Amazon Battle: Is hydropower the new Kobayashi Maru?

https://www.e-ir.info/2010/12/17/amazon-battle-is-hydropower-the-new-kobayashi-maru/

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This paper seeks to understand the links between climate change and environmental conflict by studying dam related conflicts in Brazil. The Belo Monte and the Madeira Dams have been subjected to criticism due to their negative impacts on indigenous populations of the Xingu and Madeira River. Celebrities such as James Cameron and Sigourney Weaver have lent their voices to fight against the imminent displacement of more than 30,000 indigenous people. The development of this dam projects is expected to create a 'gold rush' parallel, in which thousands of migrants will travel to these states seeking a better live. Social tension and conflict can arise between indigenous communities and new migrants due to competition over natural resources. Besides threatening the livelihood of indigenous communities, the projects also have significant negative impacts on the environment. This no-win situation or Kobayashi Maru[1] implies that sacrifices are made to either the environment or to the indigenous tribe for the sake of green energy. Despite social and environmental consequences, dam development remains a popular option among policymakers that seek to increase energy supply by using renewable resources.

Introduction

The Amazon Basin has a long standing history of resource conflict. Indigenous tribes inhabited Brazil before 1500, when a Portuguese expedition led by Pedro Alvares Cabral swung too far westward and discovered the country. It is estimated that by this time there were 2,000 indigenous tribes in Brazil. Between the pursuit of Amazonian brazilwood and gold, non-native diseases and slavery; the indigenous populations of the Amazon were decimated. After a period alienation from urban development, the indigenous population reached some 200 tribes. However, their survival has been increasingly threatened over the last century. Indigenous tribes have been forced to protect their land from rubber-tappers, explorers and other peasant invaders. The Brazilian Government responded by taking an even more favorable position toward economic growth. Economic growth often comes at the expense of natural resources. In the case of the Amazon, a serious threat comes in the form of dam development.

Anthropogenic factors such as population growth and economic development are the main drivers behind an increasing demand for energy in the Amazon region. Efforts to meet previous demands for fossil fuel by developing countries led to substantial damage to the atmosphere and are principally responsible for the current environmental degradation. As a response to unsustainable development, States created the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change governance. However, the framework still protects a state's own right for economic growth.

There is an obvious link between energy and economic growth. When the energy demand is addressed through the lens of climate change governance, it is transformed to sustainable energy or 'green energy' which often motivates the construction of dams. Although green energy sounds like a great idea, States rarely consider potential social consequences when developing these projects. Nations such as Brazil are proposing the construction of dams as a response to the increasing energy and water demands of their growing populations. Among industrialized countries, Brazil is one of the most dependent on hydro-electricity. Most of this power comes from around 600 dams (WCD, 2000). Former Brazilian president Lula da Silva has said that it is a state's responsibility to provide sustainable energy to their citizens and that hydropower will serve to that purpose. Currently, more than 60% of Brazil's energy

supply comes from hydropower. Planned projects such as the Belo Monte Dam in the Xingu River and the San Antonio/Jirau dams in the Madeira River threaten the livelihoods of thousand of indigenous tribes and farmers that are dependent on ecosystems that would likely be destroyed by these projects.

Belo Monte Dam

The Belo Monte Dam is a proposed hydroelectric dam in the Xingu River in Northeast Brazil. With a cost of US$ 19 billion and a capacity of 11,233 megawatts, the Belo Monte Dam is expected to be the world's third largest dam. The largest dam in the world is the Three Gorges in China, while the second largest is the Syncrude Tailings in Canada. The project is being developed by Odebrecht, the Government of Brazil and the Norte Energy Consortium. The dam is expected to be in operation by 2015. Belo Monte includes two dams, two artificial canals, two reservoirs and an extensive system of dikes. The dam will flood approximately 500 sq kilometers of rainforest that will decrease wildlife and displace 20,000 indigenous peoples, including isolated tribes. Dams affect the chemical composition and water temperature of rivers, leading to alterations in water oxygen levels. This creates conditions unsuitable for the survival of fish. Lack of fish will inevitably also threaten the survival of communities in Northern Amazon that obtain most of their food from fish.

According to Amazon Watch, the s construction of the dam and the deviation of the river will leave traditional communities along a 130 km stretch of the Volta Grande without water, fish, or a means of river transport. Among these tribes are the Yudja, Arara, Kayapo and the Jorunas. The Arara Indias have a long history of fighting against logging companies and other ranchers that have sought to invade their lands. Evidently, the situation will not be any different with the development of the dam projects. Other tribes have already expressed their discontent with the decision to build the dam. Megaron Tuxucumarrae, chief of the Kayapo tribe said: "We are opposed to dams on the Xingu, and will fight to protect our river". Furthermore, if indigenous peoples are going to be displaced by the construction of this project, clearly Brazil will be in violation of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) that protects indigenous people's right of prior consent to development projects that might impact their livelihoods.

Although indigenous communities are the most affected by development projects in the Amazon, they are rarely the beneficiaries. The indigenous' rights movements in Brazil began in the 1980's as a response to atrocities suffered by indigenous tribes at the hands of settlers who stole their land. Also, indigenous tribes were impacted by conflicts over resources exploitation. Indigenous peoples tried to consolidate their leadership into a national organization that would represent their claims. Political conditions and other geographical factors made this national organization unsuccessful. After 1990, indigenous communities' claims have been made public by non-governmental organizations. For example, in the Belo Monte and the Madeira Basin Dams case, Amigos da Terra and International Rivers are the leading voices in condemning the violation of the indigenous peoples' rights.

Madeira Basin Dams

The Madeira river projects are controversial. The Madeira River Hydroelectric Complex includes dam projects such as the San Antonio dam and the Jirau dam. The complex is a central part of the Initiative for the Integration of South American Regional Infrastructure (IIRSA), which promotes economic development and energy independence in the region. The complex will make it possible to navigate the Madeira River from Brazil to Peru and Bolivia. Simun Farabundo(2009) has compared this process with Eduardo Galeanos' Open Veins of Latin America. In the book, Galeano criticizes the United States' economic exploitation of South America's natural resources. Similarly, Farabundo predicts that the Madeira Dam complex will accelerate the destruction of the Amazon Forest.

Farabundo also states that the waterway would serve as a corridor for the transport of minerals, grains, timber, and other products. These resources could flow east toward Brazil's Atlantic port of Belem, and eventually on to Europe, increasing the economic integration of South America with the rest of the world. For example, the construction of the dam will allow Brazil to transport an additional 35 million tons of soybeans every year. However, cheaper transportation costs will serve as an incentive to expand the soy production in the states of Rondonia and Amazonas, increasing deforestation and invasions. This situation might create a 'gold rush' parallel, in which thousands of

migrants travel to these states seeking a better life through soybean production. This would most likely lead to increased deforestation and more rapid destruction of the Amazon, thereby worsening climate change.

The San Antonio dam is currently being built, while construction on the Jirau dam has been halted due to federal injunction. The Hydroelectric Complex, with a total capacity of 7000 megawatts, is being developed by the Energia Sustentavel do Brasil Consortium and is expected to be in operation by 2012. The Brazilian Movement of Dam Affected People estimates that 5000 households will be affected by the construction of the projects. Among the affected indigenous tribes are the Karipuna, Karitiana, Oro Win and the Wari'. Presently, the Wari' are peaceful, but they have a previous ethnic conflicts with neighboring tribes such as the Karipuna. The Ecological Corridor Guapore is also expected to be negatively impacted by the dams. The Maideira is one of the world's most ecologically diverse areas, with more than 450 species of fish. For example, the damming of the river will affect fish migration patterns, thus decreasing the diversity of species that currently inhabit the Madeira.

Roland Widmer, representative of Amigos da Terra states: "Santo Antonio and Jirau dams has already sparked massive immigration to the region, accompanied by surges in prostitution, illegal logging, and land invasions, and placing strains on weak urban infrastructure and social services. A 600% increase in deforestation rates over the previous year was reported in the area surrounding the Madeira River after the preliminary license was granted in July 2007."

Climate Change Governance and Dams

Climate change governance should be understood as the set of climate-related policies and international frameworks that seek to steer political spaces that lack formal and centralized authority (Hoffman, 2005). According to Hoffman, climate governance and its experiments make rules that shape how communities respond to climate change. These can be multilateral treaties such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, or bilateral such as the Climate Memorandum of Agreement (MoA) between China and India.

The UNFCCC, a non-binding agreement, requires all states to limit their green house gases (GHG) emissions by adopting relevant sustainable energy policies. Nonetheless the convention still protects a State's own right to achieve economic growth. On the other hand, a more stringent agreement is presented in document as the Kyoto Protocol. The protocol proposes GHG emission cuts for most developed nations. Despite the fact, that Brazil is not required to meet specific targets by the Kyoto Protocol, they play a prominent role in climate change discussions. Furthermore, Brazil has been a leader in the development and promotion of green-energy projects and hydropower development.

Brazil was the first nation to sign the UNFCCC in 1992; they also ratified the Kyoto Protocol in 2002. The delegation also proposed the Clean Development Mechanism (CDM) as a strategy to meet the targets of the Kyoto Protocol. The CDM seeks to promote carbon-crediting of project-based emission reductions in developing countries. Hydropower projects have been one of the most successful options to date, particularly in Brazil. According to Whittington (2007), the value of hydropower comes from replacing fossil-based electricity demand with a zero-emissions source of power, thus an overall significant reduction of GHG emissions.

Environmental Challenges

Despite all positive GHG benefits from hydropower, dam projects are particularly controversial due to negative environmental implications particularly those related to land erosion and aquatic species extinction. Building a dam requires some initial flooding for the creation of the reservoir and other structures such as: spillways, floodgates and check dams, in the nearby areas of the original dam. These structures negatively affect the hydrology of the rivers and the migration pattern of fish by creating barriers to their natural movement. The movement of sediment and fish is essential to maintain aquatic food chains and natural genetic stocks. Evidence from the devastating environmental impacts of dams can be seen in Colombia and India.

Based on these assumptions, there is a potential evident tradeoff between air quality and water quality in hydropower projects. This creates a Kobayashi Maru situation in which we are forced to choose between offsetting carbon

emissions or heavy environmental degradation. Future energy demands from Brazil's growing population and agro-business further complicate this challenge.

Critics of hydropower projects, such as Timothy Killeen and Glenn Switkes, have stated that drying conditions and changes in precipitation will inevitably affect the Amazon River and its tributaries, which could potentially diminish the hydropower capacity of the region. During the 2005 drought, the Madeira river water levels fell to one-tenth in comparison to rainy season levels, limiting navigation and electricity production. More recently in 2009, a massive blackout in Brazil major cities due to failures in the Itaipu dam pushed the government to accelerate the construction of additional hydropower dams in the Amazon basin. A recent forecast for 2070 by Brazil's CREAS Project stated that an increase of 4 C in temperature will be translated to as much as 15-20% reduction of rainfall levels, which will lead to a decrease in hydroelectric production.

Economic Challenges

Hydropower is the backbone of the Brazilian economy. Decreasing rainfalls mixed with increasing dry spells will diminish hydroelectric capacity by 25-50% depending on river flows. Consequently, any changes in electricity generation will affect the economic output of the region, particularly for agriculture and urban use. Figure 5 shows expected changes in hydroelectricity generation in South America. Highly hydropower dependent countries like Brazil and Venezuela are also the same countries that are expected to suffer notable declines in hydro-electricity production by 2050.

The expected population increase of 37% for 2050 will double Brazil's current energy demand. This predicted growth will lead to critical shortages in energy supply by 2050, which could be solved if Brazil diversifies its energy matrix with other sources such as nuclear and bio-mass energy. However, expected costs of the non CO2 energy revolution surpass US$ 260 million (Green Peace, 2008).

Table 1 depicts expected changes in annual flows for Brazilian river basins and its negative impact on Brazil's hydropower capacity. The columns A2 and Bs incorporate IPCC's climate change predictions for 2050. We can appreciate that the rivers basins situated in the Amazon are expected to have the most notable declines in average annual flow. For example, the Tocantins River basin's annual flow is expected to decrease by -23.40%, thus decreasing hydropower production by 0.30%.

Table 1: Results of Hydropower Changes

Results for Hydropower (Deviation from the Reference Projections) and Relative Participation of Each Basin in the Brazilian Hydropower System

Basin	Average Annual Flow		Average Power		Firm Power		Percent	
	A2 (%)	B2 (%)	A2 (%)	B2 (%)	A2	B2	Brazil	SINa
Parana River	-2.40	-8.20	0.70	-1.20			15.90	17.60
Grande	1.00	-3.40	0.30	-0.80			9.20	10.20
Paranaiba	-5.90	-5.90	-1.40	-1.90			10.20	11.30
Paranapanema	-5.00	-5.70	-1.40	-2.50			3.00	3.30
Parnaiba	-10.30	-10.30	-0.80	-0.70			0.30	0.30
Sao Francisco	-23.40	-26.40	-4.30	-7.70			8.50	9.40
Tocantins-Araguaia	-14.70	-15.80	-0.30	-0.30			15.80	17.60
Brazil (SIN)	**-8.60**	**-10.80**	**-0.70**	**-2.00**	**-1.58%**	**-3.15%**	**62.80**	**69.80**

a SIN – Sistema Interligado Nacional (Brazil Interconnected Electric Power System); Source: World Bank, Schaeffer et al., 2009)

Actors: Brazil and communities in the Xingu and Madeira rivers.

The Brazilian Government is one of the main supporters of the Initiative for Integration of South American Infrastructure. The initiative seeks to further South America's energy independency and to strengthen economic integration by developing the Amazon. But all this is under threat. The Brazilian government is building two massive

hydroelectric dams on the Madeira. Construction of these projects plus two additional dams upstream: "would transform the Madeira into an industrial shipping canal, providing the power and transport needed to move large quantities of resources out of the Amazon and accelerate its destruction." The project is the largest of the Initiative for the Integration of South American Infrastructure, or IIRSA.

The Xingu River and its indigenous reserve host more than fifteen pre-Colombian indigenous groups that speak eight different languages. Most of the Xingu natives are sedentary, primarily practicing agriculture and fishing. Among the tribes that will be affected in the Madeira basin are: the Karitiana, Karipuna, Urueu Wau Wau, and Katawixi. According to the Conselho Indigenista Missionario (CIMI), the Jacareuba indigenous lands of the Katawixi in Amazonas State are at risk of flooding due to the Santo Antonio dam.

Environment Aspects

There is an array of environmental problems related to the construction of dams in the Amazon Basin that could potentially worsen due to climate change. Dams are particularly controversial due to its negative environmental implications particularly those related to land erosion and aquatic species extinction. According to International Rivers, there are two main categories of environmental impacts associated with dam construction: those inherent to dam construction and those caused by operational features in each dam (McCully, 2001).

Examples of these are:

§ Impacts due to existence of the dam: upstream change from river valley to reservoir, changes in downstream morphology, changes in water quality, and reduction of biodiversity because of blocking of movement.

§ Impacts due dam's operation: changes in downstream hydrology (E.g.: total flows, seasonal timing), changes in downstream morphology, changes in quality, and reduction of riparian habitat diversity because of flood elimination.

According to McCully, the elimination of the benefits provided by natural flooding may be the single most ecologically damaging impact of a dam. This fragmentation of river ecosystems has undoubtedly resulted in a massive reduction in the number of species in the world's watersheds. Some of the environmental effects of dams can benefit some species. For example, impounding a reservoir will create habitat for lake fish and warm water released from a reservoir can increase the abundance of species of fish which failed to thrive in the cool river. But because dams alter the conditions to which local ecosystems have adapted, the overall impact of a dam will almost without exception be to reduce species diversity. Another environmental impact related to dams' construction is the 'lake effect'. The lake effect refers to increasing precipitation patterns caused by variation between the temperature of the air and the temperature of the body of water. Precipitation patterns become more frequent and severe, consequently increasing the probability of flood.

Other scholars such as Harsh Gupta (2002) and Jauhari (1999) have noted the close relationship between dams and earthquakes. They refer to this occurrence as Reservoir-Induced Seismicity (RIS). According to Jauhari, water pressure from the dams creates cracks and fissures in the ground under a reservoir. When the pressure of the water in the rocks increases, it lubricates geological faults under tectonic strain and creates more friction. This friction is later release in the form of temblors or earthquakes. Gupta states that globally, there are over 100 identified cases of earthquakes that scientists believe were triggered by reservoirs. Examples of these are RIS incidents are: Hoover dam (U.S., 1939), with a magnitude of 5.7; Aswan dam (Egypt, 1981), with a magnitude of 5.3; and Koyna dam (India, 1967), with a magnitude of 6.3.

Conflict Aspects

There have been conflicts between up-steam and down-stream users regarding dams' construction in Latin America. In 1979, Brazil and Paraguay announce the construction of the Itapua Dam on the Parana River, causing Argentina to concern about potential environmental repercussions and effects on their water supply. There was a tense relation

between the countries till an agreement was reached later that year. In some instances, the conflict rose beyond expectations. Most scholars would agree that hydropower projects are conflictive by nature. The lack of formal institutions in Brazil to mediate these conflicts lengthens and enhances the severity of dam-related conflicts.

McCormick(2007) states that the mediation of these conflicts in Brazil depends on informal channels often created by civil society representatives and researchers. The Anti-dam movement in Brazil began in late 1980s; about the same time Brazil was transitioning to a democratic country. Democratic countries are expected to allow better public participation in the development of policies; however, this was not the case in Brazil. Most of the hydropower projects were developed unilaterally, without consultation of the communities that were going to be impacted by the projects. Without any institution to legitimize these communities' claims, there cannot be an effective strategy to prevent conflict. Dam projects are not a popular option among civil society representatives due to their high environmental and social costs. For example, International Rivers is working to stop plans for more than 60 new dams in the Amazon region, including the Madeira and Xingu rivers. Additionally, the government of Brazil has not contemplated other options such as energy efficiency that could decrease the need for new dams.

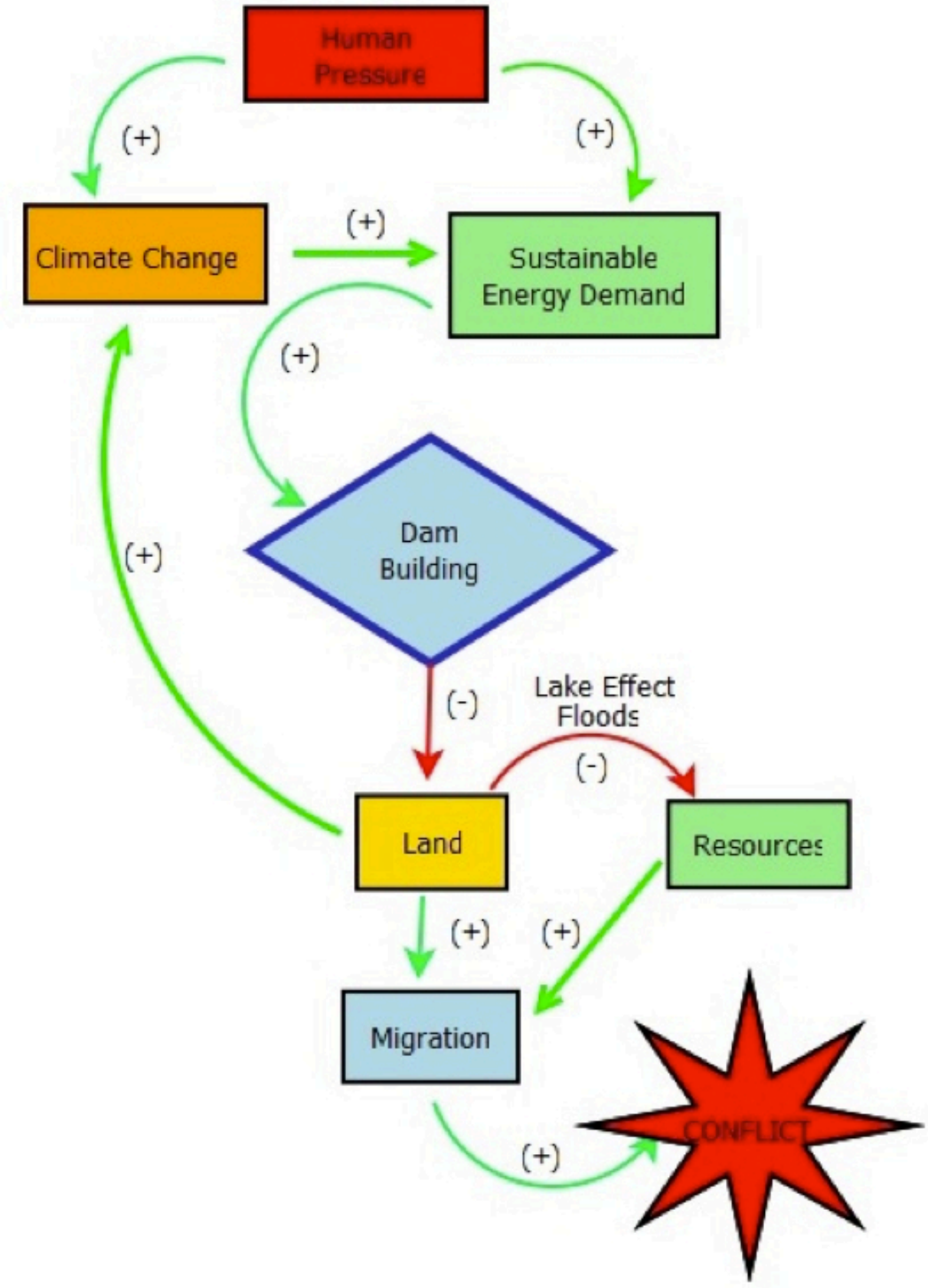
The dams will attract over 100,000 migrants to these areas. Social tension and conflict can arise between indigenous communities and new migrants due to competition over natural resources and land. According to International Rivers, the Kayapo tribes will one of the most affected tribes by construction of the Belo Monte dam. They are opposed to the project and have vowed to wage war if the government proceeds. Further understanding of the social implications of dam related conflicts will allow civil society representatives to propose a dialogue mechanism capable of incorporating the necessities of dam-affected communities.

According to Amazon Watch, Belo Monte will also attract 100,000 migrants to the region. Inevitably, this will represent a threat for Xingu's indigenous communities. Besides increasing deforestation, new migrants could increase social tensions by pushing indigenous peoples out of their territories. Approximately, 30,000 indigenous people will be displaced by the Madeira and the Xingu dams. We can estimate that 25% of these will engage in some sort of violent conflict with new migrants. Based on similar dam/water conflicts in the Amazon (see: ICE 19 – Conflict and Human Rights in the Amazon), the estimated level of civil fatalities is 5,000. Additionally, disease outbreak such as Malaria has the potential to decimate some of the isolated tribes that live in the Madeira River basin.

Environment and Conflict Overlap

The relationships between the environment and dam conflicts in Brazil are visible. For example, when human pressures, such an energy demand is addressed through a climate change governance model, it is transformed to an increase sustainable energy demand. This demand motivates the construction of dams (dam building). Building a dam requires some initial flooding for the creation of the reservoir and other structures such as: spillways, floodgates and check dams, in the nearby areas of the original dam. After the dam is in place, further flooding will occurs due to the lake effect. Inevitably, floods will decrease available land for agriculture. Land use changes will increase deforestation and could potentially exacerbate climate change. On one hand, changes in resource availability will leave some indigenous tribes land-less and will force them to migrate to urban areas. The rural-urban exchanges (migration) could potentially trigger a situation of conflict among both groups. On the other hand, changes in resource availability will increase competition among indigenous tribes and other communities that decided to stay behind in their native lands.

Figure 6


Human Pressure
(+)
(+)
Climate Change
(+)
Sustainable Energy Demand
(+)
(+)
Dam Building
(-)
Lake Effect Floods
(-)
Land
Resources
(+)
(+)
Migration
(+)
CONFLICT

Conclusion

The spatial scope of this conflict could be considered regional. Despite that the main conflict will take place in the inner Amazon, the damming of the Amazon Basin tributaries will have environmental and social impact to downstream users. If not addressed properly, conflicts over dams have the potential to disrupt Brazil's stability. These conflicts could quickly spiral from local issues into regional diplomatic situations.

No conflict has taken place between the indigenous people of the Madeira and Xingu rivers. Numerous national and international protests have taken place in order to stop the dam projects. Dam development does not necessarily have to be a Kobayashi Maru. This conflict has the potential of being resolved if the Brazilian Government reevaluates its project development processes. The government can open communication channels with indigenous communities' leaders as stipulated by the United Nations Declaration on the Rights of Ingenious People and find ways to lessen the impact that these dams will have in the livelihoods of indigenous people.

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[1] Kobayashi Maru: A no-win situation caused by a set of rules that can only be won by changing the rules, in effect, cheating. The Kobayashi Maru is a test in the fictional Star Trek universe. It is a Starfleet training exercise designed to test the character of cadets while facing a no-win situation.

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Written for: James Lee
Date written: December 5, 2010