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Impact of Gafan Dam Construction and Its Adverse Socio-Economic Effects on Bunkure Local Government Area of Kano State

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Abstract:
Human activities through large scale irrigation and dam construction significantly impinged on the ecology of the area. Measurements taken show that the dam is about 630m long, 9m high and has a head of water of 7.10m at the time of this study. It has been observed that the construction of Gafan dam consequently resulted to the impoundment of valuable land and created a serious problem to the inhabitants, approximately over 100,000 hectares was cleared for dam construction development. It was found that substantial flooding was evident in the downstream resulting in the drying-up of Fadama wetland, canal and valley side erosion leading to the eventual break down of Dan hassan–Kura road. Similarly, meadow and stems around the water course, were uprooted due to the force of the raging flood. It has also been observed that the intense overflow from the reservoir were as deep as 2.5m. Moreover, measurement taken within the lake demonstrated an inundation of 1.5m in the surface and 2.6m in the narrower central spillway. However, the runoff, which was observed and believed to be not less than 3.6m deep had eroded a massive portion of the downstream resulting to soil losses and water, about 4.9 kg m year $^{-1}$ was observed. Similarly, the observed sediment discharge was approximately 48%.

Keywords: *Dam construction, irrigation, flooding, erosion*

1. Introduction

Many current studies have made a considerable progress in understanding the impact of dam construction on the natural environment (Singer et al. 2014), Kamayama (et al. 2013), Ghosh and Guchhait (2014), Wajid et al. (2013) and Hansen et al. (2014). While few other studies have reasonably explored the effects of dams on stream flow Yongbo et al. (2014), Xu et al. (2014) and Bartley et al. (2014).

Wildi (2010) observes that small dams and related basin have prominent consequences on water dynamic and soil. Further investigation revealed that studies on dam construction disregarding its socioeconomic effects is an issue of debate among scholars.

Lin (2011) argued that Dam construction is a major engineering practice with a view to determine the association between human being and water. In the conventional hydraulic engineering large dams and waterways were constructed with the intention of deriving enormous benefits.

In a related development Ghosh and Guchhait (2014) reported that major changes on streams have occurred by fluvial engineering constructions such as sluice, embankment, canals, weirs and dams with a view to control the river surge and to further harness water supply in a fruitful manner.

Wu et al. (2004) noted that dams have caused important habitats' destruction and modify the environment that badly impinged on both aquatic and terrestrial biodiversity. Habitat disintegration entails a decline or loss of habitat and lessen habitat connectivity.

Ghosh and Guchhait (2014) observed that streams are believed to be an essential storehouse of climatic, anthropogenic and hydrological alteration since the fluvial system is the main susceptible part of the globe and any change in ecological form initiate a quick reaction from the fluvial system. Thus, dam construction and other configuration on the stream destroy its earlier natural body and force the fluvial system to penetrate into a new stage of stability with varying aggradations and degradation progression.

Marcus et al. (2012) argued that in developed countries dam construction declined in recent times because of the preponderance of cost effective and feasible scheme have been previously practiced. However, increasing knowledge of the ecological and societal brunt of dams as well as changes in philosophy has become a major issue that influences a thorough assessment of the dam project.

In several emergent countries, for instance, Lin (2012) noted that the savanna and woodland ecosystem of the flood plain depend entirely on recurring inundation from streams. Also, overflow recession and cropping is widely put into practice whereby the soil is refined taking benefit of remaining soil wetness subsequent to inundation retreat. More so, dams and its overflow intensity may negatively have an effect on agriculture and ecosystem.

The study of dam construction is of great scientific and practical importance Dias et al. (2014), Nadeu et al. (2014), Yang et al. (2014) Kano state have at least twelve (13) operating dams and reservoir of different capacity, roughly with no efficient spillway system and at the same time served the purpose for studying a number of wonderful issues in dam construction. Based on this background therefore, the aim of the study is to assess the impact of Gafan dam construction and its adverse socioeconomic effects on Bunkure Local government area of Kano state.

2. The Study Area

The study is confined to Gafan Dam, Bunkure Local Government Area of Kano state. It is approximately 53km away from Kano State and located on longitude $10^0$22E and latitude $14^0$2N with an elevation of 433m. The dam was constructed around 1980 across the River Yuri, a branch of river Shimar where a huge stock of cattles, sheep and goats coming in to drink water from the dam. However, the water from the dam is harness for irrigation purposes and an area of over 100,000 hectres under cultivation throughout the year. The main crops grown include rice, wheat, tomato, pepper, and onion.

Statistical analysis revealed that the mean annual temperature is about 28^0C during the hot season (April-May) but drastically declined to 20^0C during the harmatan period (November-February) with an annual rainfall of 1000mm. The rainfall season, generally starts from May-September lasts up to early October in some occasions. Relative humidity is normally between 90%, but a thorough assessment of this condition suggested that the humidity fluctuate over time around November with the onset of the harmatan season decreasing to 20-23% in some occasion.

3. Methodology

The research was an observational study to independently assess the impact of Gafan dam construction. The dam was repeatedly monitored over a period of seven (7) years between (2007-2014) as well as field measurements involving morphological parameters of the dam such as length, width and depth were carried out and recorded manually, water level at Gafan dam were also recorded during the period of this study. Additional hydrological considerations were established from stream examination such as water discharge, sediment intensity and height of the water.

4. Results and Discussion of Findings

The result of the study reveals that human activities involving large-scale irrigation and dam construction have an effect on the ecology of the area. Intensive farming practices on the relatively flat moorland has adversely affected the ecosystem to a very large extent. So also, saturation of water affects several portions of the irrigated field and a reduction in nutrient level was also observed.

As in most cases, dams are constructed with the intention to generate power for industrialization programme, flood control, irrigation and other household purposes, but the reverse is the case with the Gafan dam where the water is only harnessed for irrigation and domestic uses without any consideration for hydroelectric development.

Investigation reveals that the reservoir has a total capacity of 12.19million and attained its optimum capacity at three different periods, that is 1992, 2008 and 2011 rainfall season where massive flooding and erosion was detected during the aforementioned seasons due to the structural intrusion into the flood plain, eroded sediment and reservoir siltation. This consequently resulted in destruction of crops, bridges and settlements. However, during the 2011 rainfall season the incidence of flooding from the reservoir caused a severe motor accident around Dakatsalle bridge where (40) lives were lost.

It has been observed that the construction of Gafan dam has created a serious problem to the rural population, including the impoundment of extensive and valuable land, approximately over 100,000 hectares was cleared for dam construction development. Human activities around the catchment area involving farm clearance, movement of grazing animals, and deforestation resulted in widespread erosion of the catchment gradient. These consequently, trigger-off gully erosion and the gully is about 3.6m deep with some patches of meadow of different species inside and around the gully was also detected. During the period of this study, it has been observed that the dam is about 630m long, 9m high and has a head of water of 7.10m.

In the downstream, massive flooding was apparent resulting in the drying-up of Fadama land, canal and valley side erosion. The aeration of Fadama terrain and basin resulted in severe erosion as the current in the affected water way is lesser down stream. So also during this period the water table is lower, less than the significant useful stage for Fadama wetland and this adversely affect dry season irrigation. Further investigation revealed that the phase of the channel is too narrow for valley side fluvial action. Based on this background therefore, erosion is widespread downstream of the dam opening a knick point which retreat head wards.

The incidence of this phenomenon resulted to the collapsed of Dan-hassan-Kura road. Reconstruction of the road affects the ecosystem as well as the flora and fauna and this is a line with the observation of Geneletti et al. (2002) where he argued that road networks, are greatly responsible for the reduction in both the quality and amount of natural habitat. Similarly, the reduction of the majority of the habitat takes place when a natural ecosystem is transformed into a non-natural system, as it occurs in a highway construction.

It was also found that great quantities of mud blocks and sand eroded from the bank has been deposited as an extensive and deep alluvial stretch in the channel downstream. Meadow and stems around the water course was uprooted due to the force of the raging flood. The intense overflows from the reservoir were as deep as 2.5m. Moreover, the main current of the water inflow into the lake seemed to have been positioned further to its western part. Measurement taken within the lake demonstrated an inundation of 1.5m in the surface and 2. 6m in the narrower central spillway.

Ishaya et al. (2009) observed that flood prone regions owing to severe occurrence in natural rivers posed a dilemma among scholars. However, Duvail and Hamerlynck (2003) argued that the main familiar effect of the dam downstream is the decline of inundation and for that reason, a decrease in the rate, degree and length of floodplain inundation may likely occur. This yearly decrease in down stream overflow might trim down the normal efficiency of flood plains and deltas.

It was also found that the runoff, which was observed and believed to be not less than 3.6m deep had wear away a massive portion of the downstream resulting to soil losses and water, about 4.9 kg m year $^{-1}$ was observed. Similarly, the observed sediment discharge was approximately 48%.

Fearnside et al. (2001) noted that sedimentation signifies a possible and durable setback for efficient function of the dam, with repercussions for hydroelectric advancement. Water quality in the lake is the most important problem. Since plants decay in the impoundment, mutually beginning from the woodland residue left uncut, while the overflow washed out the marine wild plants that grow on the surface.

5. Adverse Socioeconomic Effects of Gafan Dam, on Bunkure Local Government

Mudzengi (2012) reported that the creation of dams has caused general socioeconomic impact on the population. Similarly, Kamayama et al. (2013) noted that the construction of dams has little positive impact which include flood control, production of electricity and management of water supply. Furthermore, upstream control of water release may harmfully influence conventional agricultural scheme and fisheries.

Therefore, the adverse socioeconomic effects in the study area include the following

(i) Loss of reservoir water on which the animals and dwellings entirely depend on, both for domestic and irrigation purposes due to flooding.

(ii) Breakdown of the communication bond between Bunkure Local government and Chirin village linking to the south and western parts of the settlement generating a serious adversity to the inhabitants who now have to devised a meandering route, Garum through Baba village for their daily activities.

(iii) The spillover effect of the reservoir trigger-off flooding downstream, resulting in the obliteration of farm crops and significant erosional damage to the Shimar bridge.

(iv) Loss of lives, properties and settlements of the dwelling

6. Conclusion

The study illustrates that the construction of Gafan dam and large scale irrigation affect the ecology to a very large extent. Dam construction development in the study area consequently led to the impoundment of valuable land and exert a severe problem to the rural population. Over 100,000 hectares was cleared for the purpose of dam construction Measurements taken show that the dam is about 630m long, 9m high and has a head of water of 7.10m. It was found that considerable flooding was observed in the downstream resulting in the drying-up of Fadama wetland, canal and valley side erosion leading to the collapsed of Dan-hassan–Kura road. Similarly, grasses and stems around the water course were dislodged due to the force of the raging flood. It has also been observed that the intense overflow from the reservoir were as deep as 2.5m. Moreover, measurement taken within the lake demonstrated an inundation of 1.5m in the surface and 2. 6m in the narrower central spillway. However, the observed runoff was at least 3.6m deep had eroded a massive section on the downstream resulting in soil losses and water, about 4.9 kg m year $^{-1}$ was observed. Similarly, the observed sediment discharge was approximately 48%.

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