Equity-based natural resource allocation for infrastructure development: evidence from large hydropower dams in Africa and Asia

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Abstract

Large hydropower infrastructure development is a key energy priority in low and middle income countries as a means to increase energy access and promote national development. Nevertheless hydropower dams can also negatively impact people's livelihoods by reducing access to local natural resources such as land, water and food. This paper analyses equity-based resource allocation from an ecological economics perspective, by looking at local resource use competition between different uses (food, energy, livelihoods) and users (villagers, urban settlers, local government and dam builders) in selected case studies in Asia and Africa. It also illustrates from a political ecology approach divergences between national priorities of energy production and growth and local development needs.

1. Introduction

In the pursuit of climate change mitigation and energy access hydropower is experiencing a new renaissance (World Bank, 2013). 1.3 billion people world-wide do not have access to electricity and 2.7 billion people rely on traditional biomass for basic needs such as cooking and heating. At the global level, Sub-Saharan Africa and developing Asia account collectively for 97% of the total population without access to electricity (IEA, 2015). The need to ensure "access to affordable, reliable, sustainable and modern energy" (United Nations, 2015) is therefore recognized as critical in Africa and Asia to the achievement of the Sustainable Development Goals (SDGs). To increase energy access in the last years, new large hydropower projects have been planned all over the world and Southeast Asia and Africa are the most targeted continents. Africa holds about 12% of the world's hydropower potential. Yet Africa produces only about 3% of the global hydropower and exploits less than 10% of its technical capacity, the lowest proportion of any of the world's regions (Appleyard, 2014). Therefore, many large hydropower dams are being built or considered in Africa (International Rivers, 2015a). On the same direction, Southeast Asian countries plan to construct 61 gigawatts (GW) of new hydroelectric generating capacity through 2020 (Mayes, 2015). As a result, 72 new projects

have been planned in Laos, 10 in Sarawak, Malaysia and at least 60 new projects are under consideration in Burma and in Cambodia (International Rivers, 2015b).

Despite the importance of hydropower dams for improving energy access in energy poor countries, the interrelationship between the population and the environment are severely affected by the construction of large infrastructure projects such as dams (WCD, 2000; Tilt et al., 2009; Lahiri-Dutt, 2012; Tullos et al., 2013; Buechler et al., 2016;). This paper aims to discuss the ecological economics of large dams' development in Africa and Asia, particularly in terms of distribution of natural resource access and local resource use between alternative uses (food, energy, livelihoods) and different users (villagers, urban settlers, local government and dam builders). The analysis is referred to selected case studies, namely Kamchay dam in Cambodia, Bakun dam in Malaysia and Bui dam in Ghana.

Reduced access to natural resources for indigenous communities after dam construction such as land, water, forests often negatively impacts their livelihoods, since natural resources represent for the majority of those people the main capital asset on which their livelihoods depend (Swiderska et al., 2008). Therefore, the ecological and the economic dimensions are strictly interlinked with regard to resource access for affected communities. Moreover, the severity of the impacts depends to some extent on the governance of these impacts in terms of how equity-based principles, such as principles of distributive justice (fairness in the distribution of access to natural resources) and procedural justice (fairness of procedures in terms of opportunities for participation in the decision making process of affected communities) (Marques et al., 2015; Urban et al, 2015a) are taken into account by the local government and dam builders in the decision making process of large dams. A political ecology approach is therefore relevant to understand how divergence between national priorities of energy production and local development needs can result in the poor implementation of social safeguards processes and therefore the unequal distribution over access to resources (Bryant and Bailey, 1997, Blaikie, 1985, Peet & Watts, 2004; Tan-Mullins, 2007).

Looking at the literature on the political ecology of state-led infrastructure development (e.g. intensive agriculture, energy projects, extractive projects), various studies highlight the uneven power relations inherent in decision making regarding these projects; usually, the costs and benefits are unequally distributed between the national and local scales and the people most affected are not involved in the planning and construction process (Turhan, 2014; Bebbington, 2009; Dominguez, 2007; Silver, 2015; McCully, 2001; Baghel and Nusser, 2010; Smits, 2015). In relation to infrastructure development and inequality, economics literature has also showed that government investment on infrastructure can increase wealth inequality over time and generate trade-offs between average welfare produced and its distribution across agents and regions (Chatterjee and Turnovsky, 2012; Bajar and Rajeev, 2015; Calderon and Serven, 2014). However, this literature has generally ignored the effects of infrastructure development on access and affordability of different affected people and on the distribution of natural resources' use. In the case of literature on inequality this is due to the fact that these studies are mainly based on quantitative econometric analyses of time-series and cross-section aggregated macro and microeconomic data to test for the effects of infrastructure development without taking into account different people's experience of distributional issues post-construction (Calderon and Serven, 2014). Moreover, looking explicitly at large dams, despite the increasing literature on the impacts of dams' construction in developing countries, there are still few studies that look explicitly at the questions of distributive and procedural justice and their implications for local development. Most of the studies on large dams

focus either on technical/financial issues (Ansar et al., 2014; Sovacool et al., 2014) or socio-ecological aspects (Bakken et al., 2014; Burke et al., 2009; Brown et al., 2009; Lerer and Scudder, 1999; Tilt et al., 2009). Among the few studies on justice principles applied specifically to dams' construction, Sovacool and Dworkin 2015 call for an energy justice approach applied to the analysis of energy infrastructure implications on local communities and for a better integration of social sciences approaches in the evaluation of large dams; however there are not yet examples of its application to specific projects. Braun 2015 looks at large dams development and inequality in Lesotho from a feminist political ecology and environmental justice perspective. Moreover, Marques et al. 2015 uses a procedural justice approach to analyze the perceived trust of affected communities and expected outcomes of two dams' projects in Portugal. Nordensvard and Urban 2015 analyse the nexus between hydropower dams and corporate social responsibility by focusing on Chinese state-owned dam builders and the implementation of social policy and social justice principles to mitigate local impacts. This paper looks from a broader perspective at how and whether both distributive and procedural justice are taken into account in the decision making process of large dams construction in relation to competing uses of different natural resources (i.e. water, energy, land, food, and forest). It provides a systematic and comparative analysis of large dams' impacts by focusing on affected peoples' perception and experience of resource access post-construction. We follow this approach inspired by Jerkins et al. 2016 idea that energy injustice recognition starts with the identification of the concern, questioning who is impacted and how victims are recognised (recognition), how benefits and costs are distributed (distribution), and impacts remediated (procedure).

Moreover, from a political ecology perspective this paper looks at how social mitigation strategies (i.e. compensation, alternative livelihoods provision and consultation processes) are being implemented by the local government and dam builders to secure a balanced natural resource access between competing users and uses.

The rest of the paper is organised as follows. In Section 2 we present the theoretical framework by situating the issue of large dams within the broader context of procedural and distributive justice from an ecological economics and political ecology perspectives. In this section we also present the methodology used to analyse the impacts of large dams on the access to natural resources and we introduce the case studies. In Section 3 we present and discuss the results of the analysis by distinguishing between people's perceptions and governance issues. Section 4 concludes the paper.

2. Conceptual framework and methodology

2.1 Conceptual framework

From an ecological economics perspective three conditions are considered necessary for sustainable economic activity, there are: appropriate scale, efficient allocation and just distribution of resources in a socio-economic system (Daly, 1992). Appropriate scale refers to the physical volume of products; allocation to the division of the resource flow among different and competing uses and distribution to the division of the resource flow among different beneficiaries (Daly, 1992). In ecological economics intra and intergenerational distributive justice is analysed, from an anthropocentric view, in terms of how changes in the allocation of resources over time and space may frustrate the potential needs satisfaction of human economic agents. Non-anthropocentric

distributive justice instead refers to the concern for nature independently from the impacts on human welfare (Van den Berg, 1997; Pelletier, 2010). According to Daly 1992 when speaking about sustainability, efficient distribution of natural resources is usually not determined by prices, and socially-just distribution is better achieved upon a social decision. Deliberative ecological economics based on the inclusion of different values in the decision making process is well established in the ecological economics literature, together with the idea that environmental preferences are socially constructed through processes of communication and interaction among different social actors (for an overview of this literature the reader is referred to Martinez-Alier and Muradian, 2015). Therefore recognition, participation and legitimacy (i.e. procedural justice) (Paavola and Adger, 2006), play a fundamental role in the decision-making process to achieve sustainable, inclusive and fair environmental governance (O'Neill and Spash, 2000).

Based on the above, this paper looks at procedural justice and intra-generational distributive justice principles in the allocation of natural resources (i.e. water, energy, land) between competing uses and users and how this affect the local population's needs in the case of large dams' construction in remote rural areas in developing countries. The allocation of natural resources between competing uses and users in remote rural communities has important implications for local development (Martinez-Alier, 2002; Martinez-Alier et al. 2010; Haberl, 2015). In rural areas in developing countries natural resources underpin the livelihoods of many among the poorest (Norfolk, 2004). The failures to implement distributive justice, and people-centred interventions through local participation (i.e. procedural justice) (Flint, 2013) result in the development of infrastructures which although promote economic growth at the national level (Calderon and Serven, 2014), often do not serve the needs of poor local communities which are directly affected by those projects (Marques et al., 2015). Unequal distribution caused by the varied forms of appropriation and control over the access to natural resources such as land, water and energy are also at the basis of the political ecology framework (Wolf, 1972, Greenberg and Park, 1994; Bryant and Bailey, 1997, Blaikie 1985, Peet & Watts, 2004; Tan-Mullins, 2007; Buechler and Hanson, 2015). Bryant and Bailey 1997 developed three fundamental assumptions when utilizing political ecology research findings to develop better policies and programs for developing countries. First, costs and benefits associated with environmental change are distributed unequally. Second, this unequal distribution inevitably reinforces or reduces existing social and economic inequalities. Third, the unequal distribution of costs and benefits and the reinforcing or reducing of pre-existing inequalities holds political implications in terms of the altered power relationships that result. Large dam construction is usually associated with irreversible social and environmental changes, whose costs and benefits are often not equally distributed between conflicting users (such as affected communities, urban settlers, local government and dam builders) and uses (such as livelihoods, energy and food production). People relocated for large dam construction usually cannot live in the immediate vicinity of their previous settlement and have to change their customary economic models, cultural traditions and existing social ties (Terminski, 2015) often without true and meaningful consultation and consent (Sovacool and Dworkin, 2015). Moreover, compensation of material and non-material conditions for affected people often results problematic and poorly managed by the local governments, dam builders and financiers, particularly in the global South. The most common problems are lack or poor compensation for people who do not have legal rights to the land they live on or use for their livelihoods and inadequacy of compensation for property and assets left behind or lost (Sovacool and Dworkin, 2015).

This paper discusses the intra-generational distribution of natural resources between competing users and uses and the associated costs and benefits, in terms of livelihood impacts, compensation issues and access to resources for large dam projects in low and middle income countries in Africa and Asia. The analysis is based on semi-structured interviews with institutional actors and affected peoples' perception and experience of resource access post-construction as explained in the methodology section below.

2.2 Methodology

We selected three dams as case studies in Southeast Asia and Africa. The dams are the Bui dam in Ghana, the Kamchay dam in Cambodia, the Bakun dam in Malaysia. Each of these dams involves the Chinese as dam developers. The methodology has been based on the realization of fieldwork at the three dam sites and in China. We conducted 69 semi-structured in-depths interviews with local communities directly affected by the dam through resettlements and/or changes to livelihoods, 28 focus group consultations with the same affected communities (of which 50% with women and 50% with men). The 4 affected communities interviewed in Ghana are farming and fishing communities resettled after the construction of the dam: Bator, Bui, Gyama and Dokokyina. The affected communities interviewed in Cambodia rely mainly on farming, fishing and the collection of forest products, such as timber, wild fruits and bamboo. These are Bat Kbal Damrei, Mortpeam, Ou Touch, Snam Prampir, Tvi Khang Cheung. The major ethnics group resettled due to the Bakun dam are the Kayan and Kenyah, 3 longhouses[1] were chosen to represent them, namely Uma Belor, Uma Balui Ukap (Kayan), and Uma Badeng (Kenyah). These communities rely mainly on farming and fishing activities, as well as the collection of non-timber forest products. We also conducted 42 interviews with institutional actors from the national and local governments and NGOs in Ghana, Cambodia and Malaysia, as well as 23 interviews with Chinese actors such as Sinohydro (a Chinese leading company for overseas projects), regulators and financiers (Table 1).

Table 1 Interview setup*

Targets	Methods	No of interviews	Further details
Affected local communities at Dam sites	Focus groups	Cambodia: 10 Ghana: 11 Malaysia: 7	50% women; 50% men
Affected individuals from local communities	Semi-structured interviews	Cambodia: 24 Ghana: 25 Malaysia: 20	Men and women
Institutional actors	Semi-structured interviews	Cambodia: 19 Ghana: 15 Malaysia: 8	National/local government, NGOs
Chinese actors	Semi-structured interviews	23	Sinohydro, regulators and financiers

[1] A longhouse is the traditional dwelling of indigenous peoples in Sarawak, Malaysia. They are usually built raised off the ground and are composed of a public area and private living quarters (fieldwork observation).

*Interviews and FGDs with affected communities have been carried out in January 2014 in Cambodia; September 2013 in Ghana; April and August 2014 in Sarawak, Malaysia. Interviews with institutional actors and Chinese actors have been carried out during the years 2013, 2014 and beginning of 2015.

We analyzed the qualitative data obtained through interviews and FGDs by categorizing and coding the sources to compare different interpretations of events (Wolcott, 1990; Wiles et al, 2005; Yin, 2009). To analyse the perception and relevance for the affected communities of the issues analysed, such as access to resources, access to services, compensation, participation, we used the amount of content that has been coded to each theme (i.e. the frequency of the content coded in percentage values). Similar methods have been used in discourse analysis, casual conversation analysis and media analysis (Greenland-Smith et al., 2016). This allows us to compare several cases to be able to draw parallels from similar findings and flag up any differences as illustrated in detail in section 3.

2.3 Case studies

Figure 1 Location of Bui dam in Ghana, Kamchay dam in Cambodia and Bakun dam in Malaysia (Source: ArcGIS)

Table 2 Technical details of Bui, Kamchay and Bakun dams

	Bui	Kamchay	Bakun
Type of dam: hydropower	rolling compacted concrete gravity dam	rolling compacted concrete gravity dam	Concrete Faced Rock fill Dam
Reservoir capacity (billion m^3)	12.57	0.68	43.8
Reservoir surface area (km^2)	288	20	695
Purpose	power generation (electricity)	power generation (electricity)	power generation (electricity)
Generating capacity (MW)	400	193	2400
Height (m)	108	114	205
Length (m)	493	568	750
Cost (US$)	790 million	311 million	2.6 billion
Average annual energy generation capacity (GWh)	980	498	16,785
Electricity supply	National grid, Brong-Ahafo, Northern Regions of the Country	Kampot, Phnom Penh and Preah Sihanouk Province	Bintulu
Type of contract	Engineering, Procurement and Construction-EPC	Build, Operate, Transfer contract (BOT)	Engineering, Procurement and Construction-EPC

References: BPA, 2015 ; Keong, 2005; Sinohydro, 2014; GEO, 2014; and International Rivers, 2014.

The Bui dam is located on the Black Volta river at the Bui Gorge, at the southern end of Bui National Park. It has a power generating capacity of 400MW, a net average energy production of 980 gigawatt hours/year (GWh/yr) and costs an estimated US$790 million. The power generated by the Bui dam is delivered by three new transmission lines to the national grid. The electricity is mainly used to satisfy the energy demand of Accra and other urban areas located in the norther regions of the country (Table 2). The dam started operation in 2013 (Environmental Resources Management, 2007). The builder of the Bui dam is Sinohydro, the Chinese dam construction leading company for overseas projects, and the developer is the Ghana Government. The Bui dam project in Ghana is an Engineering, Procurement and Construction (EPC)/Turn-key Project Contract, which means that once

the infrastructure is finished the Ghanaian government becomes immediately the owner of the project. The Bui dam is the largest Chinese-funded project and the largest foreign investment after the Akosombo Hydroelectric Power Project in Ghana. The project has been jointly funded by the Government of Ghana, the Chinese Exim-Bank via a commercial loan and buyer's credit, as well as the Government of China via a concessional loan (International Rivers, 2014). According to the literature, there are a range of environmental and social issues (Hensengerth, 2011). As a result of the construction of the dam a total of 1,216 people from six villages have been relocated from their old settlement to new settlements. Moreover, an additional four villages with about 7,500 people have lost access to portions of farmland and forests due to inundation and/or construction work in the dam site area (Environmental Resources Management, 2007). For what concerns environmental impacts, due to the creation of the reservoir, 23,450 ha of riverine forest and adjacent savannah woodland have been permanently lost. This equals about a quarter of the total forest and woodland area within the Bui national park. As a consequence riparian gallery forest and savannah habitats have been fragmented causing negative impacts on vegetation reproduction and wildlife (Environmental Resources Management, 2007).

The Kamchay Dam is the first large hydropower dam in Cambodia. It has a generating capacity of 193MW and the expected annual output is 498 GWh, however in the dry season the generating capacity may be as low as 60 MW, which is less than a third of the nameplate capacity (NGO Forum, 2013). The electricity produced by Kamchay dam is mainly used to satisfy the energy demand of the capital city, Phnom Penh. The dam is financed by China ExIm Bank as part of a US$600 million aid package to Cambodia and it costs an estimated 311 million US dollars. The Kamchay dam contract between Sinohydro and the Cambodian government is a Build, Operate, Transfer contract (BOT). Sinohydro will transfer the ownership of the dam to the Cambodian government after 44 years, in 2050. As in the case of Bui dam, even though resettlement did not take place, there are a range of reported environmental and social issues related to loss of livelihoods of the local population, dam construction in a National Park and late Environmental Impact Assessment (EIA) approvals (International Rivers, 2014). The dam is located on the Kamchay River in Bokor National Park. Again, as in the case of Ghana, the dam is located in a protected area that is the habitat of endemic and rare species (Middleton, 2008).

The Bakun dam is the first and largest dam in Borneo, Malaysia. It is the third largest concrete face rock filled dam in the world. It is located in the tropical rainforest in Belaga District, East Malaysia, Sarawak, on the river Balui. The dam development includes a reservoir occupying 695 km^2 and a total catchment area of 14,170 km^2, which corresponds to 12% of Sarawak State. The Bakun dam has a generating capacity of 2,400MW and an estimated cost of US$2.6 billion. The financiers are thought to be ExIm Bank, while the developers are the Malaysia-China Hydro Joint Venture consortium composed of Malaysian Sime Darby, Chinese SOE Sinohydro and others. Sinohydro is also the builder. The electricity is mainly used to satisfy the energy demand of urban areas in Sarawak. As in the case of Bui dam the contract is an Engineering, Procurement and Construction (EPC)/Turn-key Project Contract. Bakun is the first of a series of large dams built in a biodiversity hotspot in Borneo's tropical rainforest and on the land of the indigenous Orang Ulu people. A total of 15 longhouses composed of 9,000 indigenous people from the upper Balui river, including some semi-nomads, had to be resettled into sedentary settlements at Sungei Asap for the dam construction. Approximately 50% of the impoundment area of the Bakun dam is lands claimed under customary rights (Sovacool and Valentine 2011).

3. Results

This section presents the results obtained by analysing the interviews and focus group discussions with affected communities and institutional actors. Intra-generational distributive justice is analysed by looking at people's perception and experience of the dam's impacts post-construction and how these impacts frustrate their livelihoods and needs satisfaction (Section 3.1). Procedural justice is analysed by looking at the governance of the impacts and the interaction of affected communities with dam builders and government officials (Section 3.2).

Before going into the details of people's perception of the dams' impacts, Figure 2 shows the main results of the Nvivo coding which are further discussed in sections 3.1 and 3.2 as specified above. References represent the number of quotes coded in correspondence to each theme analysed, such as compensation, access to resources, social network, energy access, access to roads, education, healthcare etc.

As anticipated in the methodology section perception and relevance for the interviewees of the issues analysed is indicated by the frequencies, i.e. how many quotes have been coded to each theme with respect to the total quotes coded expressed in percentage values.

As displayed in Figure 2 in the case of Kamchay dam in Cambodia the themes with the higher frequencies refer to issues of energy access (15.8%) and access to local resources (17.0%). In the case of Bui dam in Ghana they refer to livelihood changes (17.7%) and interaction and communication with dam builders and government officials (11.1%). In the case of Bakun dam in Malaysia they refer to compensation (14.0%) and access to local resources (12.7%), as well as interaction and communication issues (13.7%).

From the analysis emerges that distributive justice associated to access to resources and livelihood changes, as well as procedural justice, i.e. interaction and communication with dam builders and government officials are considered by local villagers the main relevant issues. Moreover, these issues are perceived more challenging for them than the access to social services, such as education, healthcare, access to road and markets, which in turn are usually considered relevant by officials and dam builders to highlight the positive impacts of large dams on affected communities.

Sections 3.1 and 3.2 discusses some of the most relevant quotes from the interviews to better understand how local villagers have perceived changes to access to resources post-construction and interaction and communication with officials and dam builders.

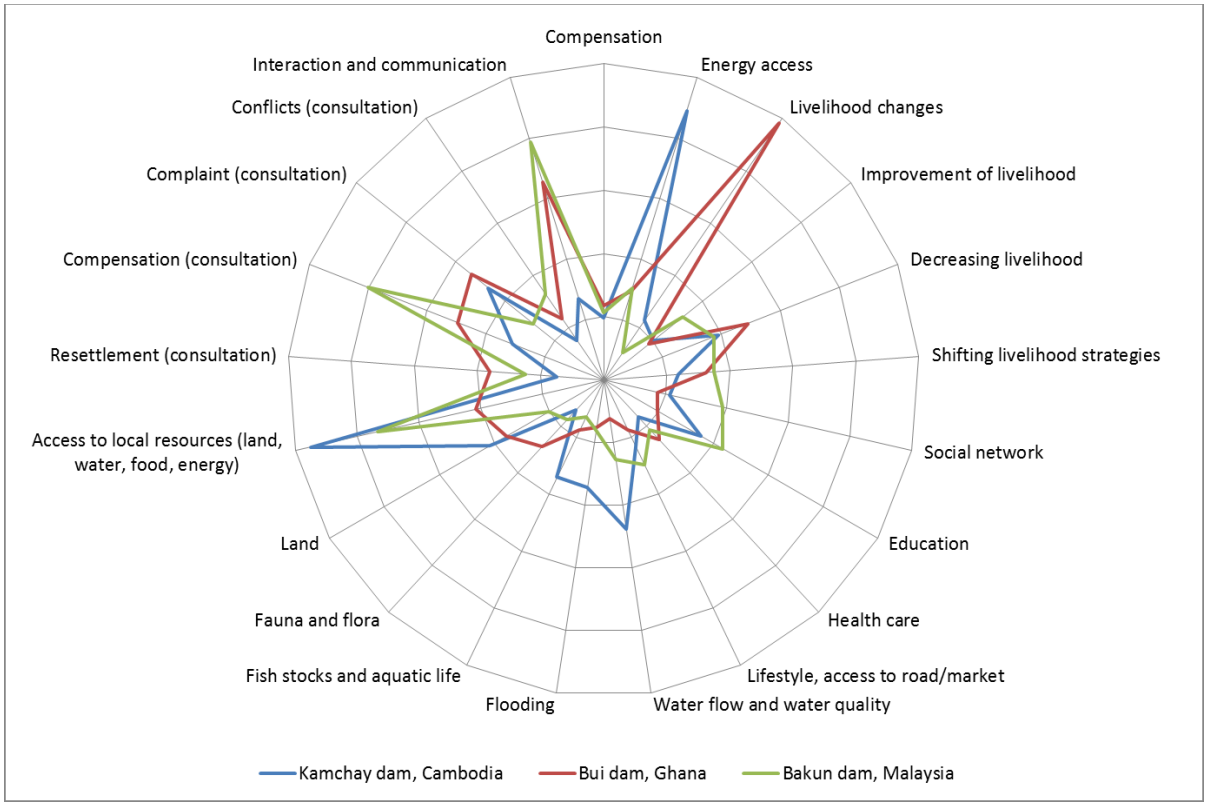

Figure 2 Frequencies (in percentage value) of references coded to each theme

3.1 Distributive justice and affected people's access to natural resources post-construction

Table 3 summaries the main aspects raised by community members during the interviews with regards to access to natural resources before and after the construction of the dams. In this section we present some selected quotes from the interviews carried out in the different research areas. The quotes refer to different interviewees in different villages. However to be able to present three different cases we focus here on the general impacts perceived by the affected communities in the different locations, instead of focusing on details of the differences between villages.

3.1.1 Land, food and forest products

Land scarcity, reduced land fertility, land insecurity and food insecurity are some of the negative consequences affected villagers have experienced after the construction of the dams.
Moreover, access to important natural assets needed to support local livelihoods, such as NTFPs (e.g. bamboo, rattan, fruits, shea butter, timber etc.) (Table 3), have become more problematic for indigenous people after the construction of the dam due to the inundation of the land and the presence of land enclosures by private companies, dam builders and local authorities. As a consequence access to land for farming has dramatically decreased after resettlement, especially in

the Bui dam and Bakun dam case studies where people have been resettled to new areas and provided with new land for cultivation as compensation for the lost land and crops.

In these cases if before resettlement indigenous communities had free access to the land inundated by the dam for agriculture - approximately 50% of the impoundment area of the Bakun dam was land claimed under customary rights established through past or existing occupation or cultivation (Sovacool and Valentine 2011) - after resettlement people can only cultivate the land provided in the new settlement site by the government. However, villagers at the Bakun dam resettlement site in Malaysia reported that the land is not enough to support family needs, also due to the difficulty of expansion for the presence of land enclosures from private companies: *"In our old place, our land was large and they replaced it with only 3 acres. The land is not enough for one family or for family expansion. All the 3 acres were used during the first year we moved here. Now, we want to plant rubber and oil palm, but the plot it's not enough. If we want to plant outside the three acres, they (the government and planting companies) will prohibit us"* (quotes from FGD with men in Sungei Asap resettlement site). Difficult access to the three acres of land received by the government as compensation is also an issue for the resettled communities. Due to the lack of a proper road, some villagers reported that they have to walk for two hours to reach their lands: *"Regarding the agricultural plots, some villagers were unable to plant. It is impossible to walk for two hours carrying 50 kg of fertilizers"* (quote from man respondent in Bakun dam resettlement site). In the case of Bui dam, complaints from the villagers interviewed were similar to the ones reported by resettled villagers in Malaysia as indicated in the following quote: *"Currently land for farming [in the resettlement area] would be inadequate if people want to engage in commercial farming. Land shortage will continue [...] especially when every young man wants a plot to farm"* (quote from Village Chief respondent in Bui dam resettlement site). Issues of land fertility in the resettlement sites are another major concern: *"almost everything is not suitable to be planted here, vegetables as well. The only thing that is suitable is oil palm trees, but there is not enough space to plant them in the three acres of land"* (quotes from man respondent in Sungei Asap resettlement site). The low fertility of the soil at Sungei Asap resettlement area is confirmed by a report on land and soil fertility (SALCO, 2008). According to this report, after the first couple of years after resettlement yields were not commensurate with the labour input, for rice, rubber and cocoa plantations. Oil palm was the only crop that could grow on such infertile soil (SALCO 2008).

Table 3 Resource access before and after dam construction as perceived by local affected communities at Bui, Bakun and Kamchay dams

	Before dam construction			After dam construction		
Resource access	**Bui**	**Bakun**	**Kamchay**	**Bui**	**Bakun**	**Kamchay**
Land	Free access through customary land rights. Main cultivations: vegetables and tubers (for private and commercial use)	Free access through customary land rights. Shifting cultivation. Main cultivations: pepper, oil palm, vegetables, rice, rubber (for private and commercial use)	Free access through customary land rights. Main cultivations: rice and vegetables.	Resettlement resulting in Land scarcity; Reduced land fertility; Land enclosure by dam builders and local authorities; no land titles	Resettlement resulting in Land scarcity; Increased distance to access agricultural plots; Land enclosure by dam builders, local authorities, logging and oil palm companies; reduced land fertility; temporary land titles	Land enclosure by dam builders and local authorities (no resettlement, all communities located downstream)
Forest products	NTFP collection: rattan, shea nuts, medical plants, dawadawa, fruits, charcoal and timber (for private and commercial use)	NTFP collection: rattan, medical plants, timber (for private and commercial use)	NTFP collection: timber, wild fruits and bamboo (for private and commercial use)	Reduced access to NTFPs; Increased distance to access NTFPs	Reduced access to NTFPs; Increased distance to access NTFPs	Reduced access to NTFPs; Increased distance to access NTFPs; land enclosure
Food	Food self-sufficiency - only occasionally commercial food	Food self-sufficiency - only occasionally commercial food	Food self-sufficiency - only occasionally commercial food	Reduced food self-sufficiency; Commodification of food	Reduced food self-sufficiency; Commodification of food	Reduced food self-sufficiency; Commodification of food
Energy	No energy access	No energy access	No energy access	Energy access for all	Energy access for all	Not energy access for all; unaffordable energy costs
Water	Easy access to river for fishing; good access to drinkable water	Easy access to river for fishing; good water quality and access to drinkable water	Fishing in the river; good water quality and access to drinkable water	Increased distance to access the river for fishing; Water scarcity and competition	Increased distance to access the reservoir for fishing; Decreased water quality	Decreased water flow and quality

In terms of land fertility the following quotes from villagers interviewed at the Bui dam resettlement site are also relevant: *"Previously [before resettlement] I was able to harvest 1000 tubers of yam, presently we can't harvest more than 30" (*quote from FGD with men in Bui dam resettlement site).
The majority of the households in the Dam site areas engage in farming and fishing as their primary source of occupation. All the households rely on their crops for subsistence purposes and the supply of food (Habia, 2009). In terms of access to food due to land infertility and scarcity, as well as increasing of foodstuff prices, especially in Ghana (Habia, 2009), after dam construction, people have reported to be less food self-sufficient and more reliant on the market for food provision: *"Previously [before the dam construction], we weren't buying food" and "Food stuff has become very expensive [due to the presence of worker immigrants in the area]. In the old village, we use to get yam for 2 Cedis*[2] *but today, yam goes for 10 Cedis for about three pieces" (*quote from FGD with female in Bui dam resettlement area).
At the Bui dam resettlement site, access to fish is also a source of concern of the affected communities. Even if the dam reservoir has led to a general boom in the fishing business, native communities have been unable to take advantage of the booming fishing industry. There are three main challenges that resettled communities complained about access to fish and fishing activities. These are: the long distance it takes to access the river from the resettlement site; the lack of skills to fish on the new expanded lake; and the fact that it is more expensive for them to buy fish as it was before.
Moreover, in the case of Bakun dam in Sarawak, Malaysia the presence of land enclosures by private planting companies, such as oil palm and rubber companies or dam builders make it difficult for resettled communities to access the lands surrounding the resettlement sites. This is restricting their ability to hunting and fishing, as reported in the following quote from a villager in the resettlement site in Sungei Asap : *"In the up river (old place), it was easy for us to find food and here the entire compounds have been blocked (by plantation and logging companies). We cannot go through the company's compound (because) they control it and there are gates for every company. We have to go to the old place to find the source of food. In the old site we were free to catch fish, go farming and we were not limited as we are here"* (quote from FGD with men in Sungei Asap resettlement site). As a consequence, for some villagers who do not have access to remunerative jobs, such as the elderly and women, livelihoods have decreased, as reported in the following quote:
"Our lives were easier there. If we wanted to catch fish, it was easy. Here, we need to use money to even buy fish at the market. We older people cannot farm as much as we did before. We raise chickens and pigs nearby. Now we no longer feed ourselves" (quote from female respondent in Sungei Asap resettlement site).
Another important issue which is not always taken into consideration during the negotiation process of large dams' construction is the issue of land property rights.
Resettled villagers in Sarawak, Malaysia reported that they do not have land titles in the resettlement sites:
"(title for land) It is not freehold grant. This is TOL (Temporary Occupational License) grant. It expires within sixty years only. When the expiry date comes, the land is no longer ours. It can be renewed but there is a chance we would have to pay. This is what scares the villagers. The land was promised to

[2] The value of the Ghana Cedi at the time of field work was 2GHS to 1USD.

us for a lifetime. When the expiry date comes, how are those people who have no money going to renew the license?"(quote from men respondents in Sungei Asap resettlement site).

In the case of Kamchay dam, the reduced bamboo forest areas due to the inundation (the dam has flooded 2,291 ha of land and forest in Bokor National Park) and the difficult access to the forest left upstream of the reservoir have severely undermined the livelihoods of the local communities, especially for those relying on NTFPs collection, such as bamboo collectors, firewood collectors and fruit sellers. Moreover, villagers reported that occasionally Sinohydro puts a ban on bamboo collection and closes off access to the area completely: *"Before the construction of the dam, they (Sinohydro) never banned the bamboo ground just now they catch our boat, if we do not have a boat, we cannot go to cut bamboo" (*quote from FGD with female in the Kamchay dam area*).*

While the bamboo ground has been banned by Sinohydro and the Cambodian government, bamboo collectors do not have many alternative jobs available in the area: *"We have no jobs to do beside that job (collecting bamboo), and working as a construction worker cannot support our family because we can earn only around half of what we earned collecting bamboo"* (quote from FGD with men in the Kamchay dam area).

The inundation of the forest area in Bokor National Park has also negatively impacted firewood collectors and fruit collectors. Firewood collectors reported that they have been banned by Sinohydro to access the dam area to avoid the illegal collection of timber from the dam site.

Moreover, fruit collectors reported that due to the clearance of the forest by Sinohydro many fruit trees were cut as well, impacting negatively the income of fruit sellers to tourists.

Similarly in the case of Bui dam, access to forest products (such as charcoal, firewood, commercial trees) has decreased after the construction of the dam, the resettlement sites are far away from the forest and therefore they don't collect them anymore. Most of the resettled communities have to buy firewood and charcoal which was freely collected from the forest before the construction of the dam. The same situation is for shea nuts, dawadawa[3], and medical plants and trees which were giving extra income to the villagers from the old sites.

Access to fish is also a source of concern of the affected communities in Kampot, Cambodia. After the construction of the dam the water flow is regulated by Sinohydro, however villagers complain that the flow is not enough, therefore the presence of the fish in the stream has decreased: *"We could catch from four to five kilograms per day, in flooded season. After the dam construction, we can catch only one or two fish per day for eating in the family. Now, fishermen do not fish anymore; they buy fish from others"* (quotes from men respondents in the Kamchay dam area). However, Kamchay dam has also had some positive effects, especially for durian and other plantations growers. Importantly, it has helped protect some areas from annual flooding. Life is better for those living in the previously flood-prone villages.

3.1.2 Access to water

In terms of access to water resources respondents from Bui dam resettlement site stated that in some villages water boreholes are not enough to satisfy the water requirement of the population, which has increased after the construction of the dam due to the presence of immigrants moving

[3] Dawadawa (scientifically Parkia Biglobosa) is a tropical tree plant from which the seeds are used to prepare fermented meals.

into the village: *"We have inadequate access to water. We have only few boreholes; we have to queue for long hours to get water for households use" (*quote from female respondent in Bui dam resettlement site).

In the case of Bakun dam, villagers reported that the water they can access in the resettlement site is polluted, smelly (smell of rust) and with a yellowish colour. Moreover, sometimes the water supply is not regular and there is no water provision for several days due to problem with water pressure to pump the water from the river. Some villagers have also stated that water pollution comes from the chemicals used in the oil palm plantations owned by private companies located on the bank of the river, as commented here: *"The water is not clean, it is like mud. Although it seems clean now, if we put it in the bottle after 2 or 3 days there is sediment in yellow colour. Because upstream there are many oil palm plantations, they use a lot of pesticides, and they go into the water, it is a big problem. Moreover, the water filter doesn't work properly"; and "The colour of water is yellowish. How are we going to eat? That is why many of us in Asap always fall sick"* (quotes from FGD with men in Sungei Asap resettlement site).

3.1.3 Access to energy

In terms of energy access, at the Bui dam resettlement site in Ghana people declared to be happy now since after the construction of the dam electricity has been provided to all resettled communities: *"The thing we appreciate most about our coming here is that previously we didn't have electricity at the village close to the lake but now we have light"* (quote from FGD with men in Bui dam resettlement site).

Similarly in the case of Bakun dam, in the old village people did not have electricity and used generators or kerosene lamp. In the resettlement site all villagers are connected to the grid and have electricity provided by the government, as stated here: *"Our lives are more convenient here with electricity"* (quote from female respondent in Sungei Asap resettlement site).

In the case of Kamchay dam the energy access situation is different. There are houses located close to the dam that do not have access to electricity yet: *"Most of the houses do not use electricity, they use kerosene lamp" and "[...] the price of electricity is too expensive"* (quote from FGD with men in the kamchay dam area). There are various reasons of the lack of electricity for some of the affected communities. Firstly, most of the electricity generated at the Kamchay dam is used in Phnom Penh, so the electricity used in the dam site area is not coming from the dam. Secondly, the electricity used by affected communities is imported (manly from Vietnam) and provided by private companies at unaffordable prices for the poorest families in the area: *"This electricity is from Vietnam, private enterprise. We are also wondering that why we live next to the dam, but the price of electricity is more expensive than other villages in the province"* (quote from FGD with men in Bat Kbal Damrei).

3.2 Procedural justice: governance of the impacts and inclusiveness

Looking at people's experience of resource access after dam construction in the case studies analysed as specified in the previous sections we found an unbalanced distribution of natural resources use between different agents (i.e. affected communities, dam builders, government authorities, and energy users), without proper compensation, consultation and mitigation of the impacts (procedural justice) as further discussed in this section.

According to most of the legislations in the countries where large dams are built, before construction can start an Environmental Impact Assessment (EIA) is usually required and needs to be approved by the local authorities. The ESIA should include a list of the social and environmental impacts of the dam, a resettlement planning framework, and the mitigation plan that details measures for reducing the environmental and social implications of the dam, including compensation provided to the affected communities. Moreover, according to international guidelines and standards affected communities should be consulted and actively involved in the decision making process since the beginning of the dam construction process (WCD, 2000). In the case studies analysed we found various shortcomings in the preparation of the EIA, consultation and participation of the local affected people, as well as the implementation of social and environmental safeguards measures, as specified hereafter.

3.2.1 Bui dam

In the case of Bui dam in Ghana the EIA has been commissioned before the construction of the dam by the Ministry of Energy of the Ghanaian government and carried out by the UK firm Environmental Resources Management (EMR) (Hensengerth, 2013; Environmental Resources Management, 2007). According to the environmental regulations in Ghana, before a development project is approved an environmental permit, obtained through the presentation of the EIA, has to be issued and presented to the Environment Protection Agency (EPA). Only when the environmental permit is obtained the loan agreement with the project funder, in this case China ExIm Bank, can be signed (Hensengerth, 2011). This procedure is important to assure that the EIA is carried out before the development of projects starts. A new local authority was created by the Ghanaian government for the management of the dam and its impacts, including the implementation of the resettlement plan, namely the Bui Power Authority (BPA). BPA is the only governmental authority with full decision power for the management, plan and execution of the Bui dam project. Even though environmental regulations and standards in Ghana are relatively strong and they reflect international standards, particularly those developed by the World Bank, and standards of the International Organisation for Standardisation (ISO) (Hensengerth, 2011), there were shortcomings in relation to the implementation of alternative livelihood schemes included in the EIA. People interviewed lamented in particular the lack of implementation of livelihood support schemes which were part of the social mitigation strategy. These included new skills training, such as providing farm equipment, new fishing techniques and new infrastructure, such as irrigation technologies, to support existing livelihoods particularly farming and fishing.

3.2.2 Kamchay dam

In the case of Kamchay dam, in Cambodia an approved Environmental Impact Assessment (EIA) is required for development projects such as dams before the dam construction can start. Moreover, consultation with all stakeholders is mandatory. The Cambodian Ministry of Environment is responsible for the conduction of the EIA and monitoring compliance with environmental legislation (Grimsditch, 2012). Nevertheless, the EIA of the Kamchay dam was approved after the construction

started. Moreover, the consultation process at the dam area was not inclusive of all affected people as our fieldwork finds and other reports confirmed (International Rivers, 2013).
Many villagers were not invited to consultation processes and became only aware of the dam once construction had started: *"Before they constructed the dam, I did not know about it. I just saw they cleared the land and I knew that they were constructing the dam"*.
On the contrary, village chiefs were involved in the consultation process, however without actively participating in the negotiation phase: *"we just went to listen to them (the Hydropower Company)"*; and *"during consultation the company already told us that people should find alternative jobs instead of collecting bamboo"*.
In addition, the implementation of mitigation measures included in the Environmental Management Plan (EMP) to mitigate the negative environmental effects of the dam construction was in place only at the late stages of the dam construction. Moreover, the US$ 5 million for implementing mitigating measures, such as replanting 2,000ha of forest, set aside by Sinohydro have never been used by the Chinese company for mitigation purposes (Middleton, 2008).
Moreover, in terms of compensation bamboo collectors, fruit vendors and fishers who lost livelihood security to the dam were not considered for compensation payments, as they did not have legal rights to the land they were using for collecting NTFPs needed to support their livelihoods.

3.2.3 Bakun dam

In the case of Bakun dam, specific environmental requirements need to be fulfilled before large infrastructure projects such as dam can be built. One of the most important environmental requirements is the preparation of the EIA which after completion needs to be approved by the Director General of Environmental Quality. The project is not allowed to proceed unless approval of the EIA report has been granted (Department of Environment, 2010). University Malaysia Sarawak (UNIMAS) acted as the main consultant for the EIA of the Bakun project. Interaction and communication with resettled people during the preparation of the EIA including negotiations of compensation terms, land allocations and resettlement have been carried out mainly between village leaders, village committees and state departments. Suggestions for compensation were discussed within the communities and brought by the village leaders to the attention of the government. However, according to interviews with the affected communities and village leaders these suggestions were never taken into consideration by the government. Moreover, villagers have been only informed by the government about the benefits of the dam, they did not participate actively in the negotiation process, but only indirectly through their village leaders, as specified in the following quote: *"15 affected villages gave suggestions about resettlements, on the allocation of lands, compensation and other issues, but sadly the suggestions were not followed. It was because the Chief Minister of that time did not agree with them. During the meeting the Chief Minister angrily asked, "Why are you asking for so much land?" and he said, "If given to the Chinese, even with a little land, they can grow a lot of plants"* (quote from village man in Sungei Asap resettlement site).
Moreover looking at compensation issues, interviewees stated that in terms of house compensation, only after more than ten years of complaints and struggles with the Government villagers obtained to get the new house in the resettlement site for free. Initially the Government was giving a new

house at a value of RM[4] 52 thousands maximum, if the value of the old house at Bakun was lower, then villagers had to pay the price difference by loan. However after more than ten years of negotiations the villagers managed to get back the differential they paid to the Government. Moreover, land compensation given to the villagers is stated to be too small, only 3 acres instead of the 10 acres initially promised by the government to villagers.

4. **Conclusions**

According to ecological economics, intra-generational distributive justice is achieved when changes in the allocation of resources over time and space do not frustrate the potential satisfaction of the needs of human economic agents. In other words, investments in infrastructure development should assure a balanced resource access by competing users or alternatively a just compensation and mitigation of the impacts, so that the satisfaction of basic needs, such as access to energy services, food provision and livelihoods of affected communities is secured. In the case studies analysed equity-based principles, such as distributive and procedural justice, have not been taken into consideration by dam builders and local developers in the decision making process. Therefore, local people's needs were not fully recognised in the planning and implementation phases of the projects. From a political ecology perspective the paper showed how the construction of the dams has altered the human-environment interactions of affected communities, as well as how local authorities and dam builders have exerted their power over the use of natural resources.

Control over the access to natural resources by dam builders and local authorities through land enclosures and diversion of the use of resources (land, forest, water) from local communities' uses (food production and livelihoods) to energy production purposes had profound impacts on society-environment interactions. Several beneficiaries of the dams have been identified: dam builders which will receive revenue from the construction of the dams (such as Chinese overseas leading builder, Sinohydro); the recipient of the electricity in urban areas (Phnom Penh, in Cambodia, Accra in Ghana and towns and Bintulu in Sarawak, Malaysia); the host government in terms of improved energy access at the national level and the possibility of strengthening economic ties with Chinese investors. However, in the case studies analysed, hectares of forestry resources were flooded or cordoned off, removing access to the local communities who are dependent on its provision for their livelihoods. As such, their livelihoods were threatened by the change in the physical environment of the dam building. In addition, the dams alter the water ecology and affect fisheries and water supplies (including drinking supplies) for the local communities. This further threatens their fundamental rights to food and water, which reinforce and reproduce social and economic inequality between the government officials, dam builders and local communities. Moreover, the limited participation and consultation of local affected people on one side and the dam-builders and host government agencies on the other side, illustrates the unequal power relations between these various stakeholders in the political environment, which resulted in the poor recognition of the victims and impacts of the projects. While large dams are considered a low carbon energy source, and can provide electricity to millions of people in countries in Africa and Asia, this research found

[4] RM is the Malaysian Ringgit, the currency of Malaysia.

significant room for improvement in the way the construction of the dams has been managed by the host governments in the case studies analysed. In terms of environmental protection, we suggest that national governments, especially in the case of Cambodia and Sarawak, Malaysia, have strict EIA legislations in addition to robust enforcement and monitoring of impact mitigation and ecological protection measures for large dams. In terms of social implications, compensation payments need to be tailored to include all the affected villagers through a better recognition of the victims, including those relying on NTFPs from land with customary rights. In addition, distributional justice concerns in terms of electricity access and affordable electricity prices for people affected by dams, need to be taken into consideration by policy makers as specified in the United Nations Sustainable Development Goals for 2030 (United Nations, 2015). Even though it is difficult to assess the overall effects of a specific dam, the weighing of benefits and costs will always be contentious, hydropower dams as a developmental infrastructure should also involve public participation through various forums and the basic principles of good governance should be applied (i.e. procedural justice): transparent decision-making, informing local people properly and listening to and addressing their concerns following a truly inclusive view of the communities. This can be done by the implementation of qualitative research methods, such as field research, in-depth interviews and focus groups as showed in this paper, but also through institutional representation of affected people from the early stages of project management. We also suggest that dam-builders and national governments implement a distributive justice approach to impact mitigation by maintaining a balance between natural resource use for infrastructure development and natural resource access to affected communities for the satisfaction of their basic needs. As showed in this paper, social justice approaches to large dams' development represent the opportunity for policy makers to explore where injustices occur (distribution); recognizing sections of society impacted by new energy projects (recognition); and therefore develop new processes of avoidance and remediation (procedure). According to our results the latter include, but are by no means limited to: redistributing benefits between competing users through just compensation for the losses and access to affordable energy prices for affected people; acknowledgment of non-recognised victims through for instance the recognition of customary land rights; inclusiveness and better institutional representation in the decision making process of local affected communities.

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