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Water Resource Management: Dam Collapse and its Implications on Agricultural production in Kankia, Northern Nigeria

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Abstract: Water is an essential resource for all forms of life on the planet Earth. But only three per cent of water is fresh despite the fact that there are many users of the world's fresh water. This makes it imperative to manage water resources especially in developing countries where there is high rate of population growth and large percentage of the population depend on agriculture as their source of livelihood. This paper examines loss of water resources through dam collapse and its implications on agricultural production in semi arid region of northern Nigeria. Data for the study were generated through field visit to the dam site to make observations on the collapsed dam and examine its impact on the local people and livestock. There were also field visit to another dam site about eight kilometers away where some of the farmers migrated. This was complemented with interview with the farmers, people of the area and snapping of pictures of the dams' sites, farmland and gardens. The results have shown that the dam collapse led to loss of water resources which has implications such as destruction of farm lands, loss of dry season farming opportunities, loss of water and pasture for livestock, movement of livestock away and migration of some farmers to another dam site. This paper therefore recommends rehabilitation of the collapsed dam, periodic maintenance and timely release of excess water during the rainy season to effectively manage this water resource.

Keywords: Water resources, Management, Dam collapse, Implications, Agricultural production

INTRODUCTION

Water resource management is the practice of planning, developing, distributing and optimum utilizing of water resources under defined water policies and regulations within a given country or region. Water resource management has to ideally regard all the competing demand for water and seek to allocate or share water on an equitable basis to satisfy all uses and demand for water. Water is an essential resource for all forms of life on the planet the fact that there are many users of the world's fresh water. This makes it imperative to manage water resources especially in developing countries where there is high rate of population growth and large percentage of the population depend on agriculture as their source of livelihood.

Water resources are the planet's most precious resource because it is life-supporting as living organisms needs water for their existence and sustenance. Water resources include all natural water on the earth, whether in gaseous, liquid or solid forms. Water bodies also contain plants, animals and materials that are valuable to man. The two types of water resources are ground water and surface water. Ground water includes water from natural springs, boreholes and wells. Surface water includes rain water, lakes, rivers, reservoirs, seasons and oceans (Ladan, 2009).

The importance of water resources to man cannot be overemphasized. These include provision of water for domestic use, agricultural production, fishing, transportation, industrial uses, hydro-electric power, recreation and tourism, minerals etc. Furthermore, according to the World Bank (2014) every development challenge of the 21st century such as food security, managing rapid urbanization, energy security, environmental protection, adapting to climate change require urgent attention to water resources management.

A dam is a man made structure built across sections of a river or stream to retain water and the water is generally used for agricultural purposes such as irrigating farmlands, garden and watering of livestock (Lodha, 2007). A dam can also be defined as a barrier constructed across a stream or river to

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impound water and raise its level for various purposes such as water supply and raise its level for various purposes such as water supply and irrigation systems increase river depth for navigation, generating electricity, control water flow during times of floods and droughts, create artificial lakes for fisheries and recreational use. However many dams are multi-purpose and fulfill several of these reasons outlined (Uyigue, 2006).

Dam collapse is when the man made structure built across a river or stream carve in leading to the escape of retained water away from the dam site. It occurs when the barrier constructed across a river or stream collapses leading to the flow of impounded water away from the dam. Dam collapse, sometimes called dam failures can be comparatively rare but when they occur can cause immense damage to properties and loss of life. In 1975, the collapse of Banquio reservoir dam and other dams in Henan province, China resulted in more casualties than any other dam collapse in history. Some of the recent collapses include Tokwe Mukoris dam in Zimbabwe that collapses on 4th February 2014 due to downstream slope failure and the collapse of a natural dam created by huge landslide across Sankoshi River in Nepal on 6th September 2014 due to geologic movements in the area (Sharma and Harris, 2014).

The collapse of dams has implications on river or stream flow, on the people leading to displacement, destruction of structures, installations and properties and lives, and agricultural production.

In Nigeria, a number of dams have collapsed over the years in different parts of the country. In July 2003, the Obudu dam collapses when the spillway was damaged by storm resulting in a fatal disaster that claimed over 200 houses, several farmlands, settlements and business concerns (Uyigue, 2006). In September 2006, the Gusau dam, a reservoir on the Sokoto River collapsed killing 40 people and about 500 homes were destroyed, displacing 1,000 people (BBC 2009). In September 2010, Goronyo dam in Sokoto State collapsed as the dams spill way completely failed causing widespread flooding of settlements and farmlands. The Kankia dam located in Kankia Katsina state collapsed on 2nd August 2013 destroying crops worth millions of Naira (the Nigerian currency) as was widely reported by the media including the News Agency of Nigeria (NAN) and the Nigerian Television Authority (NTA).

Some level of attention has been given to small dams or earth dams by scholars in Northern Nigeria. One of these studies is the study by Chii (2010),who undertook an integrated two dimensional geophysical investigation of an earth dam Zaria area Nigeria. Another study by Saleh et al (2010), examines economic impact of dam construction, the challenge and solution to agricultural productivity in Nigeria using the case study of Tura dam in Mashigi village in kankara Local Government Area of Katsina State. This study assesses dam collapse and its implications on agricultural productivity in kankia, Katsina State. The aim of this paper therefore is to undertake on site assessment of the dam collapse and its implications on agricultural production in the area.

THE STUDY AREA

Kankia (or Kankiya) is a town in Katsina State Northern Nigeria that is the headquarters of Kankia Local Government Area created in 1975. Kankia is located on latitude 12º33' north of the equator and longitude 7º48' east of Greenwich meridian. The town is situated on Trunk A federal highway from Katsina to Kano, 60 kilometers from Katsina, the capital of Katsina state and 100 kilometers from the commercial city of Kano (plate No. 1).

Kankia was founded about 300 years ago by a group of Habe hunters as a stopover point for Arab and Tuareg traders who came from as far as Egypt and Agades (Niger Republic) on their route from the then commercial centre of Katsina (Yusuf, 2006). The Habes were hunters as the area had a lot of wild animals. Also water was available, the land was good for farming and there were trading activities with the Arab and Tuaregs which serve as favourable conditions that attracted more people to come and settle in Kankia (Bawa, 2012). The Habes continue to rule the area up to the time the Fulanis took over.

Kankia has a long history and over the years had risen to the status of Kankia district and later the headquarters of Kankia local government after the local government reforms of 1975. The local government is one of the 34 in Katsina State with an area of about 2,186 square kilometers spanning 21 village areas or wards (Yusuf,2006). Kankia local government area has two districts, Kankia and Rimaye and the area has a total population of 131,395 people, made up of 77,061 males and 74,334 females, according to the 2006 census final results released by the National Population Commission (Bawa, 2012).

In terms of physical setting, the relief of the area is typically that of undulating low and lying between the Sokoto basin to the west and Borno plains to the east. The climate is Tropical Continental with long dry season of 7 – 8 months in a year and shorter rainy season lasting on the average from June to September. The mean annual rainfall is between 760 – 800mm highest temperatures are experienced in April and May with a value of about 37ºC. The land is fairly fertile with flooded plains in different areas as the soils are very deep well drained soils of sandy

loam surfaces with sandy clay (Babsal and Co., 1998). The Ichimani stream and series of ponds constitutes the drainage of the area.. The Kankia dam which is an earth dam built on this stream mainly for agricultural purposes.

The people are mainly subsistence farmers that cultivate millet guinea corn, maize, beans, ground-nut and cotton using rain- fed agriculture. Vegetables such as tomatoes, pepper, onion, garden eggs are cultivated on irrigated farmlands and gardens. Some people engaged in trading and commercial activities in Kankia and through visiting local markets within and outside Katsina State. There are also other people who are civil servants that work in Government establishments.

Figure 1:Map of Nigeria Showing Kankia

METHODOLOGY

The data for the research study was generated through field visit to the dam site on 30th March 2014. Observation on the dam and the collapsed section was made, the location of the dam in between settlement, farmlands and gardens were assessed. Using a digital camera, pictures of the dam and the gardens that used to be irrigated using the dam water were snapped, farmers that used the dam water for irrigation were interviewed as they are the target population. The interview question are on what time the dam water is used, the type of crops cultivated and the implication of the collapse of the dam is having due to the loss of irrigation water.

Field visit was also made to two other irrigation sites where some of the farmers have migrated. These two sites are beside a pond along Dutsin-ma road in Kankia and at a dam site at Sagawa village, 8 kilometers away from Kankia. At these sites farmers were seen at work and interviewed using the same questions asked to the farmers at Kankia. The gardens at Sagawa and dam were snapped and pictures were incorporated into the paper.

Secondary sources of data were collected through desk research from internet web sites related to the subject. Other sources include published journal articles, discussion papers, environmental reports and presented conference papers. The data collected was then edited to suit the guidelines of paper presentation for international water technology conferences. Descriptive analysis was employed to analyze the data with the aid of maps and pictures.

RESULTS AND DISCUSSIONS

The Kankia Dam

The Kankia dam is an earth dam built on the Ichimami stream found at the northern frontier of the town. The dam was constructed along the course of the stream which is a small tributary of River Gada. In Kankia Township and its environs, the stream gave rise to pockets of ponds and ditches that contain water mostly during the rainy season.

The dam was established in 1997 to retain rain water of the Ichimami stream for use for agricultural purposes. The dam has a total length of about 6 kilometers, covering a wide area of about 40 hectares based on field observation on the dam site. The creation of the dam is important as the area is largely semi arid where rain falls for only few months while most of the months are dry. Therefore the dam water serve as a source of water supply as it recharges wells and ponds in the area. Farmers interviewed estimated that around 500 farms and gardens uses the water of the dam for irrigation to produce crops such as maize, rice, beans, pepper, tomatoes, garden eggs, lettuce etc. There were also fishing activities that were carried out by the inhabitants of the area. A research assistant who is an indigene of the area attest to this by recalling that as a child they use to come in group to the dam for fishing. Fishermen interviewed revealed that they catch fish in both rainy and dry season which they sell at Kankia market.

The Collapse of Kankia Dam

The Kankia dam collapsed on 2nd August 2013 when part of the dams embankment collapsed and according to the resident of the area it is the first

incident of collapse experienced since the construction of the dam in 1997. According to International Federation of Red Cross and Red Crescent Societies' Information Bulletin (2013), the seasonal heavy rains in August 2013 have resulted in a lot of rain water flowing into earth dams. This has resulted in over filling the dams leading to the collapse of earth dams like that of Kankia. There are others that also collapsed in the neighbouring Kaduna State which include Kubau and Birnin Gwari earth dams (IFRCRCS, 2013). The heavy rains that filled the Kankia dam resulted in part of the dam's embankment collapsing and the water forced its way out of the dam into farmlands, gardens and open fields downstream. The collapsed dams' embankment can be seen on the figure 2 below

Figure 2:Section of the collapsed embankment of Kankia dam

A factor that is attributed to the collapse of most earth dams in Nigeria is lack of periodic maintenance as the dams need to be maintained to check its embankments and spillways. According to Chii (2010), earth dams need periodic inspection and monitoring against the development anomalous seepage paths either through the embankment, foundation or the abutment materials. However in the case of Kankia dam, the Caretaker Committee Chairman recalled that the dam was recently rehabilitated by the Federal Government of Nigeria under the constituency project of Member of Parliament representing the area, but still the dam collapsed (Ibrahim, 2013). The Chairman appealed to the representative to call the contractor back to site to reconstruct the embankment and widen the water spill way to avert future occurrence.

Implication of the Dam Collapse on Agricultural Production

The Kankia dam is primarily established for agricultural purposes to supply water to farmlands/gardens, supply water to cattle and serve as fishing ground to the local population. It is based on this that the paper highlights the implications of the dam collapse on agricultural production.

Destruction of Farmlands

The collapse of the dam led to the flow of water in torrents into farmlands behind the collapsed embankment. Farmers interviewed estimates that about fifty (50) farms were destroyed when the dam water flows into the farms and flooded them. Furthermore the farmers observed that the water washed away most of the top soil and soil nutrients that support plant growth. The farmlands close the dam suffered more destruction due to the high velocity of the water that uprooted maize, guinea corn, beans and groundout crops which were planted during the rainy season.

Loss of food crops

The affected farmers lost all their food crops that were planted on the farms which were washed away by the torrents of water from the collapsed dam. Rice and maize farms were washed away following the collapse of the dam. These two food crops are the main staples of the people who are subsistence farmers that consume most of what they produce

during the rainy season. Furthermore these farmers also lost the opportunity to produce crops during the dry seasons as the irrigation water is no longer available due to the collapsed dam.

Shortage of water supply

The community of Kankia who are mostly farmers largely depends on the dam water for supply of water for domestic purposes especially during the dry season. The Kankia dam recharges underground water that people dig wells and boreholes to obtain water for domestic purposes particularly during the dry season when water is scarce and there is no rain. Field visit to the area reveal that many wells and boreholes close to the dam site that usually contain water before the dam collapse, do not contain water after the collapse. Furthermore people now have to dig deep to reach the water table. The people of Kankia have for many years been experiencing shortage of water supply, the collapse of the dam has made a bad situation worse.

Shortage of water for cattle

The dam use to be source of water supply to farmers who rear cattle that live in Kankia and herdsmen who are nomadic in nature that do come to the dam site with their cattle to drink water. The herdsmen also graze their cattle as grasses do grow along the banks of the dam. However, the collapse of the dam has forced the herdsmen to move their cattle to the neighboring villages of Kusada and Charanchi local government areas in search of water. During field visit to the dam site, three groups of herds of cattle numbering about sixty were observed to be moving on the plain of the dam in search of water.

Loss of fishing grounds

The dam serve as fishing ground to fishermen that set traps in the dam water to catch fish for home consumption and for sell. The collapse of the dam has resulted in the movement of the dam water away and no fish can be found on the dried dam. According to Ibrahim (2013), fishermen were negatively affected by the collapse of the dam as fish stocks were carried away with the escape of the water. All fishing activities were put off by the floods and during the dry season there were no fishing activities at the time when fishing was seen going on at Sagawa dam,8 kilometers away from Kankia.

Physiological stress to plants and animals

During field visit to the dam site it was clearly observed that plants that were planted in a garden behind the dam embankment were in serious physiological stress due to lack of adequate water supply (See Figure 3). This garden uses the water of a puddle behind the collapsed embankment as source of water supply. The growth of the onion, tomatoes, pepper and garden egg and beans that were planted in the garden have being drying and the growth of the crops have become stunted. It was also observed that lower animals such as goats and sheep were observed to be scavenging on the remnants of grasses that could still be found on the dam which is quite inadequate for the large number animals that were seen there.

Figure 3:Garden crops showing symptoms of physiological stress behind the dam embankment

Migration of farmers to pond and dam sites

The collapse of the dam has devastated the source of livelihood of many farmers in Kankia. Some of these farmers have migrated to an area adjacent to a pond along Dutsinma road where they use water pumping engine to draw water that is supplied to gardens and farmlands. But the pond has started to dry as at the time of field visit and some of the crops have started drying. The farmers have then dug a borehole that they are drawing water from for the plants.

Some of the farmers from the Kankia dam have migrated to another earth dam site at Sagawa village, about eight kilometers away from Kankia. The Sagawa dam was also visited and the dam contain water with series of activities were seen to be taking place there. These activities include people using jerry cans to collect water, drawing of water to irrigate garden crops, fishing activity and herds of livestock entered the dam to drink water (see Plate No. 3). One of the irrigated gardens of onions and beans could be seen on Figure. 4. Irrigation farmers interviewed reveal that they have farmland at Kankia which they could not irrigate due to the collapsed dam. Therefore, they have to come to Sagawa and rent farmlands for dry season farming.

Figure 4:Sagawa dam with herds of cattle in it and a fisherman behind them.

Figure 5: An irrigated garden of onion and beans close to Sagawa dam

The present condition of the dam

Field visit to the dam site for data collection was held in March 2014. In May 2014, the dam was rehabilitated by rebuilding the collapsed embankment and with the rainy season beginning in June, the water starts to recollect in the dam. However, once again after a heavy downpour of rain in the month of August 2014 the rehabilitated embankment collapsed again. He rain water that collects during the 2014 rainy season flows out of the dam. It is quite clear that the contractor that was awarded the contract for the rehabilitation of the dam did a shoddy job which leads to the collapse again this year.

RECOMMENDATIONS

The following recommendations are made in order to rebuild and manage the Kankia dam as it is an important water resource in a semi-arid environment.

The Kankia dam should be rehabilitated by rebuilding the collapsed embankment and this time a very credible contractor should be awarded the contract, so that the dam does not collapse again.

Once rehabilitated the dam should be periodically inspected and monitored so that the embankment and spillways are constantly checked particularly during the rainy season when large quantity of water collects in the dam.

There should be the employment of technical personnel that will be engaged in the supervision of the dam and its condition during the rainy season so that excess water is timely released out of the dam to avert any possible collapse in future.

The Federal, State and Local governments in Nigeria should work towards ensuring that water resources especially small and large scale dams are properly managed, as their collapse not only leads to the loss of water resources but also causes destruction of lives and properties.

The Federal and State governments should provide relief materials to the farmers affected by the collapse of Kankia dam who suffered loss of farmlands and food crops with a view towards rehabilitating their shattered lives.

CONCLUSION

Water resources are the planet's most precious resources as all living organism needs this resource for their existence. However, presently in different parts of the world water resources are becoming scarce, overstretched and not well managed to ensure their optimum use. In Nigeria, there are many earth dams that were built and utilized for various purposes particularly in the semi-arid northern part. These dams are vital resources as they enhanced the socio-economic life of the people of the areas they were established. Recently some of these dams have been collapsing with severe implication on agricultural production of these areas. There is therefore the urgent need to rehabilitate the collapsed dam before the coming of 2015 rainy season, engage in periodic maintenance and releasing excess water on time during the rainy season to ensure effective management of this water resource.

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