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Dam-induced displacement and resettlement: Reflections from Tokwe-Mukorsi flood disaster, Zimbabwe

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1. Introduction

Large infrastructure development including dams usually involve diverse stakeholders with different interests [1]. On the one hand, some proponents of large dams usually envisage multiple benefits likely to be brought by the project [2]. On the other hand, opponents of certain dam projects may base their arguments on perceived negative socio-economic and irreparable environmental impacts [3,4]. Nevertheless, dam development can positively and negatively affect surrounding communities in many direct and indirect ways. The direct benefits include hydropower generation, flood protection, irrigation, industrial and domestic water supply, fishing, tourism and employment creation [2]. For example, about 21% of large dams in the world were built for hydroelectricity generation [5]. These include the Three Gorges Dam in China - the world's largest hydropower dam, and the three cascading dams (Manwan, Dachaoshan and Xiaowan) on the Upper-Mekong River [6]. In some cases, the direct benefits can trigger additional benefits such as enhanced nutrition, secondary employment, and enhanced gross domestic product [7]. Notwithstanding these benefits, some large dams generate very few economic benefits but create high economic and social costs, and environmental damages on local communities [2].

The diverging views of interested parties in dam projects can create either internal conflicts (among project designers, developers and owners) or interface conflicts (between the project and the affected population groups) [8]. Depending on their management, the conflicts may cause long gestation periods and interrupt construction work, thereby delaying completion of the projects [9]. To reduce such disputes, Mahato and Ogunlana [8] recommended three strategies: public acceptance of the project, adequate compensation and resettlement, and information sharing with the affected population groups. Despite these strategic options, large dams may still create other serious undesirable impacts on local communities, if they are not carefully planned. For example, Wang et al. [10] found that the cascading dams on the Upper-Mekong River, China widened the gap of wealth at the household level. Food production declined to family consumption levels at best, and landholding of some relocated villagers decreased as well. Careful planning of dam projects include conducting a social impact assessment (SIA) and preparing resettlement action plans (RAP) well before the construction of the dam [11]. These two can enable planners to identify or predict and mitigate any undesirable impacts of infrastructure development on host communities [12,13].

Physical and economic displacement of locals, inundation of their farms and destruction of their livelihoods are among the possible negative impacts of dam projects [6,14]. Physical displacement is when the affected people can no longer reside in their previous places, while economic displacement involves the disruption of people's livelihoods although they can remain in the same place [15]. The World Commission on Dams reported that dams displaced between '40 and 80 million' people worldwide in the past century [16]:104). In China alone, dams displaced 10.2 million people between 1950 and 1990, while close to 23 million people were cumulatively displaced by 2006 [10,16]. Where physical displacement has been involuntary or involved coercion and force, infrastructure developments have further induced trauma, joblessness, homelessness, marginalization, and community disarticulation [15,17]. In Yunnan, China, displacement was closely related with diminished social capital which was measured by exchange of financial resources and agricultural labour at household level [14]. In the Mekong River basin, Kura et al. [18] observed that hydropower projects differently impacted the livelihoods of the displaced households. When compared to well-off families, poor households needed additional support to rebuild their livelihoods in the resettlement areas. The authors concluded that dam-induced resettlement needed to consider some tailored approaches to supporting households with lower capacity for adaptation, rather than providing homogenous compensation packages. Dam projects can also impoverish host communities by destroying their productive assets, disrupting their social fabric, reducing their incomes and access to ecosystem services [14,19]. Richter et al. [20] investigated impacts of dams on livelihoods of downstream communities affected by dam projects along Kafue (Zambia), Xe Bang Fai (Lao PDR) and Omo

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(Ethiopia) rivers. They concluded that large dams can disrupt natural riverine production systems, chief among them fisheries, flood-recession agriculture and dry-season grazing. In some cases, the already vulnerable communities often suffer from these effects [21]. These impacts can last for many years and at times are irreversible. This can undermine the sustainability of the purpose of the dam [9].

Proper resettlement and compensation processes can mitigate the negative effects of forced displacement [15]. In their comparative study in China, Huang et al. [22] observed that dam-induced displacement and resettlement improved living conditions and promoted acceptance of rural cooperative medical insurance. The international best practices of dam-induced resettlement provides for compensation for loss of assets, inconvenience, restoration and improvement of livelihoods and social services/networks among others [23]. The Chinese government for example, awarded monetary compensation to people affected by the Three Gorges Dam at a rate many times more than their annual incomes [6]. Improving and transforming livelihoods can enhance the resilience of the affected communities [24]. However, some dam projects inadequately compensate the affected people [14]. In cases where compensation is paid, some developers often opt for monetary compensation as a way of delimiting their financial commitment, while others may under-value assets earmarked for compensation [25,26]. This can impoverish the displaced people.

This study investigated the social impacts brought by the construction of a large multi-purpose dam (Tokwe-Mukorsi) in Zimbabwe. It contributes to the conceptual discourse on socio-economic benefits and challenges associated with dam development. The study also informs ongoing policy discussions about the management of social risks associated with large infrastructure developments. Government agencies, humanitarian aid organisations and other policy makers involved in dam construction and resettlement benefit from such knowledge. The study uses Kirchherr and Charles [27]'s matrix framework to critically analyse the social impacts of the dam. The paper has seven sections. After this introduction, the next section critically analyses frameworks for social impact assessment of infrastructure development and justify its use of the matrix framework. Section 3 presents the background of the Tokwe-Mukorsi project while Section 4 describes the methods used to gather data. Results appear in Section 5 followed by their discussion in Section 6. The last section gives a conclusion of the study.

2. Frameworks for social impact analyses of infrastructure development

Several frameworks have been developed to advance the understanding and management of social impacts inherent in infrastructure development on host communities. Cernea [28] developed the Impoverishment Risks and Reconstruction (IRR) model that has been widely used in analysing risks associated with involuntary displacement. For example, Koirala et al. [29] used this model to explore social impacts of a hydroelectric project in Nepal. The Department for International Development (DFID) developed a multidisciplinary framework, the Sustainable Livelihood framework (SL) that highlights five livelihood assets (human, natural, financial, physical, and social), livelihood strategies and outcomes in an attempt to solve rural development problems [30]. The SL framework has been applied in flood resilience and vulnerability analysis of sugarcane farmers to climate change in Swaziland [31,32]. In the field of social impact assessment, Ofori et al. [33] applied the SL framework in the Volta Dam, Ghana while Kura et al. [18] used it in the Mekong River basin, Lao PDR. The World Commission on Dams developed another framework which outlines seven key strategies for prioritisation in order to foster sustainable dam projects [16]. Likewise, the Integrative Dam Assessment Model (IDAM) outlines seven variables (social cohesion, cultural knowledge and behaviour, material culture, infrastructure, income, wealth and macro-impacts) used to analyse social impacts of dam projects [34,35]. Other scholarly frameworks include the Relocation Framework [36], Social Impact Assessment framework [37], Framework of Wealth Analysis [6] and the Social Framework for Projects [38]. Although these framework have been empirically applied in different settings involving infrastructure developments, this study identified certain limitations associated with each one of them. Table 1 highlights these key limitations as well as the social impact variables/key tenets of the eight frameworks.

In view of the limitations presented in Table 1, this study found the matrix framework more appropriate for analysing social impact of the Tokwe-Mukorsi Dam. Owusu et al. [39] used this framework in Bui Dam, Ghana. Their results showed that the dam led to improvements in social infrastructure with positive multiplier effects in a spatially differentiated manner. Loannides and Bryan [40] also applied this framework in Manwan Dam, China. The matrix framework is an integration of key aspects from earlier models (including RF, IRR, SL, WCD and IDAM), [27]. It conceptualises the social impacts of dams from three key dimensions (space, time and value), and three components: infrastructure, livelihoods and community (Fig. 1) [27]. While the dimensions form the context in which the components operate, the components constitute the basic requirements for impact analysis [40]. The space dimension accounts for impacts occurring from the immediate vicinity of the project to upstream, downstream and other areas across the country and globe. This creates room for assessing impacts in resettlement places outside the river basin. The phases of a dam's lifetime (planning/design, construction and operation) form a key action arena for analysis. Impacts including landlessness, homelessness and food insecurity can occur during any of these phases. The value dimension depicts the positive or negative impacts across varied spatial and temporal dimensions. Different components of impacts within the matrix framework are context-specific and may exist anywhere within the dimensions. The components may reinforce each other, triggering benefits or challenges in the community.

The matrix framework is employed in this study because of four key reasons. First, the framework ensures a comprehensive analysis of dams' impact from unlimited spatial and temporal perspectives. This enables accounting for impacts beyond the immediate dam site into resettlement areas of the displaced families. Second, the framework promotes a balanced analysis of impacts including both positive and negative effects. Third, the matrix framework provides a list of contextually defined variables constituting the infrastructure, livelihoods and community components. In this way, the framework addresses the question of what data to collect on social impact of dams. Lastly, the matrix framework encourages scholars to consider the interlinkages of the three components. Researchers who employ this framework can systematically interpret and compare their findings.

3. The Tokwe-Mukorsi Dam project

The Tokwe-Mukorsi Dam is one of Zimbabwe's largest inland dam with a height of 90,3 m (296 ft) and a storage capacity close to 2 billion cubic metres of water spread over 7120 km^2 [41]. The dam is located in Masvingo province at the confluence of two rivers: Tokwe and Mukorsi [42] (Fig. 2). The main purpose of the dam is to supply irrigation water to downstream sugarcane commercial farms and generate 6–15 MW of hydropower.

Tokwe-Mukorsi is the first rock-fill dam in Zimbabwe. It is comprised of an upstream concrete face and twin drop-inlet structures that serve as its spillways. The two inlet structures are excavated into the rock of the abutments [43]. Each structure is a tunnel with a diameter of 6 m and length of 350 m. This enables them to discharge about 1090 m^3 of water per second. In a similar way, the outlet works is comprised of an upstream intake structure and a pressure tunnel connected to a gate shaft just after the crest of the dam. The tunnel also has a diameter of 6 m. From the gate shaft, 2 × 2 m diameter steel pipes connect through a dry tunnel to the valve house that is situated downstream of the dam. During the construction of the dam, this outlet tunnel served as a diversion route of water. Additionally, an upstream cofferdam designed as a