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Analysis

Trans-border public health vulnerability and hydroelectric projects: The case of Yali Falls Dam

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ABSTRACT

The need for energy due to economic and population pressure has resulted in a great expansion of hydroelectric dam projects around the world, especially in Asia. These hydroelectric projects have resulted in considerable environmental, economic, and social damage. Typically, the economic development—environmental degradation dynamic has been examined. However, rarely has the economic development, environmental degradation, public health connection been made. This paper, using primary data collected from household surveys, completes the economic, environment, public health circle by examining how economic and environmental changes from the Yali Falls dam in Vietnam has impacted the health of people living in three remote villages in Cambodia.

1. Introduction

Increased population pressure and energy demand make access to clean freshwater more difficult. This statement is particularly true for Southeast Asia where population growth is among the highest in the world and the need for additional energy supply will lead to increased pressure on water resources as countries move quickly to develop hydroelectric power. For example, due to rapid economic growth in Southeast Asia, the annual energy demand for that region is estimated to be 6% to 8% (Alauddin, 2004; Alauddin and Quiggin, 2008). International organizations such as the World Bank have made major investments in hydroelectric dam construction in the belief that increasing irrigation and hydroelectric power can stimulate economic growth and lower poverty (Duflo and Pande, 2007). Availability of energy resources is compulsory for economic development projects, such as the improvement of productive sectors of the economy, education, healthcare, and water infrastructure. However, these hydroelectric dams have caused massive displacement of people, impacted the ecosystem, destroyed arable land due to salination and water logging, and altered crop patterns (Duflo and Pande, 2007). Typically, the most affected are the poorest of society, leaving them, among other negative side-effects, vulnerable to infectious disease.

The Mekong River and its tributaries, which flow from China through Laos, Thailand, Vietnam, and Cambodia are among the most important water bodies in Asia. The Se San River, which originates in the Central Highlands of Vietnam, flows south into northeast Cambodia, connects with the Sre Pok and Se Kong Rivers, and then runs down to the Stung Treng Province and into the Mekong River, is arguably the most important tributary of the Mekong. More than 60% of the Se San River drains within Vietnam, with the remainder draining within Cambodia (Asian Development Bank, 1995). The Se San is important to Cambodia, for example, the Se San and Sre Pok rivers provide 10.4% of the flow of the Mekong River at Stung Treng (Fisheries Office, Ratanakiri Province and NTFP, 2000; Halcrow, 1999; TERRA, 1999a), and the Se San, Sre Pok, and Se Kong Rivers contribute 16.7% of the flow of the Mekong River at Kratie (TERRA, 1999b). Therefore, the Se San is one of the top rivers for potential hydropower development in Southeast Asia (TERRA, 2000). For example, the 400 MW Lower Se San 2 hydroelectric dam is a newer controversial project that has been approved by the Cambodian government. This hydroelectric project, combined with the Xayaburi dam and the Don Sahong dam in Laos, are expected to impact more than 50,000 people and have significant social and environmental impacts, such as the displacement of people and a significant drop in the fish stock in the region (Chen and Narim, 2013).

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The Vietnamese government started the construction of the 720 MW Yali Falls Dam on the Se San River in 1993. The reservoir of the dam began filling up in 1998 (Fisheries Office, Ratanakiri Province and NTFP, 2000) and was fully commissioned in 2000, although some energy was produced in early 2000 (Polimeni et al., 2011). The dam is part of the Vietnamese strategy of developing renewable energy, especially hydropower which the government projects will generate up to 62% of the country's energy supply by 2020 (Sinh, 2008). The two main markets for electricity in Vietnam are the Hanoi–Hai Phong area and the Ho Chi Minh City area, each with a large number of industrial parks serving sectors such as finance and banking, agriculture, construction, and technology. A survey by the Electricity Corporation of Vietnam found that nearly 100 industrial users of electricity consume more than 1000 kWh per day (Energy Probe Research Foundation, 2008). Therefore, a major priority for Vietnam is to produce enough energy to feed their economic engine, as well as to provide electricity to rural households, of which approximately 50% do not have access to (Energy Probe Foundation, 2008). Clearly, the Yali Falls Dam has had some positive impacts for the Vietnamese society and economy. However, there are transboundary issues that must be explored.

The dam, currently the largest in the lower Mekong basin (Fisheries Office, Ratanakiri Province and NTFP, 2000), is located approximately 70 km from the Cambodian border and impacts an estimated 100,000 people living in the river basin. These people, largely rural villagers, are heavily dependent upon the river for its services, such as drinking water, water for cooking and agriculture, and fish. Additionally, the floodplain on which they live is a grazing area for their livestock and prime land for growing their crops. The Se San is important for transportation, as well as for bathing and washing clothes.

Brown, Magee and Xu (2008) explored the vulnerabilities of the poor due to hydroelectric dams in China. They used interviews and detailed economic profiles to demonstrate the negative effects of resettlement on households in the Nu River area. Moreover, the land downstream from hydroelectric dams, and thus the livelihoods of many individuals, is also vulnerable (Mohammadpour et al., 2008).

The effect of the Yali Falls Dam in Vietnam on villagers in three northeast Cambodian villages (Phnom Kok Brao, Phnom Kok Lao, and Pi) is no exception. A majority of the poor in Cambodia live in rural communities, similar to other developing countries. As such, these individuals are vulnerable to even the smallest changes in economic, environmental, and public health conditions. Therefore, village-level primary data, as opposed to national macroeconomic data, is important because the economic structures and dynamics in these communities are fundamentally different from the national economy (FAO, 2005, p. 16). The primary data collected provides information about the three villages. Furthermore, information about households and the impact of the Yali Falls Dam on these households, as well as individuals, was collected. While much of the research on hydroelectric dams focuses on their economic and environmental costs (Goldsmith and Hildyard, 1984; McCully, 1996), this paper differs by examining how human health is affected through the impact on water quantity and quality.

The paper is structured as follows. Section 2 reviews the literature on the impact of dams on public health. Section 3 describes the Yali Falls Dam in Southeast Asia. Section 4 presents the results of the survey of the rural villages of Phnom Kok Brao, Phnom Kok Lao, and Pi, the case studies for the paper. Section 5 discusses those results while Section 6 concludes the paper.

2. Impact of Dams on Public Health

The impacts of dams are complex and can be both positive and negative. Positive externalities from dams include irrigation water for agriculture, increased energy production (Biswas and El-Habr, 1993; British Dam Society, 1999), flood control, as well as increased recreational and commercial opportunities and travel. Negative externalities include resettlement of the population (Scudder, 1981; Scudder and Colson, 1982), human health impacts, declines in the fish stock, lower quality and quantity of water downstream, and reduced economic activity, particularly in rural communities. One of the major issues related to dams is the changed hydrology and ecology of downstream ecosystems, with the impact varying depending upon their purpose. Barbier (2002) developed a model to illustrate how the economic activities downstream of the dam in the Hadejia–Jama'are floodplain in Nigeria, developed to divert water largely for irrigation purposes, are affected by a reallocation of water upstream. He found that the hydrology of the floodplain would be irreversibly altered, substantially affecting the economic livelihoods of rural households living downstream. Changes in the ecology of a floodplain affect vegetation (Attwell, 1970; Sheppe, 1985), forests (Hughes, 1988), fish (Hyslop, 1988), and animals (Dunham, 1994; Nilsson and Dynesius, 1994; Obrdlik et al., 1989). The long-term changes to an ecosystem also vary greatly (Petts, 1984; Petts, 1987; Richards, 1982, Thomas and Adams, 1999).

Although ecosystem functions are invaluable and changes to these systems could be irreversible, the evaluation of dams has typically focused on their economic costs (Ojeda et al., 2008). However, these evaluations tend to overestimate the benefits and underestimate the costs (Adams, 2000). The economic evaluation of dams generally do not account for costs such as the environmental, public health and social costs since downstream communities suffer in a variety of ways that õrequire an evaluation beyond economic impact analysis (Adams, 2000; Mehta and Srinivasan, 1999). Dams impact the agriculture, fishing, and the environment of downstream communities which in turn affect the natural, financial, physical, human, and social capital of the region in which the dam is located (Acreman et al., 2000).

The negative impact of dams on public health is related to their environmental and economic externalities. For example, Uyigue (2007) explores the correlation between the incidence of schistosomiasis and communities hosting dams in Nigeria, as well as the legal and institutional framework that exists for water resource management in the country. She reviewed the data in the literature on forty-seven dams that were tested for schistosomiasis. She found that human infection was tested for in eleven of those dams, of which ten tested positive. Furthermore, while dams have contributed to the economic development of Nigeria there has been a negative impact on the environmental conditions and on the human health of the communities hosting the dams.

Perhaps more compelling is a study by Ghebreyesus et al. (1999) which explores the incidence of malaria in children living in communities located near dams in Ethiopia. Over four quarterly cycles, they took malaria incidence surveys that lasted thirty days each in eight high-risk communities in the Tigray region in northern Ethiopia. Altogether, they obtained information on approximately 7000 children ten years or younger that live within 3 km of a dam and in control villages 8 to 10 km from the dam. They found that while malaria was prevalent in both communities, the rate of incidence in the villages near the dams was 14.0 episodes per 1000 child months at risk as compared to 1.9 in the control villages; an incidence rate seven times higher.

Often, the health impacts are less severe than schistosomiasis and malaria. McCully (1996) found that algae are likely to multiply near the surface of euthrophic reservoirs, similar to the Yali Falls Dam reservoir, causing the water to be unhealthy for household use. Other water quality issues also result from reservoirs. Nitrates created in the reservoir could cause poisoning leading to cyanosis, anoxia, stomach and intestinal disorders, dizziness, hypertension, respiratory failure, and coma (Robertson, 1992). Additionally, methylmercury poisoning, common in many large reservoirs, can lead to serious long-term health effects (McCully, 1996). Lastly, high mineral levels of hydrogen sulphate, iron, or manganese are typical in large reservoirs (Bergkam et al., 2000; McCully, 1996; Schouten, 1998) and can lead to liver and kidney problems.

For more information on the impact of dams on public health, we suggest Stanley and Alpers (1975), Brinkman et al. (1988), Parent