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Flood mitigation through hydropower dam management in Vietnam

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ABSTRACT: Vietnam is vulnerable to multiple hazards, particularly in the central region. Flood damage statistics show that this part of the country is impacted by both unfavourable terrain, and human interference leading to environmental damage. Such damage is often a result of poorly planned and managed forestry and hydropower plants. This paper examines the key vulnerabilities present in Vietnam while investigating the key problems in the development of hydropower in Vietnam; environmental impacts, design and construction of dams and the operation of dams.

Keywords: flood mitigation, forest loss, hydropower, environmental impact assessment.

1. INTRODUCTION

Human suffering has multiplied in recent years due to increased frequency and intensity of natural hazards, which are expected to rise in the coming years due to climate change. According to the World Bank, Vietnam is among the top 12 countries at risk of the five threats (drought, flood, storm, coastal 1m, and agriculture). It ranks tenth in flood risk, fourth in storm risk and second in coastal 1m risk (IRIN, 2009). In addition, according to the Global Climate Risk Index (GCRI), Vietnam was the most climate change affected country in the world for 2013, from the sixth during 1991-2011 (Harmeling and Eckstein, 2013). This risk to life and property cannot be eliminated completely; however, this research argues that it can indeed be reduced through better planned forestry and hydropower plants and better cooperation between the central government, local authorities, the private sector and communities.

Over 70% of the population of Vietnam lives in flood prone areas and is at risk of water disasters (Shaw, 2006). The focus of this research is on central Vietnam, justified by the frequent occurrence of severe floods in the region, mainly owing to its topography (Razafindrabe et al., 2014) and the lack of reliable technologies for disaster prevention and early warning (Hansson et al., 2008). On the other hand, the higher intensity of floods was primarily induced by human interference in the hydrological system (Tran et al., 2010). Side-effects of the installation of hydraulic structures such as dams should be considered more critically as they can devastate river ecosystems and undermine the rights and livelihoods of affected communities (Hansson et al., 2008). As part of disaster preparedness, we must recognize that natural hazards are an integral component our environment, and that human development must respect natural cycles and systems (Tran and Shaw, 2007).

Vietnam has more than 3,450 rivers and streams, including 10 main river basins (MORNE, 2012). The government plans to harness the hydropower potential of each one of these rivers. The maximum amount of energy that can be extracted from these rivers is 26,000MW. There have been 815 hydropower projects approved with a total installed capacity of 24,324.3MW (MOIT, 2013a). In these 815 approved projects, there are 268 hydropower plants in operation with capacity of 14,240.5MW and over 205 projects under construction with capacity of 6,198.8MW. Although the number of hydropower reservoirs is small in comparison to over 7000 reservoirs across the country, the reservoir volume is 56 billion m³, accounting for 86% of total reservoir volume of 65 billion m³ nationally (MOIT, 2013b).

In Vietnam, many residents live along waterways and their lives are heavily dependent on rivers for both agriculture and fishing. The rapid implementation of numerous hydropower plants in a short space of time would seriously affect the very existence of communities, currently densely populating riverine regions. There are 9 large hydropower plants with installed capacity larger than 60MW and 33 small and medium hydropower plants with a capacity less than 60MW on the Vu Gia – Thu Bon river system in Quang Nam province alone (Lam et al., 2013). Many households have already been disrupted and often relocated due to hydropower plants. In addition, plants have forced downstream communities to adapt to their operating procedures, defined by an unnatural cycle of flooding which defeats flood mitigation mechanisms built up over generations.

In Public-Private Partnership (PPP), a Build-Own-Operate (BOO) model is applied for hydropower plants and reservoirs in Vietnam according to Decision 30/2006/QD-BCN of the Ministry of Industry. However, the involvement of private actors in shaping the overall implementation of hydropower projects still leads to ad-hoc decision making (Suhardiman et al., 2011), while reservoir operation management of local authorities remains weak.

2. FLOOD DAMAGE STATISTICS IN VIETNAM
The scale of the problem is clearly illustrated by flood damage statistics emerging from Vietnam. We are aware that the larger the disaster and the smaller the economy, the more significant the impact (Hansson et al., 2008). The available disaster data from the Central Committee for Flood and Storm Control and the General Statistic Office suggest that flood disasters have had a severe impact on the people of Vietnam over the years, with little sign of reduction over time, in line with disaster mitigation strategies. The loss of human lives remains unacceptably high, with an annual average of deaths and missing people of 588 (see Fig. 1).

![Fig. 1: A comparison of the statistics of deaths and missing people to those injured in flooding from 1989 to 2013](image1)

![Fig. 2: A comparison of the statistics of houses collapsed and washed away to houses flooded and damaged from 1989 to 2013](image2)

The overall trend of houses collapsed and washed away has indeed reduced over the past 20 years, however, the number of houses flooded and damaged has remained relatively stable over the same period. Facing increased exposure to risk, both in living environment and agriculture production due to flood risk, but dependant on rivers for livelihoods, poor households often remain trapped in a perpetual disaster cycle (see Fig. 2). Recent figures show that central Vietnam is considered to be the area most affected by natural disasters. In 2013 alone, the region accounted for 90% of collapsed houses under flood conditions, while rice relief to the region amounted to 70% of the country’s total. Undeniably, sustainable flood loss reduction strategies are essential in the battle against poverty (Hansson et al., 2008).

3. KEY PROBLEMS IN HYDROPOWER DEVELOPMENT IN VIETNAM

Regardless of the numerous national policies, legal frameworks and national programs on forest, water resources, and environment related to hydropower and livelihoods that have been issued and implemented, flooding causes immense damage to human lives and property in Vietnam. In addition to more frequent extreme weather events due in part to accelerating climate change, a boom in hydropower development has contributed to increased flood risk through a) associated environmental impacts, b) design and construction of dam facilities and c) operation of dam facilities.

3.1 Environmental impacts

From 2006 to October 2013, 205 hydropower projects in 27 provinces and cities were implemented that utilised 19805.3 hectares of forest to build hydropower plants in which 3189.2 hectares were allocated to special-use forest, 4717 hectares to protective forest and 11899.1 hectares to production forest (Cao, 2013). The Central Highland region (Kon Tum, Gia Lai, Dak Lak, Dak Nong, and Lam Dong provinces) annexed the highest forest area for hydropower with 7952.2 hectares (Vietnam Administration Forestry, 2013). On average, 2.35 ha of special-use forest are lost for 1MW of power. For example, the Buon Tua Srah hydropower project needs 1000 ha of evergreen forest to produce its 86MW installed capacity (PanNature, 2013).

Only 3 out of 27 provinces have carried out reforestation under the guidance of Circular 24/2013/TT-BNNPTNT by the Ministry of Agriculture and Rural Development (MOARD) on the regulation of reforestation when converting forests to other purposes (Cao, 2013). Besides the loss of forest due to the development of hydropower, Vietnam has suffered severe deforestation due to two other major reasons: (1) illegal loggers can easily penetrate the forest core due to more suitable terrain being available after hydropower construction, and (2) ethnic minorities communities are often removed to resettlement sites and clear additional land for cultivation (Nguyen, 2013). When deforestation occurs, vulnerability to flooding invariably increases.

In the past, the government has not released official figures or research to report total numbers of households that are relocated in order to make space for hydropower projects in Vietnam. Undoubtedly the numbers are high, given that 91,100 people were displaced by the Son La hydropower project alone, the largest hydropower project in Vietnam. The majority of these people were not provided with arable land or with sufficient production support required to restore their livelihoods (Bui et al., 2013). These conditions are increasingly common in resettlement sites. In addition, the poverty rate for those resettled is particularly high; Song Tranh 2 plant (60.3%), A Vuong plant (80.5%) and Dak Mi plant (93.3%) (Dinh, 2013).

There is a lack of cooperation and control in hydropower from state management agencies. The majority of small and medium hydropower projects do not comply with integrated water resources management, while investors consistently aim to maximize profits. Unfortunately, public concerns are regularly neglected. At present, there is no unified management agency for all dams in
Vietnam. Various government agencies are responsible under law for reservoir dam management. MOC maintain construction quality across the board, MOARD specifically manage irrigation works, MOIT oversee hydropower projects with capacity greater than or equal 30MW, and provincial authorities manage hydropower projects with capacity less than 30MW and irrigation dams with height lower than 5m.

3.2 Design and construction of dam facilities

Water resources in river basins should be a community asset. However, in Vietnam these resources are being used for the benefit of investors. There are 5 river diversion hydropower projects in central Vietnam and many “run-of-river” hydropower projects, aiming to exploit the terrain elevation difference between two locations to increase power generation, seriously impacting both residents and the ecology.

The National Technical Regulation on Hydraulic Structures No.04-05:2012 of the Ministry of Agriculture and Rural Development stipulates that the ecological flow that must be passed through the dam is 90% of minimum flow in the dry season. This dam design regulation requires that adequate bottom outlet work needs to be included in the dam’s design. However, most hydropower plants in the Central Region do not have bottom outlet works in the dam body to discharge water in the case of the reservoir level being below the death level (Nguyen, 2013). The bottom outlet work not only has the role in discharging the ecological flow but also contributes to dam safety in flood and sand discharge. The existence of bottom outlet work depends on the design and on the investor’s decision.

The river diversion in Dak Mi 4 project has led the Vu Gia river to run out of water during the dry season and created a major conflict regarding water use between the investor and Da Nang residents. Dak Mi 4 is supposed to discharge 25m³/s through the spillway for Vu Gia river according to the guidance of the Prime Minister in Report No.75/BC-CP. However, Dak Mi 4 presently discharges only 5m³/s due to electricity generation optimization. In addition, the area was affected by a disastrous flood in November 2013, one in a series of catastrophic floods in Vietnam, which incurred huge losses of lives and property (see Table 1).

<table>
<thead>
<tr>
<th>Year/Unit</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of deaths and missing</td>
<td>40</td>
</tr>
<tr>
<td>No. of injured</td>
<td>20</td>
</tr>
<tr>
<td>No. of houses collapsed and washed away</td>
<td>225</td>
</tr>
<tr>
<td>No. of houses flooded and damaged</td>
<td>242,973</td>
</tr>
<tr>
<td>Areas of rice fields flooded</td>
<td>1,078</td>
</tr>
<tr>
<td>Areas of short-term crops flooded</td>
<td>1,827</td>
</tr>
</tbody>
</table>

3.3 Operation of dam facilities

The topography of central Vietnam is very steep toward the sea, with few large plains, or forests to contain water. As a consequence, rapid flooding is a common occurrence. Meanwhile, the construction of large reservoirs, which have the ability to effectively reduce flooding for downstream communities in this region, is very difficult due to terrain limitations. Therefore, the potential for hydropower projects to significantly address flood control tasks in the region is limited. Specifically in the Ba river basin, the flood discharge frequency is 28,483m³/s, roughly equivalent to the flood discharge of Da river at Hoa Binh dam (large government operated dam). However, the flood prevention capacity in the Da river is 7 billion m³, compared to 165.9 million m³ at Ba Ha reservoir (Government of Vietnam, 2010). This demonstrates that while reservoir operation procedures in central Vietnam can ensure dam safety, it is not necessarily a preferred safety procedure for downstream residents.

In most reservoir operation procedures, the regulation is that 2 hours prior notice be given before discharge occurs. The rainfall observation network is very sparse in the Central region. For example, there is only one station (Ban Don) in the Srepok river basin. In addition, rain gauges are measured only every 12 hours (at 7pm and 7am). In Decision No. 929/QĐ-TTg dated on 22/6/2010, the Prime Minister determined that the standard of hydro-meteorological observation stations must be comparable to developed countries and that over 90% of the stations must be automatic. However, meteorological forecasting has not been given due attention and, without a close collaboration between forecasters and hydropower operators, it will be difficult to move towards greater efficiency in downstream flood control.

During the central Vietnam floods of 2013, all hydropower reservoir operators claimed that they complied correctly with operation procedure. However, the residents who suffered the severe consequences of flooding did not absolve the operators of responsibility. Residents have limited access to information relating to reservoir operating and flood discharge procedures. In addition, local authorities lack specific provisions to empower communities to seek compensation from owners, both the legal right and a mechanism to appeal.
4. CONCLUSIONS AND RECOMMENDATIONS

When considering the hydropower development process, it can be seen that weakness in management and planning invariably lead to an increase in flood risk in central Vietnam in particular. Hydropower plays an important role in maintaining national energy security in Vietnam; however, there are many shortcomings that must be addressed in the move towards sustainable hydropower development. The following actions are recommended as potential flood mitigation methods.

1. Forest management should be given immediate attention. Simultaneously, environmental issues should be managed more effectively. The Environment Impact Assessment should be reviewed thoroughly and revised. The Strategic Environment Assessment in the all river basins should be studied for sustainable development in water resources in order to ensure the equality on water usage and meet the interests of all stakeholders.

2. Following hydropower development, it is important to build the capacity of the rainfall observation network in order to enhance forecast accuracy and increase the interval notice before flood discharge. In this scenario, dam owners can make correct and rapid decisions concerning discharge and residents can make better preparations for adequate countermeasures.

3. Considering dense hydropower cascades on river systems, each reservoir must comply strictly with the reservoir operation procedure for the whole system. All reservoir dams at level three must have monitoring equipment installed that provides the observation data of water levels and discharges in reservoirs. This data must be accessed on a system that ensures that operation procedures are followed effectively.

4. It is necessary to establish a dam safety committee and build reservoirs and dams data/information management network in Vietnam with reference to http://damsafety.org and http://geo.usace.army.mil of the United States. This internationally significant research will ultimately be a great public service to the people of Vietnam.

5. REFERENCES


