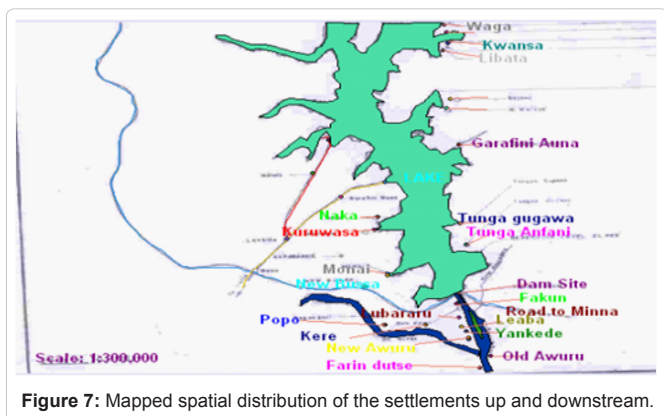


Figure 7: Mapped spatial distribution of the settlements up and downstream.

Economic and livelihood impact on the people

The downstream settlers are forced to adapt to the new ecological system and the change in their socio-economic life. The same view was reported by Olofin, (1988, 2000) [10,11] in the work on “Monitoring the impact of dams on downstream physical environment in the Tropics, Regulated Rivers”. The field data obtained actually reveals that about 75% of the inhabitants of those settlements around the dam up and downstream are far below the UN poverty line standard. Old Awuru for instance, use to be a major commercial fish centre, but has become an empty settlement due to relocation. 85% of the respondents disclosed that some sizable fish ponds in those villages are owned by people from the urban centres that employ them to nurture fishes.

Displacement of fish species: There is a great change in the fish species composition following the impoundment both in the reservoir and downstream of the dam. Fish families such as the Mormyridae and Citharinidae, which were in abundant before the dam, declined while the Characidae, Clupeidae and Cichlidae have risen in the lake. Downstream, there is an increase in Nileperch (centropomidae) and Bagridae. In term of quantity, fishery production from Faku and Awuru located 1km and 16km (below the dam) dropped from 21.5 tonnes and 34 tonnes to less than 8 tonnes and 10 tonnes per annum respectively [10,11].

Agricultural produce and soil fertility: The seasonal inundation of the downstream areas due to the climate change and dam management actually has negative impacts on the farm produce in this area as most of their farm lands are washed away by flash flood. Around Fokun and Yankede villages for instance, duricrust capping is becoming a common feature due to flooding and denudation activities.

Local access to electricity supply by the people: Kainji Hydro dam only supply electricity to major towns like New Bussa because most of the dam staffs and political leaders lives there [12]. The host villages are yet to benefit,

Comparison to other national dams: In comparing this study to other national dams that impacted much on their host communities, Grand Coulee Dam, Orange River Development Project, and Akosombo Dam scheme were selected.

a) Grand Coulee Dam, Columbia River basin, USA

The Grand Coulee Dam (GCD), located in eastern Washington

within the United States was completed in 1941 as a multi-purpose project, which includes hydropower generation. The Key physical dimensions of the GCD are as follows: Total length of dam (axis) 5 223 ft (1 592 m), Height above downstream water 350 ft (106.7 m), Total height of dam 550 ft (200.5 m), Spillway width 1 650 ft (509.2 m).

Compensation and Resettlement: The Bureau of Reclamation spent \$10.5 million making purchases in the reservoir area. They acquired land, buildings, improvements, and other facilities, such as telephone lines, telegraph lines, roads, bridges, and railroad track [13]. During the 1930s, Reclamation lacked legislative authority to assist in the relocation of people displaced by the Lake Roosevelt [13]. It was not until about 30 years later that Reclamation gained authority to assist displaced persons [13]. Reclamation cited its lack of legislative authority as the reason that it provided no resettlement assistance to the people and communities displaced by Lake Roosevelt [13]. The Colville and Spokane tribes were informed that GCD would be constructed, and at least one meeting was held on the Colville reservation [14].

Those who lost land received small cash compensation, but the government made no serious effort to mitigate resource losses or assure that relocated towns had basic utilities until over 40 years later. Reclamation planners gave low priority to relocating tribal graves. As reservoir waters rose, relocation work became rushed. Some gravesites were said to be identified too late for removal. Construction of GCD forced a drastic change in diet. As a result of moving to foods that are high in fat, sugar, and salt, the rates of heart diseases, diabetes, and other diet related illnesses have increased significantly on the reservations [15-17].

a) Orange River Development Project, South Africa (Orange River Basin)

The Orange River (also called the Gariep, the Khoi word for Great River, or Dragon River by the San) is the largest in Africa south of the Zambezi, with a total catchments area in excess of one million square kilometers. The natural flow of the Orange River constitutes more than 22% of the South Africa’s surface water resources. The formal plan for the ORDP was put forward in 1962 (a year after South Africa became a republic under the leadership of Hendrik Verwoerd). After the implementation of the project, the following impacts were observed:

- i. There was increased incidence of black fly which did cause damage to the white farmers and their livestock,
- ii. White farmers who lost their lands to submergence were fairly compensated for their economic losses (more for Gariep than Van der Kloof) but did not receive payment for the psychological costs associated with relocation
- iii. The Coloured and Black farm workers were not compensated for being displaced as a result of the ORDP.

b) Akosombo Dam scheme, Ghana

Volta River in Ghana formed by the confluence of the Black and White Volta Rivers at Yeji in the central part of the country, and flowing in a southerly course through Lake Volta, Ghana, to Ada, on the Gulf of Guinea. The total length, including the Black Volta, is 1,500 km (930 mi). Lake Volta was created by the construction of the Akosombo Dam on the river in the mid-1960s is one of the

largest artificially created lakes in the world. The Akosombo Dam and another dam built in 1981 at Kpong, 8 km (5 mi) downstream, produce enough power to meet Ghana's electricity needs.

The lake was said to have experienced a major inflow of water and flooding activities which subsequently led the submergence of nearly 740 villages and displaced about 80,000 people. About 70,000 were moved into 42 newly constructed settlements, which were to have small concrete houses, services such as schools and wells, and mechanized agriculture. Most of the settlements had major problems, including poor design, inadequate water supply, slow clearance of farmland, and poor soil. Within four years, the majority of those resettled migrated elsewhere. Cases of water-related diseases, such as schistosomiasis and malaria, increased near the reservoir [18].

Conclusion

Large dam construction generally is seen as a catalyst to economic development of any nation but experiences demonstrates very clearly that resettlement without livelihood component as an essential ingredient always leave the host communities socially and economically worse off. In fact, dams have been linked with overall biodiversity productivity reduction over time [19]. Kainji Dam impact mitigation level is not the worst of all other nation multipurpose dams elsewhere as discussed above. Although the dam host communities are calling for national attention over the burden they are bearing for the whole nation.

The ways forward are:

- Allow the affected people privileged access to the benefits derived from the scheme (power supply), and promote factors that enhance the liveability of resettlement areas
- Promotion of local marketing opportunities through improved roads and transport facilities.
- Build an effective early warning system that can prepare the downstream communities against flooding activities.
- Establish effective public participation in major projects that impact highly on the host communities as against the international donors-drive projects in most African countries

The African experience demonstrates very clearly that relocation is not enough, but a development component is an essential ingredient, if people are not to be left socially and economically worse off. If reparation is to be achieved, we thus need resettlement as development opportunity.

Acknowledgement

All appreciation is due to the management of Kainji Lake Research Institute for making available their library materials and to the authorities of the Dam Site for access to the area. I also acknowledged the cordial relationship accorded me by the village heads of those settlements through the assistance of Mr. Ibrahim an indigene of the area and a former student of federal University of technology, Minna. Many thanks to Dr. S. Halilu of Geography Department of the same University for laboratory work.

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