

# Hydropower in India: A Source of Heightened Risk and Inequality

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In June 2013 the northern Indian state of Uttarakhand was rocked by devastating floods that claimed an estimated 5,700 lives (Kazmin 2013). Such was the devastation wrought – an accurate figure may never be known. The fast-moving floodwaters formed on the steep Himalayan slopes in the state's north and ravaged villages as they careered through the valleys downstream. This disaster awoke the realisation amongst much of the Indian populace that the drivers of such an event were as much human-induced as they were nature-induced. An extreme rainfall event and the melting of Himalayan glaciers contributed to the floods, but so too did poor land-use governance and a general disregard for the environmental impacts of development (Chopra 2014, p. 18). Bidwai argues that the worst culprit was the proliferation of hydropower dam construction in the region (2013). This essay examines the environmental impact of hydropower projects, both large and small, in India. It will be argued that large hydropower produces many negative environmental and social outcomes, the impacts of which are unevenly distributed because the most marginalised communities lack participation and recognition in the decision-making process. Further, it will be argued that whilst small hydropower serves as an answer to many of the problems produced by large hydropower, a lack of government oversight still leaves surrounding communities vulnerable. Finally, the economic motives for large hydropower will be examined and used to explain the Indian governments neglect of pico hydropower despite the technologies ability to deliver electrification to inaccessible rural communities.

Water, in many forms, is celebrated throughout Indian society. The Ganga River, in Uttarakhand, is India's most sacred river and the destination of many pilgrimages – many of these pilgrims became victims of the 2013 floods (Chopra et al. 2014, p. 34-35). Large dams have traditionally been an icon of nation-building in India, symbols of modernity. Prime Minister Jawahar Nehru described dams as "Temples of Modern India" (Raina 2000, p. 148). In recent years, harnessing the potential of rivers to generate electricity through hydropower has been key to meeting the growing energy demands of India's developing economy. India is the world's third largest energy consumer, but, per capita, consume only one-third of the global average (US Energy Information Administration 2016, p. 1-2). The generation of electricity is seen as essential to India's ability to raise living standards across the country, with 400 million citizens currently living without access to it (Mishra, Khare & Agrawal 2015, p. 102). National demand was predicted to grow from 250,000 MW in 2015 to 800,000 MW in 2031-32 (Mishra, Khare & Agrawal 2015, p. 102). With 85,000 MW of untapped energy potential, hydropower projects are key to meeting this growing demand. As such – water, through its ability to support the livelihoods of India's one billion-strong population, will remain an icon of Modern India for many years to come.

Hydropower is said to be a mature technology in India, with a long history dating back to 1897. Sitting on the foothills of the Himalayas with an abundance of rivers fed by monsoonal rains, India's geography lends itself to the generation of electricity through this means. Hydropower, by definition, is a renewable source of energy as it relies on the earth's natural water cycle. However, its definition as an environmentally and socially responsible source of energy production is much more contentious – as argued in state of Uttarakhand and across India more broadly after the 2013 floods. This argument demands all the more attention in Uttarakhand given that many of the sites identified for future hydropower development in India lie within the state. Thus far, discussion in this essay has referred loosely to the concept of 'hydropower'. However, further discussion will separate hydropower into two categories – large hydropower (LHP) and small hydropower (SHP). The distinction is made necessary by the differing environmental and social impacts imposed by the respective facilities. Making the distinction on a global scale creates something of a grey area, as there is no internationally accepted definition of what size

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constitutes each characterisation. For the purpose of this essay SHP will refer to any facility with an energy output below 25 MW, whilst LHP will refer to any facility generating a volume above that level.

Large Hydropower development is synonymous with the construction of large dams, which have both positive and negative environmental and social impacts. At independence in 1947, India had fewer than 300 large dams, yet by the turn of the century it ranked third globally for large dam construction, with over 4000 built (Bhosekar, Vinayakam & Deolalikar 2009, p. 38). A significant portion of this essay will be dedicated to the discussion of the negative environmental impacts of these dams, but it would be unfair to omit any discussion of the benefits of large hydropower dams. The most obvious benefit of LHP is the generation of electricity to support India's developing economy. Hydropower dams also serve a dual purpose, in that they provide irrigation potential for rural areas. The damming of water also allows for the control of the flow of water in areas that experience seasonal rainfall – such as monsoonal India. Below, it will be explained why the negative impacts of LHP outweigh these benefits.

The discussion of the negative impacts of LHP dams will begin with those linked to the environment. The construction of a dam wall blocks the passage of water and leads to land use change – the source of many of these problems. When a reservoir is created behind the dam wall, valleys are flooded, and significant loss of forests and wildlife occurs. The loss of forests negatively impacts the earth's ability to regulate air and water quality and results in significant greenhouse gas emissions. The dams disrupt the movement of both fish and their prey heading downstream. Changes in land use and water density affect water temperature, again negatively impacting local aquatic life. Dams block the flow of sediment, leading to dangerous build up behind the dam wall and as Burton writes – contribute to navigation issues and flood risk upstream (1994, p. 62). The latter is significant to the 2013 Uttarakhand floods and this risk will be elaborated on throughout the essay. Sediment is also blocked from moving downstream to the areas in which it forms a vital part of the local ecosystem (Kondolf et al. 2014, p. 256). There are significant environmental impacts associated with the construction phase of LHP dam projects too. Despite its associated 'green energy' tag, the vast number of environmental risks associated with LHP dams is reason alone to warrant a serious re-think of their merits.

Heavily linked to the environmental impacts of large hydropower dams, are their social impacts. One risk that has been the source of many public demonstrations against dam building through India's history is human displacement. The protests against the recently completed Sardar Sarovar Dam on the Narmada River has been one of the most prominent of these demonstrations. The dam is one of 30 large dams (amongst a total of 3000 dams) built in the enormous Narmada Valley Project, from which the total number of displaced people is said to be upwards of one million people. Hemadri et al. estimated in 1999 that the total displacement arising from India's post-independence dam construction was somewhere between 21 million and 50 million people (p. vii). Compounding the impact of the displacement is the inadequate rehabilitative system which Mehta writes focuses too much on financial compensation for lost assets and too little on replacement of destroyed livelihoods and loss of self-sustainability (2005, p. 643). Huber goes one step further to claim that obtaining such compensation in cases of hydropower dam construction in India can rest on social status (2019, p. 423).

Tribal populations make up a large portion of the estimated 320,000 people displaced and thousands more effected by the Sardar Sarovar Dam (Mehta 2005, p. 615). Their plight is largely ignored by a government whose weak legislation does not recognise their customary rights to land ownership and whose justification for this exploitative behaviour mirrors similar justification used in the late-colonial era. A framework for the determination of resettlement and rehabilitation rights for those affected by the dam does exist in the form of the Narmada Water Disputes Tribunal Award (NWDT Award). However, one's right to make a claim rests on their ability to prove ownership of a land title. Tribal populations make up a significant number of the displaced in the Narmada Valley, in the case of the Sardar Sarovar Dam, Hemadri et al. estimate this figure to be 57.6% (1999, p. xxii). Many of these people have no official land title despite living in the valley for generations, cultivating the land to which they hold strong customary rights (Mehta 2005, p. 632). The NWDT Award does not recognise customary claims though, only accounting for those with a legal land title. Despite this upheaval, the government promised the benefits of this project outweigh the discussed costs. Such justification saw Flood draw parallels to late-colonial era reasoning that sought to justify "cultural and environmental displaced of indigenous people on the grounds

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that it brought the benefits of modern civilisation to 'backward' cultures" (1997, p. 16). The major benefit from the construction of the hydroelectric element of the Sardar Sarovar Dam was said to be increased electricity output. This would prove of little assistance to the poorer tribal populations most effected by the dam. As Flood writes, electricity is primarily used by urban consumers, the tribal populations depend on other sources of energy – namely biomass (1997, p. 14). This disproves the argument that benefits from the dam would be shared throughout society. The above discussion pertains to issues of environmental justice, in which the those with less political agency are disproportionately affected.

David Schlosberg's environmental justice framework serves as a good way to consider the way in which the impacts of interactions between humans and the environment are unevenly distributed throughout society. He argues that theories of liberal justice tend to reduce our understanding of injustices to issues of distribution (Schlosberg 2007, p.518). His assertion is supported by Young, who writes of the need to delve beyond issues of distribution in order to arrive at reasons for this injustice (1990, p. 1). The solution offered up by Schlosberg is a three-pronged approach to a discussion of environmental justice that is encompassing of – distribution, recognition and participation. A consideration of the latter two goes some way to explaining the existence of the former. Recognition refers the way in which privilege and oppression work to recognise the vulnerabilities of some parts of society, but not others. Recognition injustice occurs in the above example of tribal people in the Narmada Valley. The framework to provide compensation for the displacement of these people inadequately recognised their history and practices by not allowing those with customary claims on land rights to be compensated. Further, in reference to compensation for hydroelectric dams built in Uttarakhand, Huber found that social status was a big determinant of one's ability to make a claim (2019, p. 423). Participatory justice refers to the ability of various social groups to participate in the decision-making process. Such a concept is particularly interesting in the case of India – self-coined 'the world's largest democracy'. Hemadri et al. argue that women are disempowered by displacement because they have limited ability within the family structure to take part in the decision-making process that determines how any compensation money will be spent (1999, p. xxiii). Similarly, tribal populations are less equipped to negotiate with state officials and court. This saw the non-tribal population twice as successful than the tribal population in securing resettlement land, when eligible. Whilst a more detailed evaluation of the political and financial incentives for hydropower construction will be undertaken below, it becomes evident that those most vulnerable to its impacts are not represented or recognised in the decision-making process. Consequently, the impacts of large hydropower development are disproportionately distributed through society, particularly at the expense of tribal populations and women.

The social impacts of LHP are felt downstream too. Rivers form the livelihoods of many rural populations – they rely on the flow of water for personal and agricultural use, and the supply of aquatic life for fishing operations. The construction and operation of LHP dams threatens these activities. LHP dams are structures of control, empowering its owners and operators to control the flow of resources downstream. This leads to not only distributive injustice, but also participatory injustice. Prior to the construction of the dam, it was very hard for any party to gain control of a river. To achieve desired outcomes required the engagement of all who interacted with the river. However, dams are a man-made mechanism by which its owners can consolidate control of rivers and negate the need for communal cooperation. In an even more sinister sense, dam construction can be used as a tool to exert global political control. Much concern exists over China's dam-building activities on the Upper Mekong River. These fears are chiefly related to the control China stands to gain over less powerful countries downstream – Myanmar, Thailand, Laos, Cambodia and Vietnam. China claims that the series of dams it is constructing in the Mekong serve the purpose of hydropower proliferation and the development of shipping routes, many are more cynical though (Goh 2004, p.12; Bernstein 2017; Global Risk Intelligence 2019, p. 17).

After the June 2013 Uttarakhand floods, waters receded in the deep valleys of the Himalayan state to reveal the extent of the damage. The impacts, besides the death toll previously discussed, were devastating. Major infrastructure was destroyed – including over 2,300 roads, 1,400 drinking water schemes and 145 bridges (Chopra 2014, p. 14). An estimated 4,200 villages were affected, over 300 of them seriously (Chopra). Kedarnath was one of the worst hit, buried deep in mud, silt, boulders and rubble. Survivors and first responders recalled scenes of unresponsive limbs poking out from beneath feet of rubble. The floods came after a decade of intensive hydropower dam development in the Indian Himalayas. The ambitious plan of the Indian government to triple its

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hydropower generation capacity between 2003 and 2025 led to a congestion of dams along Himalayan rivers, in some places built only 10km apart (Schneider 2014). One professor described the congestion as created by a 'dam culture', similar to the road congestion created by Mumbai and Delhi's 'car culture' (Schneider 2014). Arguing against discourse that blames the floods on natural causes, Chopra writes that through this development process the state government continually displayed an anti-environment attitude in pushing for a model of economic growth that disregarded local environmental fragilities (2014, p. 18).

An independent report submitted to the Ministry of Environment and Forests in 2014 found that hydropower development in Uttarakhand significantly amplified the severity of the floods. Chiefly responsible, the report concluded, was the poorly managed construction process of the dams, which left mountains rocks, debris, silt and mud unmanaged along riverbanks (Schneider 2014). The report also noted the individual project-orientated nature of previous environmental impact assessments, arguing they neglected to consider the cumulative impact of building multiple dams in close proximity along the same river system. A 2014 Oxfam Report into the 2013 floods identified deforestation as a major contributing factor. The report says that the construction of hydropower dams has been a major driver of the steady decrease in forested areas in Uttarakhand since independence (Chopra 2014, p. 19). There is a strong correlation between deforestation, intense rainfall events and landslides, such as those that swept across the town of Kedarnath during the 2013 floods (Bhatt 1992). Despite the wealth of evidence suggesting the role of hydropower dams in the 2013 floods, the Indian governments have swayed little from their dam building agenda as on March 7, 2019 they reclassified all LHP dams as 'renewable'.

Successive Indian union and state governments have adopted a policy of ignorance when it comes to the environmental and social risks of hydropower development. Huber found that even in Sikkim, one of India's most environmentally conscious states, obvious risks have been brushed 'under the carpet' in favour of economic considerations (2019, p. 419). Hydropower development has long been economically motivated in India's Eastern Himalayan region, labelled 'India's future powerhouse' (Vagholikar & Das 2010, p. 1). Governments have facilitated and incentivised the entrance of private investors into this hydro-business model by shielding them from accountability (Huber 2019, p. 419). This in turn has increased the uneven distribution of vulnerabilities created. The hydropower business model created by state governments privatises public goods for consumption elsewhere, whilst externalising the risks locally (Huber 2019, p. 429). In this way, privatisation policies have worked to ignore and further the risks of hydropower in the Himalayas.

The environmental and social impacts of LHP have been comprehensively covered in this essay, attention will now turn to an alternative form of hydropower – small hydropower (SHP). SHP comprises of hydropower plants with an electricity generation capacity of 25 MW or less. SHP serves as an alternative to LHP and an answer to the drawbacks that projects on the scale of the latter carry (Nautiyal et al. 2011, p. 2022; Mishra et al. 2015, p. 102). The benefits of SHP compared to LHP stem from both the size and type of infrastructure built. As the name suggests, SHP is smaller in nature than LHP and does not require big dams for water storage, reducing the risk of deforestation and displacement. About 75% of SHP uses a run-of-river design, relying on the natural flow of the river to drive its turbines (Mishra et al. 2015, p. 104). Projects of this type are less intrusive on the natural environment as they negate the need for large dams and the associated negative impacts they bring. SHP projects are also said to be a more appropriate way to electrify rural areas, as only a stream or smaller river is required (Nautiyal et al. 2011, p. 2024). They provide a more cost-effective option than other alternatives (Mishra et al. 2015, p. 104) and have a shorter energy payback time (Nautiyal et al. 2011, p. 2022).

The development of SHP in India is not without its impacts. The advent of these can be linked to the belief that SHP is safe and the Indian government's resulting policy of exempting projects of this nature from environmental impact assessments (Jumani et al. 2017, p. 501). Despite promising to be small and non-disruptive in nature, many rural communities have found that SHP plants built near them are anything but that. Basu explored the impact of SHP in rural areas on kuhls – low cost, community managed irrigation systems. He found that disruptions to the flow of water into Jadhval Kuhl had impacted more than 300 farmers and caused a decline in 289 species of fish (Basu 2017). A study by Jumani et al. across nine villages impacted by SHP construction saw 68.5% of respondents perceive a decline in fish abundance (2017, p. 505). Whilst SHP appears to negate many of the major drawbacks of LHP, there is greater need for the Indian government to scrutinise their development

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more closely – particularly in instances where many are built in close proximity.

Pico hydro, defined as hydropower facilities with a power generation capacity of under 1 KW (some definitions suggest 5 KW), addresses the problems that larger SHP facilities cannot. The advantages of this technology are twofold: it is sustainable, and it provides electrification to rural communities in hard-to-access areas that larger hydropower has failed to do. Its small size, operating on a household or small community scale, lends itself to the avoidance of the negative environmental and social impacts that larger hydro projects carry – deforestation, displacement and disruption to aquatic life. Pico hydro is also a more accessible source of electricity for communities in the most inaccessible areas. Kapoor writes of the successful installation of 400 pico schemes in the Indian state of Karnataka – empowering communities who were previously served by unreliable or non-existent grid electricity supply (2013, p. 870). Pico technology is also a popular technology in Laos, though its development is stifled by underrepresentation in government policy. It is estimated that 20% of households have access to the technology in the northern regions of Laos (Smits & Bush 2010, p. 121). The hilly terrain and the abundance of streams located in this area make pico hydro an ideal source of energy. Pico offers an equitable alternative to the proliferation of LHP in Laos, and a solution to the transborder environmental injustices wrought by these large dams, of which up to 95% of the electricity generated is exported to Thailand (Matthews 2012, p. 401). Smits & Bush partly attribute this underutilisation of pico technology to the Laos governments economic motivations, as evidenced by its rent-seeking behaviour (2010, p. 125). In contrast to LHP, the invisible system of pico technology supply and operation makes it hard to monitor, control and therefore, profit from (Smits & Bush 2010, p. 125). Whilst considerable differences in governance structures exist between Laos and India, what they do share in common is the underutilisation of environmentally and socially just alternatives, in favour of pursuing the economic rewards of large-scale development.

This essay has examined India's attempts to capture the electricity generating potential of water through hydropower technology. Whilst hydropower presents a cleaner option than dirtier forms of electricity production, it does not come without its negative impacts. This essay has identified a number of these environmental and social impacts occurring as a result of hydropower dam facilities. Environmental impacts include deforestation, the loss of wildlife, the loss of aquatic life, changes to the flow of waterways, changes in water temperature, the build-up of sediment and the creation of landslide hazards. Social impacts include human displacement, loss of livelihood and heightened flood risk. Schlosberg's environmental justice framework was then used to argue that the distributive injustice of tribal displacement, wrought by large hydropower schemes, was largely a result of the tribal communities lacking participation in the decision-making process and lacking recognition of their plight by government officials. Several policy and structural faults were identified to explain why the proliferation of hazardous large hydropower schemes continues to this day, despite the lessons learnt from the 2013 Uttarakhand flood disaster. This includes privatisation policies that shield investors from accountability, identified risks being ignored in favour of economic development and the recent reclassification of large hydropower schemes as 'renewable' sources of energy. Whilst small hydropower is shown to produce fewer negative impacts than large hydropower and is more cost-effective, it is not without its own risks. These risks stem from poor government policy that allows small hydro projects to be constructed without undergoing an environmental impact assessment. Pico hydropower is then suggested as an alternative to both large and small hydro developments. However, as is the case in Laos, the Indian government is motivated by the economic incentives of large hydro. Thus, the potential of pico hydro is vastly underutilised despite its suitability for providing electricity to inaccessible rural communities. As its middle class continues to swell, the Indian government must seek to meet its citizens increasing demand for energy. Hydropower will no doubt be central to those conversations. However, those in positions of power must be mindful of the environmental and social impacts that this supposed 'green technology' imposes on local communities, particularly those living on the margins. With a greater awareness of the way land and river use changes affect the environment, future disasters on the scale of the Uttarakhand floods of 2013 can be avoided.

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