



BALANCING POWER AND PROGRESS: THE SOCIO- ENVIRONMENTAL DYNAMICS OF DAM DEVELOPMENT IN NORTHEASTERN INDIA

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Abstract

The quest for power and energy has its roots in the aspirations of nations to achieve economic growth and development for a better future. As the 20th century came to a close, dams emerged as pivotal players in the realm of energy generation technology. Global concerns about climate change and the increasing desire for a clean and environmentally friendly future have significantly propelled the construction of dams, surpassing the preference for thermal and nuclear power plants. This shift is primarily attributed to the perception of hydropower energy as a cleaner and more sustainable alternative, in contrast to traditional, polluting energy generation methods such as thermal and nuclear power.

In the Indian context, dam construction has been an integral part of the nation's journey since gaining independence, intensifying in tandem with India's pursuit of economic growth and development. Notably, numerous mega-dams have been erected on the country's major rivers, including the Bhakra-Nangal dam on the Sutlej River, Sardar Sarovar Dam in Narmada river, Hirakud Dam on the Mahanadi River, Nagarjuna Sagar dam on the Krishna River, Pandoh dam on the Beas River, Ukai dam on the Tapti River, Gandhi Sagar dam on the Chambal River, and others. These monumental structures have been revered as the cornerstones of energy security and instrumental in driving India's economic progress. In terms of cost-benefit analyses dams have some good things they do, like preventing floods, helping with farming by providing water for irrigation, and making electricity. But we also need to think about the bad things about dams, like how they can harm the environment and the people who live both downstream and upstream from the dam. It's like weighing the good and bad sides of dams to decide if they're a good idea or not.

The north-eastern region of India has been recognized as the nation's upcoming economic hub, and there are plans for approximately 168 substantial hydroelectric projects, aiming for a combined installed capacity of 63,328 megawatts in the area. There is considerable apprehension regarding the confirmed and anticipated societal and environmental consequences of these hydroelectric initiatives in the north-eastern area. This paper delves into the Assam context, emphasizing the sociological aspects of hydropower project development in North-eastern India and its ramifications on the environment and local ecology in the downstream areas in Assam.

Keywords- Large dams, North East India, Downstream impact, Environmental sociology, Assam, Environment, Ecological impact

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INTRODUCTION

North-eastern India, a region known for its lush green landscapes, diverse cultures, and unique biodiversity, has witnessed a substantial surge in dam development over the past few decades. The promise of hydropower generation, water resource management, and economic growth has driven numerous dam projects in this region, leading to profound socio-environmental changes. While these initiatives have the potential to address pressing energy needs and enhance the overall infrastructure, they also bring forth complex challenges related to environmental preservation, indigenous rights, and equitable development. The lush ecosystems of North-eastern India are home to many endemic species, and the indigenous communities rely heavily on these ecosystems for their cultural and economic sustenance.

STATEMENT OF THE PROBLEM

The extensive construction of dams in North-eastern India poses a multifaceted challenge. It necessitates a careful examination of how the development of these dams intersects with the socio-environmental dynamics of the region. The collision between the quest for power generation and progress with the preservation of the environment and the safeguarding of indigenous rights is a central concern. As these dams become increasingly integral to the region's development, it is vital to assess the trade-offs and synergies between economic progress, environmental sustainability, and social justice. This paper aims to explore into this intricate interplay between power and progress, seeking to understand the socio-environmental dynamics that arise from dam development in North-eastern India.

SIGNIFICANCE OF THE STUDY

This research is significant for several reasons. Firstly, it contributes to the growing body of literature on dam development and its socio-environmental implications, particularly in the context of North-eastern India, where the discourse remains limited. Secondly, it offers insights into the challenges and opportunities for policymakers, local communities, and development practitioners who seek sustainable and equitable solutions for dam projects. Understanding the socio-environmental dynamics of dam development is crucial for achieving a balance between economic growth and the preservation of the unique ecosystems and cultures in this region.

LITERATURE REVIEW

Environmental Impact

One of the prominent themes in the literature on dam development in North-eastern India is its environmental impact. Dutta and Saikia (2019) underscored the significant ecological implications of dam projects. They noted that these projects can lead to alterations in river ecosystems, disruptions in natural water flow patterns, and adverse consequences for aquatic biodiversity. Such impacts are often felt downstream, affecting not only the environment but also the livelihoods of local communities. The study calls for careful consideration of environmental concerns in the planning and execution of dam projects (Dutta & Saikia, 2019).

Displacement and resettlement issues are a recurrent concern in the literature. Mahanta and Bordoloi (2018) examined the challenges associated with the displacement of local communities in the context of the Ranganadi Hydroelectric Project. Their research highlighted the difficulties in ensuring the effective resettlement and compensation of displaced populations. The study argued that finding suitable alternative livelihoods and ensuring the well-being of those displaced pose considerable challenges, leading to disruptions in the socio-economic fabric of affected communities (Mahanta & Bordoloi, 2018).

The cultural and social impacts of dam development on indigenous and local communities in North-eastern India have been another significant research focus. Pathak (2017) conducted a case study of the Ranganadi Hydroelectric Project, shedding light on the erosion of traditional lifestyles, cultural practices, and social cohesion among affected communities. This research emphasized the need to consider cultural preservation and community well-being as essential components of dam development projects (Pathak, 2017).

Water resource management, particularly in the context of dam development, has been a subject of investigation. Kalita and Barua (2016) explored the impact of the Kopili Dam on flood and water resource management in downstream areas. Their study demonstrated that the construction of dams can lead to complex changes in water availability and quality, with consequences for agriculture, fisheries, and overall water management in the region (Kalita & Barua, 2016).

Regulatory and governance challenges associated with dam projects in North-eastern India have also garnered research attention. Roy and Pandey (2018) critically analyzed the governance of

hydropower development in the Northeast Indian Himalayas. They highlighted the complexity of decision-making processes, environmental assessments, and the role of government agencies in dam development. The study pointed out that opaque decision-making and the potential for corruption can hinder effective governance and regulation (Roy & Pandey, 2018).

The development of dams often triggers conflicts and protests, as affected communities and environmental activists raise concerns about the environmental and socio-economic impacts of such projects. Hussain and Das (2014) conducted a study on dam politics and protests in North-eastern India, using the Subansiri Lower Hydroelectric Project as a case study. Their research provided insights into the nature of conflicts and protests that can arise, as well as the implications for project timelines and costs (Hussain & Das, 2014).

Researchers in the region have also analyzed the trade-offs associated with dam development. Hazarika and Bhattacharjya (2016) assessed the benefits and costs of small hydropower projects in North-eastern India. The study highlighted the need to balance the advantages of dam projects, such as hydroelectric power generation, irrigation, and flood control, with the negative socio-environmental consequences. The research underscored the importance of informed decision-making and impact assessment (Hazarika & Bhattacharjya, 2016).

In response to the multifaceted challenges posed by dam development, the concept of adaptive management has gained attention in the literature. Some studies, such as the one by Hazarika and Bhattacharjya (2016), emphasize the need for flexible and responsive approaches to mitigate negative impacts and adapt to changing circumstances during and after dam construction. Adaptive management strategies are seen as essential for enhancing the sustainability and socio-environmental acceptability of dam projects in North-eastern India (Hazarika & Bhattacharjya, 2016).

The findings from past dam development projects in North-eastern India have provided valuable lessons for future endeavors. Policymakers and stakeholders can use these insights to make more informed decisions, address the challenges posed by dams, and improve the sustainability and social acceptability of future projects. The accumulated knowledge from the literature emphasizes the importance of comprehensive assessments, careful planning, and responsive strategies to navigate the complexities of dam development in this region.

The literature on dam development in North-eastern India reflects a rich body of research that addresses critical socio-environmental, regulatory, and adaptive management aspects of dam projects. These studies collectively provide a comprehensive understanding of the challenges and opportunities associated with dam development in a region known for its ecological diversity and cultural richness. While dam development is pursued for its potential benefits, it is essential to consider the environmental, social, and cultural context in order to create sustainable and equitable outcomes. The lessons learned from past experiences serve as valuable guidance for shaping the future of dam development in North-eastern India.

RESEARCH OBJECTIVES

The primary objective of this study is to comprehensively analyze the socio-environmental dynamics associated with dam development in North-eastern India.

RESEARCH QUESTIONS

To achieve this overarching goal, we will address the following research questions:

- What are the socio-environmental impacts of dam development in North-eastern India on local communities and indigenous populations?
- How do power structures and decision-making processes influence dam development in the region?
- What policy frameworks and community-based initiatives exist to balance power and progress in the context of dam development?

METHODOLOGY

In this study, a rigorous secondary data analysis approach is employed to explore our research topic in-depth. The primary sources of secondary data encompass a wide range of materials, including books, scholarly journals, government reports, newspaper articles, and various other reliable sources. These sources collectively constitute a valuable repository of previously gathered and published information pertinent to our research objectives.

THEORETICAL FRAMEWORKS ON SOCIO-ENVIRONMENTAL DYNAMICS

The socio-environmental dynamics of dam development involve complex interconnections between human societies and their natural surroundings. Theoretical frameworks provide valuable lenses through which we can understand these dynamics, analyzing the intricate relationships between dams, ecosystems, and

communities. In this overview, we explore several key theoretical perspectives that shed light on the social and environmental dimensions of dam development.

Political ecology offers a robust framework for understanding the socio-environmental dynamics of dam development. This perspective emphasizes the power relations that shape decisions regarding dam construction. Scholars employing political ecology examine how political, economic, and institutional forces influence the allocation of water resources, the displacement of communities, and the distribution of costs and benefits. This framework highlights the importance of recognizing the often uneven distribution of environmental impacts and how these dynamics are shaped by societal power structures (Blaikie & Brookfield, 1987).

The concept of environmental justice is central to understanding the impacts of dam development on marginalized communities. Environmental justice theories emphasize the disproportionate burden of environmental hazards and dislocations borne by disadvantaged groups. In the context of dams, this framework emphasize how historically marginalized populations, including indigenous communities and low-income groups, are often the most affected by displacement, loss of livelihoods, and ecological degradation. Environmental justice theory calls for equitable decision-making processes and the fair distribution of the costs and benefits of dam development (Schlosberg & Collins, 2014).

SIA is a practical framework used to analyze the social consequences of dam development. It employs a multidisciplinary approach to assess the potential impacts on local communities, considering aspects such as livelihoods, culture, and quality of life. SIA frameworks are instrumental in predicting and mitigating the negative social outcomes of dam projects. They provide a structured method for involving affected communities in the decision-making process, ensuring that their concerns are addressed and integrated into project planning (Vanclay, Esteves, & Aucamp, 2015).

Resilience theory is increasingly relevant in the context of dam development and its socio-environmental impacts. It focuses on the adaptive capacity of communities and ecosystems to withstand and recover from disruptions caused by dam projects. This framework recognizes the potential for both social and ecological systems to adapt and reorganize in response to change. In the context of dams, resilience theory emphasizes the need for adaptive management strategies that allow

for the flexible response to unforeseen consequences and the promotion of sustainability in the face of complex socio-environmental challenges (Folke et al., 2010).

Social capital theory explores the social relationships, networks, and trust that influence the ability of communities to address the impacts of dam development. It emphasizes the importance of community cohesion and collective action in responding to socio-environmental challenges. Communities with strong social capital are often better equipped to negotiate for their rights, access resources, and participate in decision-making processes related to dams. This theoretical framework highlights the role of social capital in empowering communities to address and mitigate negative impacts (Putnam, 2000).

Stakeholder theory provides a perspective on the multiple actors involved in dam development and their interests. This framework emphasizes the importance of recognizing and engaging with a wide range of stakeholders, including affected communities, government agencies, NGOs, and private sector entities. By understanding the diverse interests and concerns of these stakeholders, it becomes possible to foster collaborative and inclusive decision-making processes that take into account the social and environmental dimensions of dam development (Freeman, 2010).

The ecological modernization framework focuses on the potential for technological and institutional innovations to address environmental challenges. In the context of dams, it highlights the importance of developing and implementing environmentally sustainable technologies and practices. This perspective promotes the integration of eco-friendly engineering solutions, such as fish ladders and sediment management, to reduce the ecological impact of dams while allowing for the generation of clean energy and water resource management (Mol, 2002).

The socio-environmental dynamics of dam development require a nuanced and interdisciplinary approach to understand the complex interactions between ecological systems, human societies, and the institutions that govern them. These theoretical frameworks offer valuable insights into the power structures, justice considerations, and adaptive strategies that underlie the impacts of dam projects on local communities and ecosystems. Combining these perspectives can help guide policymakers, practitioners, and researchers in creating more sustainable and socially just approaches to dam development that

balance the pursuit of economic benefits with the protection of the environment and the well-being of affected communities.

SOCIO-ENVIRONMENTAL DYNAMICS

Overview of the Major Dams in North-eastern India

North-eastern India, a region characterized by its breathtaking landscapes, abundant water resources, and cultural diversity, is home to several major dams that serve various purposes, from hydroelectric power generation to flood control and irrigation. These dams play a crucial role in the socio-economic development of the region. This overview provides insights into some of the most significant dams in North-eastern India, their purposes, and their socio-environmental impacts, drawing from a range of studies and reports.

1. Loktak Hydroelectric Project, Manipur

The Loktak Hydroelectric Project, located in Manipur, is one of the prominent dams in North-eastern India. It harnesses the potential of the Loktak Lake, the largest freshwater lake in North-eastern India, for hydroelectric power generation. The project, commissioned in 1983, has an installed capacity of 105 MW (NHPC, 2020). It not only contributes to the region's power needs but also serves as a flood control mechanism. However, the project has raised concerns about its impact on the lake's ecology and the traditional livelihoods of local communities (NHPC, 2020).

2. Subansiri Lower Hydroelectric Project, Assam and Arunachal Pradesh

The Subansiri Lower Hydroelectric Project, situated in Assam and Arunachal Pradesh, is one of the largest dam projects in North-eastern India. Once completed, it is expected to have a substantial installed capacity of 2,000 MW (NHPC, 2020). The project has faced significant delays and protests due to concerns about its environmental and social impact, including potential downstream consequences for river ecosystems and local communities (NHPC, 2020). It exemplifies the challenges associated with large-scale dam development in the region.

3. Ranganadi Hydroelectric Project, Assam

The Ranganadi Hydroelectric Project, located in Assam, is a vital source of power for the state. This dam has an installed capacity of 405 MW (NHPC, 2020). The project, commissioned in 2001, draws water from the Ranganadi River and contributes to both electricity generation and flood control (NHPC, 2020). However, research has

highlighted the socio-environmental challenges posed by the project, including the displacement of local communities and changes in river ecology (Mahanta & Bordoloi, 2018).

4. Kopili Hydroelectric Project, Assam

The Kopili Hydroelectric Project, also in Assam, is another notable dam development in North-eastern India. Commissioned in 1977, it has an installed capacity of 275 MW (NHPC, 2020). The project primarily focuses on electricity generation and has played a role in boosting Assam's power supply. However, it has also had environmental consequences, with research highlighting its impact on flood patterns and water resource management in downstream areas (Kalita & Barua, 2016).

5. Doyang Hydroelectric Project, Nagaland

The Doyang Hydroelectric Project in Nagaland is a smaller-scale dam project with an installed capacity of 75 MW (NHPC, 2020). It contributes to both electricity generation and flood control. This project has helped improve power availability in Nagaland, contributing to the region's socio-economic development. However, like other dam projects, it is not without its socio-environmental challenges, which require careful management and mitigation (NHPC, 2020).

6. Khandong Dam, Meghalaya

The Khandong Dam in Meghalaya serves primarily for water supply and irrigation. It is located on the Uiam River and provides water for both domestic and agricultural use. The dam plays a critical role in supporting agriculture in the state. However, it is essential to manage the reservoir and surrounding catchment areas sustainably to ensure continued access to clean water for local communities (CEA, 2019).

7. Rongnichu Hydroelectric Project, Sikkim

The Rongnichu Hydroelectric Project in Sikkim is a smaller dam with an installed capacity of 21 MW (NHPC, 2020). It contributes to electricity generation and supports the power needs of the state. The project reflects the region's focus on harnessing its water resources for sustainable energy production. Like other dams, it requires careful monitoring and management to address potential environmental and social concerns (NHPC, 2020).

The construction and operation of major dams in North-eastern India have significant socio-environmental implications. These projects often entail the displacement of local communities,

affecting their traditional livelihoods and social cohesion (Mahanta & Bordoloi, 2018). Dams can lead to changes in river ecosystems, impacting aquatic biodiversity and altering natural water flow patterns (Dutta & Saikia, 2019). The socio-environmental consequences, including cultural erosion and ecological disruption, underline the importance of comprehensive environmental assessments, effective resettlement and compensation programs, and adaptive management strategies (Pathak, 2017; Hazarika & Bhattacharjya, 2016).

Major dams in North-eastern India play a crucial role in fulfilling the region's energy and water resource needs. They have the potential to drive socio-economic development and provide flood control mechanisms. However, their construction and operation also pose environmental and social challenges that necessitate careful planning and management. The ongoing research and attention to these issues highlight the importance of adopting sustainable and adaptive strategies to ensure that major dams in the region contribute to long-term development while minimizing their socio-environmental impact.

Impacts on Local Communities and Indigenous Populations

While dam development holds the promise of economic growth and infrastructural advancement, it has far-reaching consequences for local communities and particularly for indigenous populations. The construction of dams often necessitates the displacement of communities from their traditional lands and livelihoods. Indigenous groups, in particular, frequently experience the loss of their cultural heritage, disrupted lifestyles, and challenges adapting to new environments. Disputes over compensation, resettlement, and the loss of access to essential resources like water and forests can strain the social fabric of these communities.

Environmental Consequences and Ecological Changes

Dam development in North-eastern India leads to a series of environmental consequences and ecological changes. Alterations in river flow patterns, sedimentation rates, and temperature can disrupt aquatic ecosystems and jeopardize native flora and fauna. Changes in water levels and quality can have cascading impacts on agriculture, fisheries, and the delicate ecological balance of the region. Additionally, the inundation of land for reservoirs often results in deforestation, further impacting local biodiversity and contributing to greenhouse gas emissions.

Power Structures and Decision-Making Processes in Dam Development

The dynamics of power structures and decision-making processes play a pivotal role in the development of dams in North-eastern India. Government agencies, corporate entities, and influential stakeholders often wield significant control over the planning and execution of dam projects. This concentration of decision-making power can sometimes come at the expense of local and indigenous populations, who may find their voices marginalized. The decision-making process frequently lacks transparency and public participation, contributing to a lack of accountability. Environmental and social impact assessments, though mandated, are at times criticized for their inadequacy and limited consideration of long-term environmental and societal consequences.

These entrenched power structures and decision-making processes underscore the central challenge of balancing power and progress in the realm of dam development in North-eastern India. The lack of meaningful community involvement and the dominance of external interests can hinder the achievement of sustainable, equitable, and environmentally responsible development in the region. Understanding and addressing these socio-environmental dynamics is essential for fostering responsible, balanced, and inclusive approaches to dam development in North-eastern India.

BALANCING POWER AND PROGRESS

Government Policies and Regulatory Frameworks

Effective governance through well-structured policies and regulatory frameworks can play a crucial role in balancing power and progress in the context of dam development. Government policies should prioritize environmental sustainability, social justice, and the protection of indigenous rights. Robust regulatory mechanisms are essential to ensure that dam projects adhere to stringent environmental impact assessments and social safeguards. A transparent and accountable decision-making process, guided by these policies and frameworks, can help mitigate the negative consequences of dam development.

The Role of Local Communities and Grassroots Movements

Local communities and grassroots movements are vital actors in the endeavor to balance power and progress in dam development. Their active participation and advocacy can empower them to

negotiate for their rights and interests. Grassroots movements can amplify local voices and raise awareness of socio-environmental concerns associated with dams. Engaging with local communities in the decision-making process, listening to their concerns, and respecting their traditional knowledge are essential steps toward achieving a more equitable and sustainable approach to dam development.

Collaborative and Sustainable Development Approaches

Collaborative and sustainable development approaches offer promising avenues for balancing power and progress. Collaboration between government agencies, project developers, local communities, and environmental organizations can foster a more holistic understanding of the complex challenges posed by dam development. The adoption of sustainable development practices emphasizes a balanced integration of economic growth, environmental conservation, and social well-being. Such approaches recognize the interdependence of these factors and strive for long-term, equitable benefits.

Case Studies Illustrating Successful or Unsuccessful Attempts at Balancing Power and Progress

Examining specific case studies can shed light on both successful and unsuccessful attempts at balancing power and progress in dam development in North-eastern India. Successful cases highlight instances where government policies, community involvement, and sustainable development approaches have led to positive outcomes, such as minimized environmental impacts and equitable benefits for local communities. In contrast, unsuccessful cases reveal situations where power imbalances, inadequate policies, and limited community engagement have resulted in adverse socio-environmental consequences, including displacement, ecological degradation, and social conflict.

By analyzing such case studies, this research aims to provide insights into the strategies and practices that can contribute to more effective and equitable dam development in North-eastern India. It is imperative to draw lessons from both successful and unsuccessful attempts to inform future policies and practices, ultimately promoting a more balanced and sustainable approach to dam development in the region.

MAJOR FINDINGS

Socio-economic Disparities: Dam development projects can lead to socio-economic disparities, where affected communities may not equally benefit from the development, and some groups may be disproportionately impacted in terms of displacement, livelihoods, and access to resources.

- **Environmental Impact:** Dam projects have a significant impact on the environment. They can alter river ecosystems, disrupt natural water flow patterns, and affect aquatic biodiversity. These changes have downstream consequences for the environment and local communities, impacting the overall ecological balance.

- **Displacement and Resettlement:** Many dam development projects lead to the displacement of local communities. However, the effectiveness of resettlement and compensation programs is often a major concern. Finding suitable alternative livelihoods for displaced populations and ensuring their well-being is challenging and can result in social and economic disruptions.

- **Cultural and Social Impacts:** Dams can have cultural and social impacts on indigenous and local communities. Traditional lifestyles, cultural practices, and social cohesion can be eroded, leading to a loss of cultural identity and social disruption.

- **Water Resource Management:** Dam construction can have complex impacts on water resources. Changes in water availability and quality can affect agriculture, fisheries, and overall water management in the region. This can have far-reaching consequences for the livelihoods and well-being of local communities.

- **Regulatory and Governance Challenges:** Dam projects often face complex regulatory and governance issues. Decision-making processes, environmental assessments, and the role of government agencies can be opaque and sometimes prone to corruption, creating challenges in ensuring transparency and accountability in project development.

- **Conflicts and Protests:** The development of dams frequently triggers conflicts and protests. Affected communities and environmental activists may challenge these projects due to concerns about their environmental and socio-economic impacts. These conflicts can lead to delays and added costs for the projects.

- **Benefits and Trade-offs:** Researchers often examine the trade-offs associated with dam development. While dams offer benefits such as hydroelectric power generation, irrigation, and flood control, these benefits must be weighed against the negative socio-environmental consequences. Striking a balance between

development benefits and environmental and social costs is a key challenge.

• **Adaptive Management:** Some studies emphasize the importance of adaptive management in dam development. This approach advocates for flexible and responsive strategies to mitigate negative impacts and adapt to changing circumstances during and after dam construction, helping to enhance the sustainability of such projects.

• **Lessons for Future Projects:** The findings from past dam development projects offer valuable lessons for future endeavors. Policymakers and stakeholders can use these insights to make more informed decisions, address the challenges posed by dams, and improve the sustainability and social acceptability of future projects.

These findings highlight the complex and multifaceted nature of dam development projects and emphasize the need for comprehensive assessments, careful planning, and adaptive management to ensure the sustainability and equitable outcomes of such ventures.

CONCLUSION

The socio-environmental dynamics of dam development in north-eastern India are emblematic of the global challenge of reconciling the need for power generation with the imperative of environmental sustainability. The region's dams have undoubtedly been instrumental in propelling progress and prosperity, but they have also brought to the forefront the critical need to respect the rights and cultures of indigenous communities and preserve the environment. Striking a balance between power and progress necessitates thoughtful planning, inclusive decision-making, and sustainable engineering practices. It is a challenge that requires collective efforts, not just for the people of north-eastern India but for the entire world, as we grapple with similar dilemmas in our pursuit of a sustainable future.

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