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Economic Effects of the Failure of Kandesha Dam on Local Communities in Mumbwa District, Zambia

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ABSTRACT

Despite of undoubtful economic contribution to the nation, sometimes dam causes sufferings due to uncertain breakage. The study investigated the economic effects of the breakage of Kandesha Dam in the far West of Lusaka Business District. It shows that the magnitude and intensity of the impact of dam breaking is dependent on the anthropogenic activities downstream of the dams. The most notable effects of the breaking of Kandesha dam included loss of income (24%), reduced working capitals among community members (14%), due to disturbed business activities resulting from the rampant flooding (12%). Generally, the findings showed diversity of economic effects following the breaking of the dams. The paper recommends regulation of human activities on the immediate downstream in order to minimize the ultimate impact of the dam breaking. Landscape-based assessment of catchment in order to understand the biophysical processes and human activities before siting and constructing dams would potentially reduce the risk of future breaking of dams and, could further immunize several economic losses on both government and community members part.

INTRODUCTION

Dams have been built for thousands of years and served multiple purposes to harness water for hydropower, domestic use and industrial purposes (Warren and Robin, 1993). Benefits of dams include food security considerations, expansion of roads and other infrastructure elements important for micro and macroeconomic developments. Reliance on dams in many places resulted in grouping of industries, people and capital, increasing production intensification and population density. Although dam construction brings positive gains to the people, at the same time it brings some laudable environmental, economic and social challenges to the society. For instance, ecological problems such as changes in water quality, channel morphology, aquatic flora and fauna, growth of aquatic weeds, spread of waterborne diseases and resettlement of people in river basins are rampant. Prior studies show that more than 250 communities annually lose their home and farmlands around the world due to dams breaking (Newswatch, 2001).

It is no mere exaggeration that dams contribute to the economic growth of many nations. Dams built round the world have played an 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 those dams generate 19% of world electricity (World Commission on Dams, 2000). Warren and Robin (1993) show that creation of large reservoirs inevitably brings a lot of changes in its wake, such as agricultural innovations in the form of modern large irrigation, improved fishing as well as infrastructural facilities such as health, roads, modern housing, electricity and water supply.

The breaking of the Kandesha Dam in Mumbwa District on the far west of Lusaka disrupted over 700 families

and over 4000 people in the area due to heavy rainfall that happened in December 2020 and early 2021 (Red Cross, 2021). The overarching research question was, what were the economic gains and losses from the failure of the Kandesha Dam on communities living on the downstream? It is hoped that, the findings of the study may be of use to scholars around water education, dam management and water economists. The findings may also be used to establish a criterion for mitigation of breaking of dams, particularly those used for agriculture, fishing and irrigation. The study also brought out education issues that may inform environmental educators.

LITERATURE REVIEW

A case study of Chalillo Dam located on the Macal River in Belize, Central America shows that as with all infrastructure development, the dam presents direct costs and benefits to the country of Belize, while also placing externalized costs on the local communities supported by the Macal River and the surrounding environment. The environmental impact of the dam post construction was analyzed more than economic impact. However, there is an information gap in the economic impact even in the Chalillo Dam based on the interpretation of the communities on the downstream (The World Commission on Dams, 2000). This is attributed to Belize being a small country where funding limits the priority of economic impact. Economic impacts are not limited to assets in the inundation area, but extend to infrastructure and resources that serve a much broader area. In addition to direct damage from dam failure, economic impacts include the amount of time required to repair or replace and reopen businesses, governmental and nonprofit making agencies, and industrial facilities damaged by the dam failure (Jansen (1999). The consequence assessment provided in the study accounts for a variety of direct

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and indirect economic consequences. Direct economic consequences include the costs of repairing damage and replacing lost items. Indirect economic consequences include the loss of jobs, the loss of sales, and the cost of securing alternative space for residential or business purposes (Jansen, 1999). Ekenberg, Brouwers and Vari (2003) carried out a study in Austria on the social impacts of the dam failure. The finding was that social impacts of the breaking of the dam can range from emigration of people who have lost jobs to immigration of workers to help with repair and rebuilding. Social impacts include a shortage of safe, affordable housing. On the other hand, it includes loss of confidence in public officials, loss of social cohesiveness, and loss of recreational opportunities, decreased level of government supported community services, and diminished quality of life, as well as identification with new communities and discovery of new social opportunities.

The study by Jansen (1999) in Brazil also identified potential social impacts of breaking dams, including loss of housing, jobs, social organizations, recreation, culture, mental and physical health, loss of government service, and political climate. Thomas (2006) conducted research in the Netherlands to identify the environmental impacts of a dam failure. Findings were drawn that it depends heavily on the information gathered regarding properties in the area and also the nature of human activities especially on the downstream.

In their respective studies in Nigeria and Cameroon

(Dunning and Durden, 2009) also show that biophysical, engineering and human factors tend to affect dam breakage with several economic consequences similar to those earlier mentioned. A study carried out in South Africa by the Department of Homeland Security (2011) on the Dams Sector: Estimating Economic Consequences for Dam Failure Scenarios showed similar trends. Federal Emergency Management Agency (2008) carried out research on Risk Prioritization Tool for Dams. In this approach, specific emphasis is laid on the treatment of potentially high losses associated with dam breaks in Uganda. These losses occur rarely but bring heavy impacts in case of dam break.

Causes of dam failure in Zambia include faulty design or construction, use of substandard materials, over-topping due to surplus water, deliberate sabotage or because of severe shakings. In some cases, where the dam structure might remain intact, the neighboring hillsides crumble having the same effect as the dam collapsing. Sediment transport and sedimentation data in dams is widely documented by Sichingabula (1997); Muchanga (2011) in the Luangwa Catchment; Muchanga (2017), Muchanga *et al.* (2019), Mphande and Sichingabula (2019) in Mkushi District, Muchanga (2020); Hamatuli and Muchanga (2021) in Central Province, Simweene and Muchanga (2022) in Monze District. However, these and many other studies within Zambian context focus on the problem that may likely contribute to breaking of the dams and, not necessarily the breaking and related consequences.

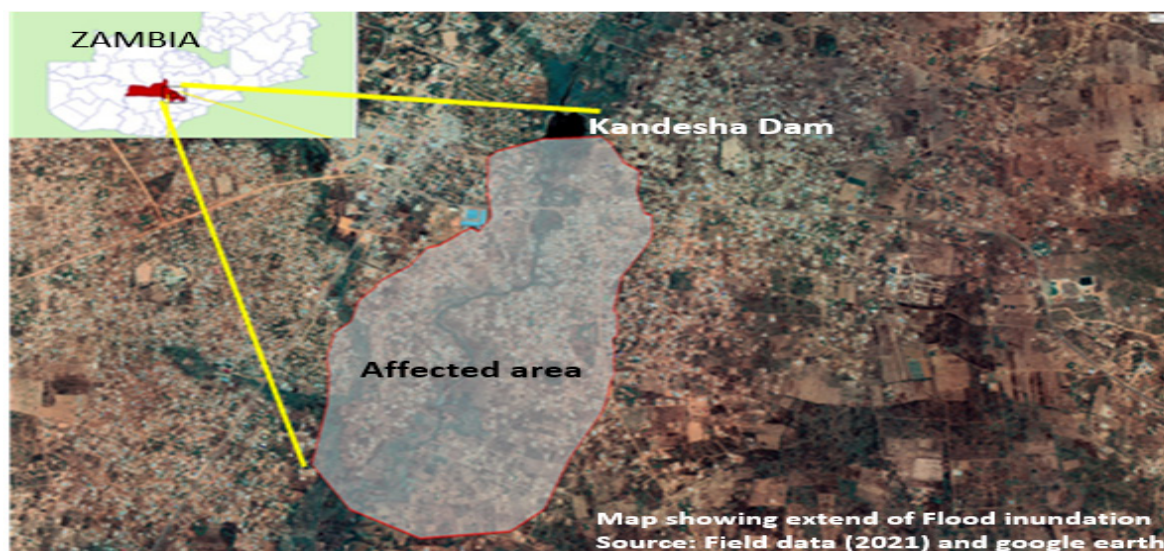


Figure 1: Map showing extend of Flood inundation

MATERIALS AND METHODS

Mumbwa District is located at latitude -14.987983 and longitude 27.069540° in Mumbwa District, far west of Lusaka Central Business District, at an elevation of 1200 meters above sea level and with approximate catchment size of 11 Km². The mean annual rainfall is between 800-1000 mm. Dwellers in the catchment engage in both rain-fed and irrigated farming, fishing, gardening, small scale business activities of different types, among

others (DMMU, 2020). The study was methodologically informed by qualitative research methodology which involved getting opinions, views and feelings of the parties involved. Specifically, a descriptive survey design concerned with a rich and clear description of events relevant to the study (Bryman, 2008). In this study, the sample size comprised 130 people from surrounding communities downstream of the Kandesha Dam, 40 were fishermen, 60 were farmers and 30 were small scale

business personnel downstream of the dam. The selection of participants was done using the purposive sampling technique. In this case study, the researchers interviewed relevant and selected people using semi-structured interviews with the aid of online google form. The qualitative data was analyzed using Descriptive statistics in form of graphs and Narrative Analysis for qualitative data. This was done by transcribing the interviews, summarizing and highlighting the key themes in the narratives.

RESULTS

The study finding on type of family to which participants belonged suggest that, extended family living could have been the most spatially distributed among the communities downstream of the Kandesha Dam. This could be noticed from the earlier findings by Red Cross (2021) and had implications on the magnitude of the impact of dam breaking.

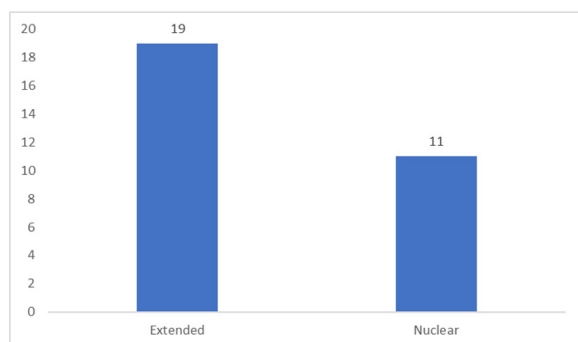


Figure 2: Type of family living to which participants belonged

Effects of the breaking of the dam

The study found that, the breaking of the Kandesha Dam led to loss of standard means of livelihood such as fishing and market gardening which were dependent on the availability of water in the Dam. Businesses were negatively affected by the breaking of the dam. Some of the perspectives shared by the participants were as shown in Figure 3 and as illustrated in some verbatims.

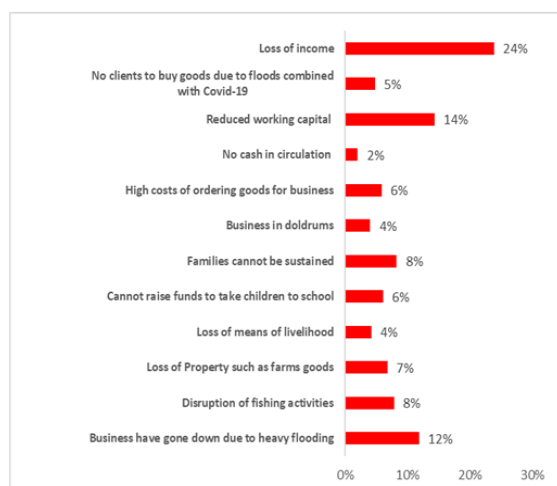


Figure 3: Tabulated effects of dam failure on local communities

“The breaking down of the dam made the transaction levels in my business to go down as there is less cash circulation within the area now.”

“The mortality rate of fish was very high hence, there was little or no fish for me to catch. Then there is this COVID-19, which has already stressed us because people cannot move frequently, so this has really affected us”

“We are flooded and I lost my goods, my livelihood depends on fishing. Breaking of the dam has impacted my businesses negatively as this is my major source of income which helps me take my children to school and helps me to take care of my family in general.”

“My daily income has drastically reduced. My business in the doldrums, many people lost most of the businesses as they had plantations near the dam this really had a negative impact as many people could not buy as compared to the past thus, my business was slow in return not generating enough profits, hence making ordering costly.”

“I could not make as much income as I used to make before the dam was broken. It has affected my income since the yields have gone down as water has drained and has developed a mud near the torrential flowing river bordered by mud and sand that had been under water. I am unable to get the things I need for my business because I don’t have the capital anymore.”

Temporal coping strategies

Following the breaking of the dam, the victims resolved to temporal alternative means of livelihood such as small-scale businesses namely, piece works, selling vegetables and opening grocery shops ‘tuntamba’; mobile money kiosk. Mobile money business seemed to have been the quickest means of coping with the breaking of the dam (Figure 4).

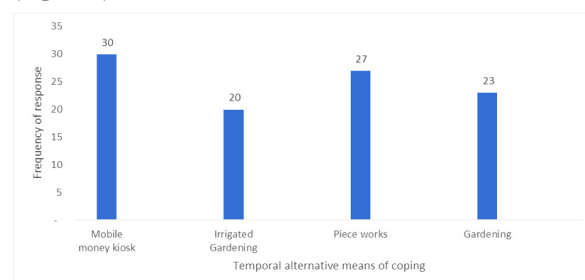


Figure 3: Temporal coping strategies after the breaking of the dam

RESULTS SYNTHESIS

The breaking of dams comes with diverse challenges especially on families which are already socioeconomically disadvantaged. For most sedentary farmers, dams form the main plinth of economic activities such that if dams are removed, it is more like removing the very source of income. Earlier studies By Sichingabula (1997); Muchanga (2017) show similar evidence from southern Zambia. The study from Kandesha Catchment clearly demonstrates that if not well managed, dam breaking could have far reached consequences beyond torrential

flooding and high discharges to disruption of school attendance, declining in profits and working capitals as well as poor circulation of cash. The study was done at the pick of COVID-19, which according to Muchanga *et al.* (2020) ravaged most of the families in Zambia and also led to drastic loss of income for many physical business-dependent rural families. The breaking of the Kandesha dam worsened the mental stresses, which people were already going through. It was also noted that, many varieties of fish species in the dam were carried away downstream such that some species died reducing the fishing activities in the area and eventually, family income and business activities. Whilst earlier cited case studies seem to focus on the large-scale infrastructure losses and engineering cost of restoring dams (World Commission on Dams 2000; Ekenberg, Brouwers and Vari, 2003; Jansen 1999; Dunning and Durden, 2009), the case study from Kandesha focused on how the poor and often excluded families were affected by the flood. The findings actually seem to suggest that, many of the local communities may not be concerned about the economic and engineering costs of the breaking of the dam on the government coffers, but rather on their own local wellbeing. This means that local people may need to be sensitized about the cost of constructing such infrastructure and to discourage them from any activities that may punctuate dam breaking. High turbidity was also noted by the participants and significantly affected the quality of water in flooded shallow wells and also streams. The Red Cross and the DMMU played a significant role in the provision of emergency help in food, clothes and beddings. They also played an evacuation role for affected families some of which were made to stay on top of the house roof up to 24 hours before the arrival of rescue team. These were the only supposed gains from the dam breakage.

Having lost their sources of income, many families resolved to alternative means of livelihood as narrated by the participants, the most predominant being operating of mobile money kiosks. The contextual policy implication of this study is that, the government must integrate precise spatial planning strategies in the siting and construction of dams in order to prevent and minimize the impact of dam breakage downstream. As earlier study by Thomas (2006) shows, the magnitude and intensity of dam breaking is mainly dependent on where humans and their activities are located. Meaning if they are far away from the buffer zones of the downstream, the impact would be moderate. The study perspective therefore disagrees with earlier suggestions by Sickingabula (1997) that such human activities as gardening must be downstream because in case of dam breakage, there would be a large-scale loss of means of livelihood as was the case in Kandesha Catchment. Instead, they must settle downstream away from the banks of the dams. Moreover, the government must ensure that, local people adopt permanent alternative means of livelihood that would keep them away from the buffer zones of the dams. As the Climatic

changes are projected to worsen in the next half century (Chisanga *et al.* 2022), there is also need to adopt whole landscape-based management of catchments in order to have a clearer understanding of biophysical and human dimensions in the management of dams and prevention of such disasters as the Kandesha Dam breakage, Chisola *et al.* (2020) recommends this approach.

CONCLUSION

The study generally concludes that, the breaking of the Kandesha Dam had detrimental economic effects on the economic standing of the local people who lost means of livelihoods. The most common challenge was loss of income, especially for those who were directly dependent on the dam. Going beyond this case study, the findings suggest that, human settlements must be discouraged on the immediate downstream of the dams in order to reduce the risk of loss of life, property and means of livelihood. The study was inherently limited by a small sample given that, by the time fieldwork was being conducted, there were COVID-19 restrictions such that many people could not be accessed. The study was inclined on qualitative dimension thus rendering it highly subjective, hence, the study epistemically suggests detailed quantitative studies on the cost-benefit analysis of breaking of dams among interested researchers locally and internationally.

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