

Sustainable Development and Environmental Challenges: A Case Study of Dibang Hydro Power Megaproject

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Abstract

Large Hydropower projects are often seen as a symbol of sustainable development and clean energy, but their actual social, ecological, and cultural consequences remain extremely debatable. This paper aims to examine the Dibang Multipurpose Hydropower project in Arunachal Pradesh, North East India to understand how sustainability is practiced and understood in mega infrastructure development. Using the Dibang project as case study, the paper analyses projects commitment towards Sustainability development goals, particularly areas related to Energy, Environmental protection, social justice, and community participation. The paper collects data from Governmental reports, Environmental impact assessment reports, policy, documents, and existing literature. The study aims to review the Trade-offs between energy security, ecological conservation, and indigenous livelihoods and the participation.

Keywords: Dibang Project Dam, Development, Indigenous Local Communities

Introduction

Hydropower is a crucial element of sustainable energy solutions worldwide. By harnessing natural river and water body flows, it plays a vital role in meeting global energy needs while reducing environmental impacts linked to fossil fuels. Hydropower significantly contributes to various Sustainable Development Goals (SDGs) set by the United Nations, providing dependable electricity to urban and rural areas, enhancing living standards, fostering economic growth, and promoting a sustainable future.

Currently, hydroelectric energy is the most common source of renewable energy production, and it accounts for around 70 % of all sustainable energy production around the World. By reducing reliance on fossil fuels, hydropower aids in curbing greenhouse gas emissions and supports sustainable development goals. Hydropower is pivotal to India's energy strategy, offering clean and sustainable electricity (Barlocher, 2021). The Dibang Hydropower project aligns closely with India's aspirations to augment the share of renewable energy sources in its energy portfolio, thereby strengthening energy security and fostering economic growth.

While hydroelectric dams have been able to contribute greatly to human socio-economic development, they have also caused significant impacts on the hydrological cycle and on freshwater ecosystems. Wherever natural hydrological cycles are modified, large portions of natural habitats are flooded, biodiversity is lost, and the surrounding environment deteriorates (MoEF&CC, 2016).

This Paper presents an overview of the Dibang Multipurpose Dam Project, which aims to harness the substantial hydropower potential of the Dibang River in Arunachal Pradesh. With an envisioned capacity

exceeding 2,880 megawatts, it is positioned as a significant source of renewable energy to meet increasing demand of renewable energy production. However, the chapter also discusses concerns regarding potential adverse impacts and environmental risks associated with the project. It explores the complex interplay of interests among various stakeholders involved in the project.

The Paper is divided into four sections. The first section explores the various dimensions of sustainability, emphasizing how hydropower fits into this broader concept. It discusses the environmental, social, and economic aspects that need to be considered to ensure sustainable development. The second section focuses specifically on the Dibang hydropower project and examines how it aligns with the Sustainable Development Goals (SDGs). It highlights the project's potential contributions to renewable energy generation and its role in meeting regional and national energy demands. The third section underlines into the impacts—both positive and negative—of the Dibang hydroelectric project. It critically assesses how the construction and operation of the dam could affect the local ecosystem, including flora, fauna, and communities residing in the area. This section discusses potential disruptions to biodiversity and socio-economic implications for local populations. The final part of the Paper addresses the differing perspectives and controversies surrounding the Dibang project. It examines the various stakeholder viewpoints, including affected communities, environmental activists, and governmental agencies. Furthermore, it explores how the government has attempted to manage and mitigate these controversies through policy measures, consultation processes, and environmental impact assessments.

Research gap

Despite several existing studies on hydropower development, sustainability, and associated environmental risks, region-specific research examining the Sustainable Development Goals (SDGs), indigenous livelihoods, environmental governance, and policies in Northeast India remains limited. While the Dibang Multipurpose Dam project is mentioned in various policy reports and articles, systematic academic studies addressing on-ground socio-environmental concerns are limited. This study offers a holistic, case-based assessment of the Dibang project through the lens of sustainable development and effective environmental governance.

Different aspects of Sustainability

The notion of human beings living harmoniously with nature has ancient roots, but gained modern significance through the concept of sustainable development which emerged alongside environmental movements in the late 1960s and early 1970s. It became a focal point at the 1972 United Nations Conference on the Human Environment in Stockholm, leading to the Stockholm Declaration. This declaration asserted the possibility of achieving economic growth equitably while minimizing environmental harm. “The idea evolved and was crystallized in the 1987 UN report "Our Common Future," defining sustainable development as "meeting present needs without compromising the ability of future generations to meet their own" (WCED, 1987). Governments, businesses, and civil society have since strived to embed sustainability into development practices. This commitment was further underscored by the 1992 Rio Declaration and reaffirmed at the 2002 Johannesburg Declaration, marking milestones in global sustainable development efforts. (UNCED, 1992).

The World Summit on Sustainable Development in 2002 stipulated in of its Plan of Implementation that hydropower should be included in the drive to increase the contribution of renewable energy throughout

the world. In recent times this has been further supplemented by climate change mitigation and adaptation targets (WSSD, 2002).

Hydropower projects are complex, involving economic, social, and environmental dimensions that must be balanced for sustainability. Economically, sustainability requires efficient resource use and minimizing unforeseen costs through evaluation. Socially, hydropower can alleviate poverty and improve community well-being by providing access to clean energy and water, reducing health risks, and fostering economic opportunities, especially in remote areas. However, negative social impacts like resettlement and environmental concerns such as reduced fish stocks and ecosystem disruptions must be carefully managed through improved planning and mitigation strategies. Environmentally, hydropower contributes minimally to global issues like pollution and climate change, serving as critical infrastructure for water management (Malek et al, 2010).

Hydropower projects, such as the Dibang mega dam in India, are increasingly prevalent globally due to growing energy demands and the abundant potential of hydropower (Kumari, 2024). While these projects offer substantial energy generation capabilities, they also bring significant environmental and social implications hence the sustainability of hydropower development is critical and necessitates thorough assessment. Studies have evaluated both the benefits and costs of hydropower projects across different regions, emphasizing the need for a comprehensive understanding of their environmental and community impacts. Evaluating the economic performance and greenhouse gas emissions of hydropower dams is crucial for their role in clean energy transitions and climate change mitigation (Baurzhan et al., 2021). Additionally, the social impacts of dam-induced displacement and resettlement underscore the complex challenges faced by affected communities (Huang et al., 2018).

In addressing these considerations, it is essential to conduct holistic evaluations that integrate ecosystem health, human well-being, and environmental sustainability into the planning and implementation of hydropower projects (Kittinger et al., 2010). Incorporating assessments of environmental flows, evaluating climate change impacts on dam safety, and considering emissions assessments for sustainable dam structures are crucial steps towards promoting responsible hydropower development (Alvanchi et al., 2020). By engaging in transparent decision-making processes and addressing these multidimensional aspects, stakeholders can work towards achieving sustainable hydropower development that balances energy needs with environmental and social considerations.

Dibang Hydropower Project and Sustainable Development Goals

Sustainable development encompasses economic, social, and environmental dimensions (Malek, 2010). In the context of the Dibang Hydropower project, which is a significant developmental initiative, the focus on enhancing production and productivity aligns with sustainable development goals, especially in rural areas where agriculture is a primary livelihood source (Schindler et al., 2015). The Dibang Hydropower project can align with sustainable development by incorporating principles of sustainability in its operations, focusing on enhancing productivity sustainably, integrating green practices, and fostering collaboration across various stakeholders to address economic, social, and environmental aspects of development (Vishnoi, 2023).

Economic and Social considerations

Typically, Hydropower project promises various economic and social benefits to the beneficiaries that could significantly uplift the region where it is implemented. Economically, it is expected to create jobs,

generate income, and develop infrastructure, thereby fostering overall economic growth and advancement (Wang et al., 2020). These benefits extend to local communities by providing employment opportunities, additional income sources, further compensating to those adversely affected which not only improve individual financial well-being but also stimulate local economies and support livelihoods (Ibid).

Socially, the Dibang Hydroproject anticipates substantial positive impacts on the local community. These include enhanced community infrastructure, improved public services, and increased involvement in local development initiatives (Recho, ND). The project aims to promote social cohesion and community participation, offering avenues for residents to engage and benefit from its outcomes (Vishnoi, 2023). Moreover, it seeks to elevate the overall quality of life in the area.

Furthermore, the project is poised to support sustainable community development by fostering social and cultural growth (Ibid). Through encouraging community engagement and participation, the project can enhance social well-being and promote cultural exchange within the region (Recho, ND). Additionally, the economic benefits generated are expected to raise living standards and improve overall community welfare (Inchima, 2021).

Arunachal Chief Minister, Pema Khandu during his last year site inspection visit stated, “Arunachal Pradesh is set to receive about Rs 700 crore every year in free power from the 2,880-MW Dibang Multipurpose Project alone.” He added, “More than the megawatts, the project is about jobs for our youth, funds for local development, and new opportunities in tourism and business. It's about making sure that the people of Dibang and across Arunachal feel the impact of growth in their daily lives.” (India Today, NE, 2025)

Despite of all these benefits, the project initially has faced strong resistance from the local communities as the project’s implications are far reaching.

Local Communities Reasons on resisting the Dam Project

The controversy surrounding the Dibang project is multifaceted. It involves a range of issues encompassing environmental, social, and economic concerns that have led to opposition from indigenous communities, biodiversity threats, and conflicts between stakeholders. Addressing these issues requires a comprehensive understanding of the impacts of hydroelectric projects and the implementation of sustainable practices to mitigate negative consequences (Sharma, 2018).

The Dibang Multipurpose Project (DMP) proposed on the Dibang river in Arunachal Pradesh by NHPC Ltd (National Hydro Power Corporation), is said to be India’s highest dam. A concrete gravity dam that will resist the pressure of impounding water through its own weight, its capacity is 3000 megawatts (MW). The dam is a hydropower-cum-flood moderation scheme to be set up in Munli, which is situated about 43km from Roing (Ministry of Power, 2024)

The Idu Mishmi tribe, residing in the Dibang Valley and Lower Dibang Valley districts and referring to the river Dibang as Talon, depend largely on agriculture and animal husbandry. They vehemently oppose the project due to concerns about livelihood loss, land damage, and the potential threat to their traditional lifestyle (Pisharoty, 2019).

Safety Concerns Regarding Dibang Dam

A committee appointed by the Planning Commission (Dr. C.D. Thatte & Dr. M.S. Reddy) raised serious doubts about the geological stability of the Subansiri Lower Project's dam foundation, constructed by NHPC Ltd. The committee warned that NHPC disregarded seismic design recommendations, potentially

under-designing for the region's seismic hazards. So based on these past experiences, safety concerns related to seismic risks and dam stability has been raised. Local communities fear similar oversights in the construction of the Dibang project. (Mimi, 2013)

Environmental Impact

The Dibang project will submerge 4009 hectares of land and affect 43 villages, displacing 859 families from the Idu Mishmi tribe. It involves acquiring 5827.8 hectares of land, including 5056.50 hectares of community forests. The influx of 5800 laborers for the project could significantly alter the demographics of the area, which is home to the small Idu Mishmi tribe (Bhattacharya, 2023). Moreover, the dam's reservoir would disrupt natural sediment flow downstream, affecting soil fertility and agriculture, while also obstructing fish migration routes, crucial for local fisheries and ecosystems (Gupta et al, 2024).

Biodiversity Threat

The Dibang river, with its islands and bird species, is an Important Bird Area and potential Ramsar site. The project's impact on this ecosystem, including the endangered Bengal Florican, is a major concern raised by the Bombay Natural History Society (Mokany et al, 2012). Moreover, study shows that the region is a homeland to endangered mammal species like Asiatic golden cats, snow tigers and clouded leopards (Jain, 2020).

Social and Cultural Impact

The social implications concerns raised about the compensatory afforestation requirements under the Forest Conservation Act on local tribal communities, particularly affecting their land rights, losing their ancestral land and forests, central to tribe's livelihoods and cultural practices such as the rearing of Mithun cattle, are significant. The Bombay Natural History Society has highlighted the potential adverse effects of such requirements on indigenous communities, echoing broader issues of dispossession and cultural disruption faced by tribal groups (Mimi, 2013).

Land Use and Livelihoods

Land use and livelihoods within the expansive 59,811.88-hectare catchment area of the Dibang project are deeply intertwined and face substantial impacts. The implementation of reservoir maintenance necessitates stringent land use restrictions, posing threats to traditional jhum cultivation—a cornerstone of local agriculture—and the sustainable livelihoods of surrounding communities. These restrictions could potentially result in the displacement of villages and the degradation of nearby lands, exacerbating the socio-economic challenges already faced by affected communities. The dual pressures of land use change and livelihood disruption underscore the complex and multifaceted impacts of large-scale infrastructure projects on local ecosystems and societies (Sharma, 2018; Mimi, 2013).

Overview of the Dibang Multipurpose Project, its Environmental Contentious, and Compliance issues

The Dibang river originates on the Indo-Chinese (or rather -Tibetan) border, and then flows through the Mishmi Hills in the Upper Dibang valley district and the Lower Dibang Valley District. After a length of 195 km, it enters the River Lohit, an upstream tributary of the transboundary Brahmaputra River system,

flows and merges in the Ganges Delta in Bangladesh, before ending its course in the Bay of Bengal (Ibid). In the Lower Dibang valley, the river has a steep river gradient and often changes its course in spring due to an increase of upstream glacial meltwaters, which in turn can cause flooding of agricultural lands and forests, as well as landslides. The high stream gradient of the river makes it ideal for harnessing hydropower. As of July 2016, a total of eighteen hydropower projects, with a power potential ranging from 20 to 4500 MW, had been proposed or planned in the Dibang basin (Malek et al, 2020). However, it is one particular dam project that has provoked much controversy: the Dibang Multipurpose Project.

This project is distinctively multipurpose compared to other dam projects in the state of Arunachal Pradesh because it serves as a storage-based hydroelectric initiative aimed at managing floods caused by the Brahmaputra River's monsoon overflow in Assam (Pisharoty, 2019)

This proposed dam's first stone was laid in 2008 without any prior Environment Impact assessment (EIA), but the project was halted multiple times due to massive opposition from local Idu Mishmi population, international environmental protectionists, scientists, and lawyers. In fact, the Idu Mishmis are an ethnic community, and the Dibang Valley is their ancestral home. The construction of this dam would oblige them to move from their traditional land and would flood a forest which is not only their primary source of subsistence, but which also holds great spiritual value for them. Being traditionally animistic, Idu Mishmis attribute intellectual capacities such as rationality and culture to non-human creatures, be it spirits or animals. Their beliefs prompt them to have a profound respect towards nature because forests house and protect all types of creatures.

As mentioned above, the construction of this dam would have several benefits but would also have negative effects on the local populations and environment. On the one hand the construction of the dam plans to generate income for the Arunachal Pradesh district given that it would create many job opportunities. Furthermore, the transport of heavy machinery and the arrival of workers would entail the construction of roads and amenities which could enhance the socio-economic situation of locals. Finally, the dam itself would generate up to 3000 MG of electricity and reduce the risk of any downstream floods.

Impact on Ecosystem and Downstream Area

On another hand, the flooding of the reservoir would cause the displacement of some 13'000 people, mainly belonging to the Idu Mishmi tribe, from their ancestral lands, as well as destroy many hectares of forest and rare flora. Moreover, the dam will hinder the local fish species from migrating, and natural sedimentation of minerals from flowing downstream. The blocked sedimentation will induce a reduced soil fertility over time, which will essentially affect downstream farmers, but the build-up of sediments will also increase the risk of clogging up in the dam, thus reducing its performance of producing power.

The Dibang high dam is located in seismic zone V and experiences heavy rainfall during the monsoon season. With a vast reservoir spanning 43.0 km, there is concern that intense rainfall coupled with a significant earthquake could saturate steep slopes, potentially triggering large-scale landslides. These landslides could generate water waves within the reservoir, potentially leading to overtopping and posing significant safety risks to downstream areas in Assam, regardless of the dam's structural integrity (Vagholika, 2010). Local communities in downstream Assam had expressed opposition to the project, citing concerns about its impact on the Dibru-Saikhowa Park along the Assam-Arunachal Pradesh border. They had called for comprehensive environmental impact assessments (EIAs) that consider their needs and ensure compensation in case of dam failure (Saikia, 2012).

Legal and Regulatory Challenges

The project has faced legal challenges related to environmental clearances and compliance with forest conservation laws. India's Forest Rights Act, which recognizes the rights of forest-dwelling communities, adds another layer of complexity to the issue.

The project initially faced criticism due to the ecological impact. It involved felling of over 300,000 trees which would disrupt the habitat of wildlife species like elephants, hoolock gibbon, clouded leopard, tiger, fishing cat, snow leopard and the Himalayan black bear that have the highest protection under the country's wildlife laws (Hill, 2017).

Therefore, the project was earlier rejected by the environment ministry's forest advisory committee (FAC) twice – July 2013 and April 2014 – on account of environmental and social concerns. In one of the rejections, in July 2013, the FAC had even noted that “ecological, environmental and social costs of diversion of such a vast tract of forest land, which is a major source of livelihood of the tribal population of the state, will far outweigh the benefits likely to accrue from the project.” (Chakraborty, 2015)

Following this, a revised plan proposing a reduction of the dam height from 288 to 278 meters, and resultant reduction of forest land requirement by 478.6 hectares (taking the requirement to 4,577.84 hectares from the 5,056.5 hectares originally proposed) was submitted. The number of trees to be felled was reduced from 3.5 lakh to 3.2 lakh (Bhattacharya, 2023). This proposal too was initially rejected as the Forest Advisory Committee (FAC) deemed the reduction insufficient to mitigate the project's impact on the biodiversity-rich forest ecosystem in Arunachal Pradesh. Despite earlier concerns about endemic species, the project received stage-I clearance in September 2014 and stage-II in September 2020, with economic viability overriding further height reductions to preserve more forest and finally stage -II clearance came in September 2020 (Aggarwal, 2019).

It is interesting to note here that in its February 28, 2017 deliberations, the FAC emphasized that “the land in which the project is proposed covers two pristine forests with riverine growth that once cut cannot be replaced, the experts wrote in their letter” (Jha, 2022). The Union power ministry and the MoEF&CC's impact assessment division approved the project despite these environmental concerns. Minutes from a May 28, 2022 FAC meeting noted transparency concerns and unresolved approval issues, though supporting documents have not been made public (Perinchery, 2022). Despite objections from environmentalists and local communities, the project ultimately gained FAC clearance in a very arbitrary manner, despite many flaws in the EIA report (Down to earth, 2015) illustrating the challenge of balancing development with environmental preservation in major infrastructure endeavours.

The approval from the Ministry of Environment, Forests and Climate Change (MoEF&CC) is primarily driven by economic considerations. It aims to provide uninterrupted electricity to Arunachal Pradesh, with the state receiving 13.46% of the power generated from the project at no cost, amounting to 12% of the total power. Additionally, local communities will receive 1% of the power for free through a local area development fund. These benefits total Rs 26,785 crores over the project's 40-year lifespan. Moreover, the project will facilitate significant water storage capacity, aiding in annual flood control in parts of Arunachal Pradesh and Assam (Pisharoty, 2019).

Measures taken by the Government

The Government of Arunachal Pradesh in its “Vision 2030” had set a target to develop full hydropower potential of the state. This is in line with the plan of Government of India to develop the hydropower potential in North Eastern States for long-term, sustainable development of NE Region, in addition to

providing clean green energy for the nation (vishnoi, 2023) Besides generating around 11233 MU of electricity every year and providing peaking support of average 6 hours on daily basis, the project will provide flood mitigation, which will be significantly beneficial for downstream areas of Arunachal Pradesh and Assam.

The Indian government and state authorities are managing the Dibang Multipurpose Project (DMP) to balance economic growth with environmental conservation and indigenous community rights. Initially designed for 3000 MW, the project's dam height was reduced to 2880 MW after optimization studies aimed at minimizing forest land impact. Environmental and social assessments are integral to planning, alongside engineering and financial considerations. Cumulative Impact Assessment and Environmental impact assessment of upstream and downstream basin of the project has been carried out to minimise the negative impacts (MoEF&CC, 2016).

The project team engaged local communities through participatory approaches, incorporating their feedback from EIA and EMP public hearings. NHPC has allocated Rs. 640 crores, including Rs. 171 crores in the EMP, to address community concerns and enhance environmental and social mitigation measures (Vishnoi, 2019).

Hydraulic studies showed minimal downstream water level impact, with flood moderation reducing submergence by 45% during extreme events. Compensatory Afforestation plans to plant 9200 hectares, double the diverted forest area, supported by Rs. 213.44 crore. Wildlife conservation includes Rs. 17.85 crore for ex-situ efforts like orchidarium and nest boxes. Socioeconomic plans prioritize local community rights with Rs. 819 crores disbursed for land compensation and rehabilitation. Rs. 70 crore funds community development including infrastructure and educational initiatives. The DMP aims to generate local employment, improve infrastructure, and provide Arunachal Pradesh with significant benefits such as free power and annual development funds of approximately Rs. 100 crores. Additionally, Rs. 380 crore is allocated for forestry conservation and research through State CAMPA (Compensatory Afforestation Fund Management and Planning Authority) (Pisharoty, 2019).

Following these, In the year 2019, one of the important measures taken by the government to mitigate concerns regarding the dam amidst the controversy was the press release statement. It stated that the Cabinet Committee on Economic Affairs (CCEA) has approved the Dam Safety Bill, 2019, which will address surveillance, inspection, operation, and maintenance of specified dams nationwide. It includes the establishment of a National Committee on Dam Safety to develop policies and endorse key regulations. Additionally, the Bill introduces provisions for a 'National Dam Safety Authority', a regulatory body responsible for formulating safety policies, while each state will establish a 'Dam Safety Organisation' managed by field officers (Pisharoty, 2019). As per the latest NHPC records, the project is progressing as a major, yet controversial sustainable energy initiative.

Conclusion

In summary, sustainable development presents a crucial framework for tackling today's pressing environmental challenges, illustrated by projects such as the Dibang Hydroelectric Project. While these endeavours aim to meet rising energy demands, they must navigate intricate ecological landscapes and societal expectations. The project highlights the importance of rigorous environmental impact assessments, inclusive stakeholder engagement, and adaptive management practices to ensure that development aligns with long-term sustainability objectives. A significant challenge involves the potential disturbance to local biodiversity and ecosystems caused by the construction therefore, the project needs to

prioritize strategies that consider and alleviate these impacts and safeguard the ecological equilibrium of the area through constant monitoring and assessment to ensure the long-term sustainability of this project. Furthermore, the environmental impact assessment (EIA) process has faced criticism for inadequately addressing ecosystem risks (Naidu, 2022). Controversies surrounding these projects often lead to conflicts among affected communities, companies, and governmental bodies, particularly when consultations and comprehensive environmental studies are lacking.

Given these controversies, it is crucial to prioritize sustainability considerations in such projects. Effective stakeholder management and conflict resolution are essential for addressing sustainable development challenges associated with hydroelectric schemes, as observed in these projects. Looking ahead, integrating robust policies, technological advancements, and community-centered approaches will be essential in achieving a harmonious balance between development goals and environmental preservation. Lastly, if these guidelines are adhered properly, Dibang Project can serve as a model for sustainable and inclusive development in the 21st century.

In conclusion, the sustainability of the Dibang project will only be determined once it is completed in 2032. Stakeholders will need to observe whether it achieves its intended objectives and fulfils its promises of uninterrupted electricity supply, local community benefits, restoration and rehabilitation of ecosystem and effective flood control measures. The success of the project in meeting these goals will be crucial in evaluating its long-term sustainability and impact on the region. Thus, the coming years will be pivotal in assessing the project's overall effectiveness and durability.

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