



DAMS ARE UNRENEWABLE

A Discussion Paper

Community Research and Development Centre
Nigeria



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SECTION ONE

INTRODUCTION

Controversy exists on whether dams should be included in the list of renewable energy sources or not. I could remember in an international conference held in Nigeria in 2004, organized by One Sky, a Canadian organization, this issue caused a very hot argument. Even up till date, in many publications, dam technology is still counted among the renewables. We are aware that there are different types of dams, that is, small and large dams. Some are of the opinion that small dams are renewable sources of energy while the large dams are not renewable.

For the benefit of stakeholders who may not be familiar with the term dam, 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.

The building of dams started long time ago. The Sadd-el-kafara Dam, built in Egypt is believed to be the oldest dam in the world. It was built in about 2700 B.C., located on the Nile River about 20 miles south of Cairo. Also, by 1000 B.C. the Assyrians had built dams across the Tigris River near Samaria and other places in Mesopotamia. The Romans also built many dams which the best known is the Cornalido earth dam north of Merida in southern Spain. The remains of earth embankment built for diverting water to large community reservoirs can still be found in Sri Lanka and Israel (Schnitter, 1994; McCully, 1996). After the fall of the Roman Empire, the act of building dams hardly advanced until the end of the sixteenth century.

The construction of dams of appreciable heights and storage capacity became possible after the development of cement concrete and the mechanization of earth-moving and material-handling equipment. The last century witnessed a dramatic increase in the construction of large dams. By 1949, about 5000 large dams had been built worldwide, three-quarter of them in industrialized countries. Today, over 45,000 large dams had been built in over 140 countries of the world (ICOLD, 1998). The top five dam-building countries are China, United States, India, Spain and Japan and they account for nearly 80% of all large

dams worldwide. China alone has built around 22,000 large dams, the USA over 6390 large dams, India with over 4000 dams and Spain and Japan with between 1000 and 1200 dams each.

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 the Nigeria. The effect of the sahelian drought of 1972 – 1975 aggravated 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. The objectives of this paper are to appraise the performance of dams with particular reference to the Nigerian situation and provide a platform for the development of new policies on water development projects in Nigeria and elsewhere.

SECTION TWO

IMPACTS OF DAMS

Ecological impact of dams

The World Commission on Dams (2000) reported that 60% of the World Rivers have been affected by dams and diversions. The impact of dams on the ecosystem include the physical, chemical and geomorphological changes that occur when a river is blocked and altering the natural distribution and timing of stream flow. Dam construction also causes changes in primary biological productivity including effect on riverine riparian plant life and downstream habitat. The construction of storage dam and the subsequent inundation of the reservoir area effectively kill terrestrial plants and forest and displace animals (WCD, 2000). Dam construction results in decrease in water quality and variable changes in the seasonal timing of water yield (Bruijnzeel, 1990).

Emission of Greenhouse Gases (GHG)

The emission of greenhouse gases (GHG) from reservoirs due to rotting vegetation and carbon inflow from the catchments is a recently identified ecosystem impact of storage dams. Estimate suggests that the gross emissions from reservoirs may account for between 1% and 28% of the global warming potential of GHG emissions (WCD, 2000). This challenges the conventional ideal that hydropower produces only positive atmospheric effects such as a reduction in emissions of carbon dioxide, nitrous oxides, sulphuric oxides and particulate when compared with other power generation sources that burn fossil fuels (Bosi, 2000). This implies that all reservoirs emit GHG.

Alteration of Flow Regime

Storage dam alter the natural distribution and timing of stream flow. Flow regimes are the key driving variable for downstream aquatic ecosystem. Flood timing, duration and frequency are all critical for the survival of communities of plants and animals living downstream. Impoundment may result in a variety of downstream modifications that may be important to its physico-chemical conditions and the stream biota. The specific changes that occur when a river is dammed depend on a complex series of interactions resulting from operation and construction of dams (Ogbeibu, 2002). These changes compromise the dynamic aspects of rivers that are fundamental to maintaining the character of aquatic ecosystem.

Biodiversity Loss

Dams have led to the loss of aquatic biodiversity, loss of forest and wildlife habitat and species population. Dams disrupt the movement of species leading to changes in upstream and down stream species composition. Many river-dwelling species have several migratory patterns. For example, adult of anadromous fish such as salmon migrate up stream to spawn and the young descend. While for catadromous fish such as the eels, the adult migrate down stream and the young ascend upstream. Dams block these migrations. This is one of the most significant ecosystem impacts. Change in the physico-chemical properties of water bodies due to dam may lead directly to the death of aquatic biota (WCD, 2000).

Social Impact

The lives of many people and societies have been negatively affected by dams. An estimated 40-80 million people worldwide have been physically displaced by dam (WCD, 2000). In China alone, 10.2 million people were displaced between 1950 and 1990 (ADB, 1999). Though, independent source estimated that actual number is much higher than the official figure with 10 million people displaced in Yangtz Valley alone (Jing, 1999). Among the projects involving displacement funded by the World Bank, large dams account for 63% of displacement (World bank, 1996). Indigenous people and ethnic minority suffer disproportionately as they lack citizenship, tenancy or land tenure papers.

The failure of dams has also led to displacement of many people, and even in many cases cause the death of some. In Nigeria, the Ojirami dam in southern Nigeria, failed in 1980 and affected two communities, Enwan and Akuku. Many people in Enwan and Akuku communities lost their houses and other property worth millions of naira to the huge flood plunging the communities into serious housing problems. Those who once lived in their houses have been forced to relocate and now live in rented houses. It also led to the problem of overcrowding in many houses. Up to 30 persons living in houses meant for 10 persons (Ogbeide et al, 2002).

Gender-Related Impacts

It has been extensively documented that there is gender inequalities in access and control of economic and natural resources. In Asia and Africa, women may have the right to use land and forest but are rarely allowed to own or inherit the land they use (Mehta and Srinivasan, 1999). For affected communities, dams have widened gender disparities either by imposing a disproportionate share of social cost on

women or through an inequitable allocation of the benefits generated. For instance, when the Mahaweli dam in Sri Lanka was built, the prevailing rule which allowed women the independent right to co-own and control land was undermined by a new arrangement that allow the house hold to nominate one heir usually a son (Agarwal, 1996).

Impact of Cultural Heritage

Dams have adversely affected the cultural heritage of many communities through loss of cultural resources (temple, shrines, sacred elements of the landscape, artifacts and buildings). The submergence and degradation of archeological resources (plants and animals remains, burial sites and archeological elements are other significant cultural impacts of dams. Dams can also cause loss of or damage of cultural heritage through land reclamation and irrigation project. During the construction of the Inanda dam in South Africa, remains of human bodies buried under the reservoir site were exhumed and all buried in one hole profoundly disturbed local communities (Gwala, 2000). The risk of submerging ancestral graves is one of the reasons the Himba people in Namibia opposed the planned Epupa dam (WCD, 2000).

Health Related Impacts

Environmental change and social disruption resulting from the construction and operation of large dams and the associated infrastructure developments such as irrigation schemes can have significant adverse health outcomes for local populations and downstream communities. Among the resettled, access to drinking water, health services and ability to cope with new social and physical environment determines health conditions. Numerous vector-borne diseases are associated with reservoir development in tropical areas. Schistosomiasis (or Bilharzias), for instance, spread through snails breeding in still or slow moving waters was a significant public health problem that emerged from many water development projects.

Out of the 323 dams in Nigeria, 47 (15%) have been surveyed for the presence of local snail intermediate host species of schistosomiasis, while 11 were investigated for human infection. Findings shows that 20 (43%) of the 47 dams harbour the intermediate host of the disease. Human infection was recorded in 10 out of the 11 investigated for human infection (Ofoezie, 2002). Rift valley Fever has also spread due to the presence of Aswan and Kariba dams and irrigation systems along the Blue Nile in Sudan (Jobin, 1999). Most reservoirs and irrigation projects undertaken in malaria endemic areas increase malaria transmission and disease. The increase was more pronounced

for dams below 1900 meters of altitude and less pronounced above that altitude (Government of India, 2000)

SECTION THREE

DAM DISASTERS IN NIGERIA

There have been several cases of dam-related disasters in Nigeria displacing thousands of people and plunging them into poverty and destroying properties.

Shiroro Dam

Over 26 villages in Kede, Lakpma and Shiroro Local Government in Niger State were flooded by the waters from Rivers Niger and Kaduna in 2003. The flood displaced about 10,000 persons in Ketscho in Kede Local Government who were said to have moved to Kwara State, while other 13,500 person in Lakpam and Shiroro were rendered homeless. In the affected areas, houses, property, farm produce and animals were destroyed by the flood which struck in the early hours of Saturday 11th September, 2003. The flood resulted from a downpour and the release of excess water from the Shiroro Hydro-Electric Dam by the National Electric Power Authority (NEPA). The affected villages include Galadima Kogo, Gofa, Kusasun, Pai, Lagado, Nakpinda and Karai. The people suffered for the sacrifice they made by releasing their land for the construction of the Shiroro Dam for the good of the nation. (This Day, September 16, 2003)

Similarly in 1999 at least seven local government districts in the state were flooded when water from the Shiroro Dam was released. Thousands of houses and buildings in the state, including schools and hospitals were either destroyed or damaged in the disaster. Eight people were killed and 2,215 displaced in flooding in Kano State, in northern Nigeria.

Obudu Dam

The Obudu Dam spillway was damaged by storm in July 2003 which resulted in fatal disaster that claimed over 200 houses, several farmlands, settlements and business concerns. The disaster was allegedly caused by the release of excess water from the Lagdo Dam in Cameroun, which overflowed Benue and Niger River banks. Besides the release of excess water from Lagdo Dam, expert attributed the disaster to intensive and non-stop rainfall in Obudu on the fateful day for 16 hours. The rainfall recorded at the Obudu Dam meteorological station was 314.5mm, more than 15 years average rainfall for the peak months of July and September, which was not anticipated for when the dam was constructed. The cumulative effect of these events, led to the overflow of all water courses including the ones leading to

Obudu Dam. The excessive flood discharge and load on spillway channel lead to the failure of the dam.

Then, the estimated cost of rehabilitating the dam and completing the outstanding works on the irrigation area was valued at about ₦350m (approximately \$2.8m). The dam was commissioned in 1999 to provide water for irrigation to indigenes of the area that are predominantly farmers as well as serves recreational and tourism purposes. It was also constructed to create employment to the youths through fishing. Moreover, water from the dam was to be treated and supply water for the people. The people forwarded an appeal to the government to urgently come to their rescue. They expressed the fear that if the spillway was not rehabilitated before the next rainy season, the entire Obudu may be taken-over by flood (Daily Champion October 23, 2003) .

Igabi Dam

Property worth about ₦500 million (\$3.9m) were destroyed while thousands of people were rendered homeless in Kaduna State when River Kaduna overflowed its banks and submerged several streets and housing estates. The flood was caused by the collapse of Igabi Dam. Affected by the flood are Mamman Kotangora Estate, Kirgo Road extension, Kabala area and parts of Malali Estate. At the Mamman Kotangora Estate, household items including rugs, television sets, fridges, chairs, tables and other expensive electronics were damaged when water from the river submerged most of the houses there. Several mechanic workshops, grocery stores and pharmaceutical shops were also submerged.

At Kirgo area, apart from household items, maize and sugar cane farms were also destroyed. It was learnt that a manual irrigation system constructed by some farmers in the area made it possible for the river water to submerge places like Mamman Kotangora Estate and Kabala area. Apart from churches and mosques which were destroyed, the Nsukka town hall located at Kirgo Road extension was also affected.

SECTION FOUR

SOCIO-ECONOMIC AND ENVIRONMENTAL PERFORMANC OF SMALL DAMS

The general notion that only large dams have adverse impacts on the environment and livelihood has been proven otherwise by study carried out by Ogbeide et al (2003) on Ojirami Dam. In this session, I am presenting this case study on Ojirami Dam which is a small dam (from the standard definition by International Commission on Large Dams) to show that small dams equally have adverse effect on people and the environment.

Ojirami Dam

Ojirami dam is located in Ojirami Community in Akoko Edo Local Government Area in the northern part of Edo State, southern Nigeria. It is the first dam that was constructed in the state and was funded by the Federal Government of Nigeria. The foundation stone was laid on the 26th of March 1971 and was commissioned on the 20th of January, 1974 by the then Head of State, Gen. Yakubu Gowon. The dam was constructed across River Onyami which flows into River Ose. Akoko Edo region is a basement terrain, having several of exposed basement rocks of granitic origin. The people are mainly farmers and occasionally engage in fishing, though their fishing has been marred by the presence of the dam especially by people downstream.

The height of the dam is 3.9m with a storage capacity of 900,000 gallons. The main purpose of the dam is to supply water to the communities in Akoko Edo at an output capacity of 245m³/hr. At the construction of the dam, it supplied water to sixteen communities in Akoko Edo which included Ojirami, Ojirami Petesi, Ojirami Afekunu, Dagbala, Uneme-Eturu, Akuku, Enwan, Igarra, Okpe, Ikao, Ugboshi, Okpilla, Ibillo, Uneme-Osu, Ojah and Osoro. By 2003, the dam could supply water to only eight of the sixteen communities which include Ojirami, Ojirami Petesi, Ojirami Afekunu, Dagbala, Uneme-Eturu, Akuku, Enwan, and Igarra. The reason for the drop in coverage is due to increasing demand by the inhabitants of the benefiting communities which has gone beyond projection.

Ecological Impact

As is the case with many regulated streams, Onyami River over which the dam is constructed is not allowed to flow naturally. According to the dam officials, the flood gate is locked most of the time during the dry season to retain water in the reservoir. Consequently, the down

stream part of the river is starved of water, which has marred fishing activities downstream. For this reason, fishing is only possible in the reservoir and in the upstream session of the dam. Fishing at the downstream is now seasonal being possible only during the raining season. During the raining season, the flood gate is left open which according to the dam officials, is a strategy to prevent the dam from overflowing since the volume of water increases during this wet period of the year. The water is allowed to flow more constantly to the downstream part to control the volume of water in the dam reservoir.

Social Impact

Before the construction of the dam, the inhabitants of the communities where the Onyami River served depended on the river for water and aquatic food. As at 2003, the dam supplied water to only eight communities reducing the coverage area to 50% of the initial coverage area when it was commissioned over two decades ago.

Ojirami dam failed in August 30th 1980 and inundated two communities- Akuku and Enwan. The failure was due to technical breakdown and negligence on the part of the dam official on duty. Three years before the flood, the electronic switch controlling the flood gate was out of function and was operated manually. Moreover, before then, no alarm was installed to give warning to the officials and communities when the water exceeded its limit in the reservoir. An alarm was only installed after the dam failed.

Many people in Enwan and Akuku communities lost their houses and other property worth millions of naira to the huge flood plunging the communities into serious housing problems. Those who once lived in their houses have been forced to relocate and now live in rented houses. It also led to the problem of overcrowding in many houses. The people say that up to 30 persons now live in houses meant for 10 persons. Although the flood did not directly lead to the death of any person at the time of the failure, yet, many persons may have died due to the traumatic experiences caused by the flood.

In Akuku, as many as 185 houses were destroyed by the flood. Government neither relocated nor resettled them. Government however gave the affected people food stuff and mats two weeks after the incident and never rebuild their houses. The then governor awarded the contract to build ten houses to a contractor, the contractor built the houses to different stages, and none was completed and till date. Yet, the communities pay so much to get connected to the main water supply.

Economic Impacts

Several hectares of farmlands containing cocoa trees, yams, maize, etc, were destroyed by the flood resulting from the failure of the dam. Grocery shops were destroyed. Many families now have to spend so much money paying rent; such moneys would have been spent on other things when they still lived in their houses. The victims are now out of business and barely survive.

SECTION FIVE

ALTERNATIVE TECHNOLOGIES

Many alternatives exist for the supply of water and electricity. These alternatives include renewable energy sources such wind, ocean wave and tides, solar, biomass, and geothermal energy. They are 'renewable' because they are regularly replenished by natural processes and are therefore in endless supply. They also can operate without adversely affecting the environment. In combating climate change and poverty, new renewable energy sources create a decentralized option that generate jobs and income and empowers local communities and strengthens self reliance.

Wind power is the fastest growing of the renewable energy option and is competitive with other conventional options when a government support is provided as an incentive. Global annual growth installed capacity of wind turbine averaged 40% between 1994 and 1998 (IEA, 1998). Europe has 70% grid-connected wind capacity, North America about 19%, Asia about 10%. About 45% of European wind capacity is installed in Germany. In addition to wind, solar, biomass and ocean energy system (waves, tidal energy, and ocean thermal) have application for grid power.

Water supply options include rain water harvesting, desalination of marine water, wastewater recycling. In 1999, enough water was recycled in the Bay Area of California to meet the needs of 2 million people (WCD, 2000). Desalination contributes to water supply in 120 countries with 60% of the 11000 desalination plants being located in the water-scarce Middle East. Thailand is typical of the increasing number of traditional rainwater harvesting technologies that have been upgraded to provide affordable and sustainable supplies (WCD, 2000).

Renewable Energy Potential in Nigeria

Nigeria has high potential to harness energy from renewable sources. The country falls within the tropics of Cancer and Capricorn where there is abundance of sunlight. Unlike the conventional energy resources, solar energy development is not as capital intensive. Therefore, it is fundamental to proffer the strategy of diversifying energy resource development outside the conventional energy resource. This means that, adequate funds should be channeled towards the development of other non-conventional, less capital intensive and non-hazardous energy resources in Nigeria. With the abundance supply of solar energy in Nigeria, efforts need to be geared towards research

and development of solar electricity generation.

The development of wind power plants is being undertaken by many countries for the generation of electricity in their quest to exploit renewable energy sources and Nigeria should not be left out. With wind energy available at an annual average speed of 2.0 m/s near the coast to 4.0 m/s at the northern borders, the country possess enormous potential to develop and utilize energy from the wind for electricity generation. The coastal regions of the south and the northern part of the country are possible suitable sites for wind energy exploitation. There is need to embark on research to determine actual values for wind energy potential.

The potential for bioenergy development is high. Nigeria has all the vegetational regions of West Africa except that of the desert. Agriculture is the dominant economic activity, which contributes 41% of Nigeria's GDP and employs the highest labour. Roughly 75 percent (74 million hectares) of Nigeria's total land (98 million hectares) is arable and about 40 percent of this is cultivated, leaving the remaining 60% of arable land idle. Nigeria's farmland is cultivable and would have medium for good productivity if properly managed. Policy, institutional and technological approach is inevitable to harness bioenergy potential in Nigeria.

Conclusion

Although hydropower is easily replenish naturally and is abundant in supply, the adverse effect on the environment and livelihood is a significant factor that should be considered. Considering the later aspect, it is unsustainable source of energy. Therefore, there is need to intensify and exploit other renewable options that are more environmentally friendly than dams, whether small or large dams. The notion that only large dams have adverse effect on people and the environment should be discarded. Dams in general should be seen as unrenowable and it is time the world begins to look away from dams and exploit other options such as wind power, solar, biomas and ocean energy system to produce electricity. For water supply, rain water harvesting, desalination of marine water, wastewater recycling are better options.

It is recommended that:

- Policies be developed that will foster the development alternative sources of energy such as wind, solar and bioenergy.
- The government should increase access to energy especially in the rural areas using renewable energy.
- The government should encourage the importation of renewable energy and energy efficiency products by making them duty-free.
- The government should develop good management practices of energy generating facilities.
- Increase awareness on the Kyoto Protocol and it flexible mechanisms especially the Clean Development Mechanism.
- The Nigerian government should take advantage of the provision in the Clean Development Mechanism to achieve sustainable development.

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