EPRA International Journal of Socio-Economic and Environmental Outlook (SEEO) ISSN: 2348-4101
Volume: 10 | Issue: 7| July 2023 | SJIF Impact Factor (2023): 8.153 | Journal DOI: 10.36713/epra0314 | Peer-Reviewed Journal

ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS OF HYDRO POWER PROJECT: A CASE STUDY OF THE LOKTAK HYDROELECTRIC PROJECT IN MANIPUR

Mairembam Rajeev Singh[1], Dr. Kh. Tomba Singh[2]
[1]*Research Scholar, Department of Commerce, Manipur University, Canchipur, Imphal-795003*
[2]*Professor, Department of Commerce, Manipur University, Canchipur, Imphal-795003*

Article DOI: https://doi.org/10.36713/epra13794
DOI No: 10.36713/epra13794

ABSTRACT
Energy is essential to modern economies and to living in the modern world. To achieve economic growth, improve living conditions, and alleviate poverty, it is essential. Access to energy is therefore considered one of the most important development goals. Due to factors such as high energy costs, unaffordable grid infrastructure, and geographically dispersed populations, providing access to the majority of the world's population can prove challenging. Renewable energy technologies, on the other hand, provide affordable and sustainable electricity to millions of people. There are a number of economically viable options for rural electrification through renewable energy technologies. In terms of renewable energy, India heavily relies on hydropower. Hydropower projects can adversely affect the environment and socio-economic well-being of the population. As an energy source, hydropower contributes to economic development and meets the growing energy needs of countries. Dam construction, however, alters water flow and sediment load, adversely impacting the environment and the population's livelihoods. Various differences exist between upstream and downstream needs, demands, and challenges. In this paper, we attempt to assess the effects of hydropower projects on society in terms of the environment as well as socio-economic conditions.

KEYWORDS: *Impact, Hydroelectric, Livelihood, Displacement, and Decommission.*

1. INTRODUCTION

Global power utilization is expected to increase throughout the years because populations are growing, industrialization is expanding, urbanization is happening, and modernization is taking place. The United Nations Energy Data Organization's Global Energy Outlook 2013 indicates that the worldwide essential energy requirements are 1.60 × 1014 kWh currently and are expected to reach close to 2.40 × 1014 kWh by 2040. There will be a large increase in global electricity use within 15–20 years. In one to two decades, China, India, Morocco, etc., are expected to double their electricity consumption (Pazheri et al., 2014).

Hydropower system produces around 20% of the world's power. Compared to other forms of energy, such as fossil fuels, hydropower is generally considered a 'clean' energy source. A country's carbon footprint is reduced by using hydropower as a renewable energy source (Nguyen et al., 2016). The emissions of greenhouse gases from hydropower plants are much lower than those from thermal power plants. As vegetation decays in flooded areas and cement is extensively used in dam construction, hydropower creates greenhouse gas emissions (Kalitsi, 2003).

There are, however, some negative social and environmental impacts of hydropower reservoir construction, including the loss of traditional livelihoods for communities, flooding of arable land, and loss of the ecosystem (Kubiszewski et al., 2013). Before such projects are approved, environmental impact assessments (EIAs) are conducted to mitigate these negative impacts. Forced displacement is frequently caused by large-scale infrastructure projects. Approximately ten million people are displaced annually due to dam construction, urban development, transportation, and infrastructure projects (World Bank, 1996). Despite this shockingly high number, it failed to account for a large number of displaced people. Dam construction has the most significant

adverse social impacts because of the ill-planned resettlement of people from flooded areas (McCartney et al., 2005).

There are likely to be benefits to communities impacted by hydropower development, such as improved access to electricity, jobs, and infrastructure. The people who have been displaced and resettled elsewhere are at risk of impoverishment, which may manifest as landlessness, food insecurity, unemployment, marginalization, and disarticulation from their community. During their study of dam and hydropower development in Vietnam, Ty, Westen, and Zoomers (2013) concluded that most resettled households were poorer than before.

2. LOKTAK LAKE

The Loktak Lake in Manipur is the largest freshwater lake in North-Eastern India. The Loktak Lake lies between latitudes 24° 25' N and 24° 41' N, and longitudes 93° 46' E and 93° 55' E. Loktak Lake can be found near Moirang in Manipur state (Space Application Centre, ISRO, 2009). Due to the floating mats (heterogeneous mass of vegetation, soil, and organic matter at various stages of decomposition) on the lake, it is also known as the only floating lake in the world. This lake is characterised by floating mats made of decaying vegetable matter, locally called "phumdi". These mats play a significant role in the socio-cultural life of the locals. These phumdis are most widespread in Loktak lake. Approximately 246.72 km2 of open water and marshy land line the southern part of Imphal valley up to the confluence of the Manipur River and Khuga River in Imphal West district. On the edges of the lake and within the lake, there are 14 hills with varying heights, and in the south, there are three islands called Sendra, Ithing, and Thanga.

3. LOKTAK HYDROELECTRIC PROJECT

In 1971, the Ministry of Irrigation and Power, Government of India, undertook construction of the Loktak Hydroelectric Project (LHEP), which was completed in 1983 by the National Hydro Electric Power Corporation (NHPC). Originally, LHEP was handled by a central agency called Loktak Hydro Project Authority.

On the confluence of the Manipur River, Khuga River, and Ungamel channel, the Ithai Barrage was constructed in 1979 near the village of Ithai, south of the Loktak wetlands. By means of the 10.7 meter high and the 5 x 10 km waterway tunnels, the water stored in the wetlands is transferred west of the Manipur valley to the narrow Leimatak River, which is 312 meters lower than the Loktak wetlands. By converting the Loktak wetlands into a reservoir for maintenance of the LHEP, the Ithai Barrage was constructed downstream of the Manipur River to maintain sufficient water volume in the Loktak wetlands. By using 3 units of solar energy and 35 MW of power, LHEP is able to generate 105 MW of power and provide lift irrigation facilities for 24,000 hectares of land.

4. REVIEWS OF RELATED LITERATURE

Singh (1993) in his study *"Impact of the Ithai Barrage on the Environment of Manipur: An Overview"* highlighted the merits and demerits of the Loktak Multipurpose Hydroelectric Project. He pointed out that there are several negative aspects of the Ithai Barrage to the environment of Manipur, particularly in terms of agriculture, fisheries, and socio-economic aspects of the state's inhabitants. He further added that these could have been avoided to some extent if we had conducted an Environmental Impact Assessment (EIA) of the project before its initiation. He urged the authority to take up some remedial measures for the maintenance of the natural ecosystem of the lake. According to him, there should be dialogue among local administrators, experts, and residents near and around the lake, along with external advice and suggestions to mitigate the negative effects that the locals are facing.

Pathak (2011) conducted a study on *"Social Cost-Benefit Analysis: A Study of Power Projects"*. He highlighted that the plants are improving the demographic factors namely –savings, income distribution, employment generation. He also thrown light on certain factors that will lead to more efficiency such as coal washing in case of thermal plants that will reduce the ash content in domestic coal from 40% to 10%, which will lead to reduced coal consumption in thermal plants and consequently lower tariffs for the end user.

Singh (2017) in his study *"The Loktak Hydro Electricity Power Project in Manipur and its Impact on the Socio-economic Conditions to the Catchment Areas"* stressed on the need of decommissioning or removing the Ithai Barrage from the Manipur River. He reveal that Loktak Hydro Electric Project is already a curse for Manipur, that has inflicted so much of suffering with no responsibility and accountability of the project proponent, NHPC. And he also added that there is no review of the project, for its relevance and rationale even after nearly forty years of project operation.

Singh, Singh and Dhar (2018) conducted a study on *"Problems and Prospects of Dams in Manipur"* and identified that the negative effect of the dams are must more higher than the positive effect. He reveals that due to the disturbance of normal flow of river by the dams, many swamps have dried up in the state. It has severe effects to the wetland ecosystem including Loktak Lake which is the habitat of many rare flora and fauna. These dams cause floods and draughts very often in Imphal valley. It was concluded that proper rehabilitation and counselling should be given to the affected people.

Thakur (2020) in her study *"The Ithai Barrage of Manipur: To Decommission or not"* pointed out that Ithai barrage lead to increase in flooding in periferial areas of Loktak lake, Obstruct traditional fishing culture, decrease the thickness of Phumdis and threatens the survival of the rare Sangai deer, and caused conflict between authorities and locals. He also highlighted the dangers of decommissioning the dam.

5. OBJECTIVES

This study seeks to gain a deeper understanding of the socio-economic conditions, relief and rehabilitation programs and overall impact of hydropower projects in the Bishnupur district. The current study focuses specifically on the Loktak hydroelectric project. These are the specific objectives:

1. To investigate the impact of the projects on the lives of the affected people.
2. To explore the impact of the projects on the environment.
3. To identify the problems encountered by the affected people in daily living.
4. To study the relief, rehabilitation, and resettlement programmes of Government (Central and State) and Non-Government Organizations (NGOs) for the affected people.

6. MATERIALS AND METHODS

The present study is descriptive in nature. A combination of primary and secondary data sources is used in the study, including published government and non-government records, and personal observations. Snowball interview is carried out based on unstructured questions. The present study relied on secondary sources for the conceptual and historical framework of environment and development attributes. Various sources of information were scanned, analyzed, and collated, including books, journals, government documents, research articles, and newspaper articles.

7. IMPACT OF LOKTAK HYDROELECTRIC PROJECT

7.1Positive Impacts

There have been certain environmental benefits associated with the completion of the Ithai barrage and commissioning of the Loktak Hydroelectric Project (LHEP) in Manipur, that are really considered to be the project's merits.

7.1.1. Conservation of Water and Preservation of the Lake

Through the Ithal barrage, Loktak's water level can be maintained at 768.5 feet above mean sea level to preserve the lake. There is no longer any land encroachment around the lake's perimeter. As a result, it allowed for the accumulation of adequate water volume to supplement the state's water supply and storage problems, which are related to various environmental issues, such as floods, droughts, and buffering climatic conditions. If we leave Loktak Lake to continue its natural process, with its increasing siltation and land encroachment over the past 2/3 decades, a very different scenario may exist today. If we had not taken up the project, Loktak Lake's geographical area (276 sq. km.) could have been reduced by about 50 sq. Km. with an average depth of less than 1 meter.

7.1.2. Generation of Power

It has been a significant contribution of Loktak Lake to generate 105 MW of electricity in 3 phases of 35 MW each. Only 35 MW of the total 105 MW were used by Manipur and the remaining 70 MW were sold to neighbouring states. From the Loktak project, the state would be able to earn approximately 21-22 crores of rupees per year (about 6 lakh rupees per day). In 1991-1992, the project produced excess energy, increasing income to about Rs 30 crores in a year, thereby increasing power production by 17.3% over 1990-1991.

7.1.3. Irrigation Facilities

As well as generating power, the Loktak Multipurpose Hydro-Electric Project has been able to provide water to nearly 25,000 hectares of cultivated land for lift irrigation, providing the opportunity for double cropping.

7.1.4. Employment Opportunities

Over 500 people have been directly employed as staff of the Loktak Hydro-Project since the project was initiated. The project has also provided at least 2,000 people with jobs by starting small-scale industries in rural areas using the power generated.

7.1.5. Supply of Water for Loktak Down-Stream

Additionally, as well as producing power, the Loktak project will also supply water for the Loktak Down Stream Project, which is proposed to generate 96 MW of power for the state.

7.2. Negative Impacts

7.2.1. Loss of Livelihood

A major problem has arisen for the socio-economic life and environment of Manipur due to the Ithai Barrage, which threatens the existence of the Manipur valley as a viable and sustainable ecosystem. A total of 83,450 hectares of agricultural lands were affected by the Ithai Barrage on both sides of the dam. Approximately 20,000 of these hectares were double cropped. Thousands of hectares of paddy fields in the vicinity of Loktak Pat, Pumlen Pat, Lamjaokhong (Khoidum Lamjao) Pat, etc., which have been used as high yielding fields for generations are all submerged. Directly and indirectly, more than 100,000 indigenous people, mainly from the Meitei community, were impacted. As a result of the construction of the Ithai Dam, Manipur has been transformed from a state with surplus food to one dependent on imported food. Moirangphou, Waiyu Chara (wild rice), and other indigenous rice varieties were also lost due to the submergence of large areas of agriculture land. Rice varieties native to Manipur, such as Waiyu Chara, are capable of growing even in high water and have long served as a major source of food sustenance.

Communities in and around Loktak wetlands also rely heavily on fishing as a source of livelihood. As a result of the commissioning of Ithai Barrage, the fish catch in Loktak wetlands has drastically decreased. The Ithai Barrage has disrupted and blocked fish migration from Chindwin-Irrawaddy river system to Manipur river system. The variety of fish in Manipur has also decreased significantly since the barrage was commissioned. Loktak wetlands have suffered a decline in fish resources that impacted the livelihoods, health, and cultures of the fishing communities.

7.2.2. Displacement

There was a massive displacement of indigenous people from Thanga, Keibul, Nongmaikhong, Ningthoukhong, Bishenpur, and Ithai areas as a result of the LHEP. As of today, there have been no resettlements or rehabilitations for the displaced families. The NHPC refuses to compensate or provide appropriate rehabilitation measures for more than 100,000 people directly and indirectly impacted by the Ithai Barrage. A lawsuit seeking crop compensation for crops lost to the submersion by the Ithai Barrage was filed by the affected communities in the Guwahati High Court. For failing to take adequate mitigation measures before construction and for not implementing proper rehabilitation measures for communities affected by the Loktak project, the Loktak project affected areas action committee (LPAAAC) brought a legal action against NHPC and the GOM between 1994 and 2001. It has been reported that at least twelve writ petitions have been filed seeking compensation for damage done to agricultural land due to the construction of the LHEP. NHPC, however, instead challenged the affected communities' petition, claiming the livelihood impacts were caused by natural floods in the Loktak area and not the LHEP.

7.2.3. Loss of Indigenous Flora and Fauna Species

One of the significant reasons for the disappearance of fishes and the loss of our natural fishery is the Ithai barrage. Several indigenous fishes such as Ngaton, Khabak, Pengba, Tharaak, Ngaaraa, Ngaatin, etc disappeared. There is evidence that these fishes migrate from Burma's Chindwin-Irrawady river system to Manipur's Imphal/Manipur River to breed in the adjoining lakes and streams. The Ithai barrage caused these fishs to lose their migratory routes and become unable to reach the valley, resulting in their disappearance from our waters. The natural fisheries in Manipur accounted for about 60% of the fish products in the past because culture fisheries were not common in the state until 1960.

The Ithai Dam has caused a drastic increase in the water level of Loktak, affecting the production of food and commercial plants. The production of 23 aquatic edible plants, e.g., Heikak, Thaangjing, Tharo, Thambaal, Loklei, and Pulei had been reduced significantly due to their failure to germinate as well as their failure to extend their roots to the bottom of the lake. However, the water level in the southern part of the Manipur river beyond Ithai barrage has declined substantially due to the reduction in water flow, which has prevented the growth of "Nungsam" commonly found on the pebbles under the water. Due to the increase in the water level of Loktak

lake, several plants of commercial importance, such as Tou, Singnut, Imom, Charot, etc., also disappeared or were greatly reduced. Likewise, they caused a great deal of damage to the economy of our state.

7.2.4. Impact on Sangai's Habitat

As a result of the Ithai barrage, Loktak Lake's constant water level has an adverse impact on the biodiversity and existence of the critically endangered Brow-Antlered Deer of Kelbul Lamjao National Park (KLNP), the only floating park in the world. Prior to the Ithai Barrage, during the monsoons, floating biomass, or the Phumdis, floats on the water and in the dry season, it sinks to the bed of the wetland and soaks up the nutrients, helping the vegetation to grow. When the rains returned, the Phumdis, with their nutrient-laced plant roots, would float again. Due to the Ithai Barrage, Loktak wetland was "permanently flooded" by the reservoir of LHEP, disrupting this natural cycle. As a result of continuous storage of water in the KLNP park area because of Ithai Barrage, phumdis float throughout the year, preventing them from absorbing nutrients, thus reducing their growth. Depleted vegetation in these thinned Phumdis makes it impossible for Sangai to breed.

7.2.5. Increasing Floods

Manipur has suffered series of floods as NHPC refuses to open the sluice gates of the Ithai Barrage after heavy rains in catchment areas of Loktak wetlands, which has resulted in submersion of agricultural areas in Manipur valley and deluge of villages in and around the Ithai Barrage, such as Nongmaikhong, Laphupat Tera, and Ithai. The flood water reaches up to Hiyangthang and many other settlement areas of Khangabok, Leishangthem, Tentha, Athokpam, Mayang Imphal, Nambol and many places around Ikop pat, Kharung pat and Pumlen pat etc. Communities in and around Loktak wetlands make fervent appeals to the NHPC every time heavy rains or floods submerge their agriculture land, threatening their livelihood because the Ithai Barrage blocks the discharge of flood waters through Manipur River. NHPC insisted on maintaining appropriate water levels so that they could generate full power during high water levels, which delayed their response to flooding. Such an ordeal has lasted for many decades. Many communities around the Loktak wetlands have long suffered from the Ithai Barrage.

7.2.6. Increasing Siltation Rate of the Loktak Lake

With silt deposits of 336,325 tonnes every year, the lake's water-holding capacity is 25 percent lower than it was before. Due to the Ithai barrage, there has been a blockage of water flow in Loktak Lake's outlet through Imphal River, which has affected the usual removal of silt with the flow of water from Loktak Lake. From different inlets of the catchment area of the lake, the silts were deposited into Loktak Lake itself. Consequently, the lake bottom raised due to increased siltation. Due to the annual deposit of 336,325 tonnes of silt, the lake's water holding capacity has been reduced by 25 percent.

8. DISCUSSION AND CONCLUSION

We cannot deny the fact that the Loktak Hydroelectric Project provides some benefits to the people of Manipur. Water level above mean sea level is maintained at Loktak lake in order to preserve it. Around the lake's perimeter, no land encroachment has been observed. As a result, it allowed for the accumulation of adequate water volume to supplement the state's water supply and storage problems. It has been a significant contribution of the Loktak Hydroelectric Project to generate 105 MW of electricity in 3 phases of 35 MW each. As well as generating power, the Loktak Multipurpose Hydroelectric Project has been able to provide water to nearly 25,000 hectares of cultivated land for lift irrigation, providing the opportunity for double cropping. Moreover, approximately 500 people have been directly employed as staff of the Loktak Hydro-Project since the project was initiated.

Meanwhile, the Ithai Barrage affected 83,450 hectares of agricultural lands on both sides of the dam, resulting in livelihood losses. Loktak wetlands and the surrounding communities are also heavily dependent on fishing for their livelihoods. Communities have experienced a drastic decline in fish catch since the Ithai Barrage was commissioned. As a result of the LHEP, indigenous people were displaced from Thanga, Keibul, Nongmaikhong, Ningthoukhong, Bishenpur, and Ithai areas. The displaced families have not yet been resettled or rehabilitated. As a result of the Ithai barrage, fishes are disappearing and our natural fishery is being lost. A significant amount of damage has been done to the production of food and commercially important aquatic plants around Loktak because of the Ithai Dam. Furthermore, the Keibul Lamjao National Park which is the home to Sangai, is adversely affected by the constant water level of Loktak Lake.

After heavy rains in the catchment areas of Loktak wetlands, NHPC has refused to open the sluice gates of the Ithai Barrage, resulting in floods in Manipur. As a result, agricultural areas have been submerged in the valley

and villages like Nongmaikhong, Laphupat Tera, and Ithai are flooded. Moreover, the water holding capacity of the Loktak lake has declined by about 25 percent due to heavy silt deposition.

From the study, we are evident that Loktak Hydroelectric Project causes severe problems in terms of the environment and socio-economy of local people than its benefits. These could have been avoided to some extent if proper environmental impact assessment (EIA) had been conducted before the initiation of the project. Manipur's people and activists demand to decommission the Loktak Hydroelectric Project and Ithai dam. Decommission seems to be justified to resolve these issues caused by Loktak Hydroelectric Project and the Ithai dam. Before coming to that conclusion, a proper scientific and unbiased analysis should be done to understand and find the consequence of decommissioning the project. Taking down the dam now implies undoing 39 years of ecological adaptations and imposing a radically different state upon the ecosystem. Human life, plants, and animals that have slowly adapted to the ecological changes brought about by dam construction will feel the stress of this change.

9. SUGGESTION

1. Proper Environmental Impact Assessment should be done before the initiation of any project.
2. Proper Evaluation or Appraisal of the project must be done beyond the financial perspective with proper tools and techniques such as Social Cost Benefit Analysis.
3. The government should consider building small hydropower projects instead of large ones, which have a less negative impact on society.

REFERENCES

1. *Kalitsi, E. A. K. (2003). Problems and Prospects for Hydropower Development in Africa.*
2. *Kubiszewski, I., Costanza, R., Paquet, P., & Halimi, S. (2013). Hydropower development in the lower Mekong basin: Alternative approaches to deal with uncertainty. Regional Environmental Change, 13(1), 3–15. https://doi.org/10.1007/s10113-012-0303-8*
3. *Nguyen, H. T., Lobry de Bruyn, L., & Koech, R. (2016). Impact of hydropower dam development on agriculturally based livelihoods of resettled communities: a case study of Duong Hoa Commune in central Vietnam. International Journal of Water Resources Development, 32(6), 978–996. https://doi.org/10.1080/07900627.2015.1121138*
4. *Pathak, R. (2018). Social Cost-Benefit Analysis: A Study of Power Projects, 1-22.*
5. *Pazheri, F. R., Othman, M. F., & Malik, N. H. (2014). A review on global renewable electricity scenario. Renewable and Sustainable Energy Reviews, 31, 835–845. https://doi.org/10.1016/J.RSER.2013.12.020*
6. *Singh, H. (1993). Impact of the Ithai Barrage on the Environment of Manipur: An Overview.*
7. *Singh, L., Singh, K., Dhar, I. (2018). Problems and Prospects of Dams in Manipur. IOSR Journal of Applied Geology and Geophysics, 6(3), 30-35.*
8. *Singh, K. (2017). The Loktak Hydro Electricity Power Project in Manipur and its Impact on Socio-economic Conditions to the Catchment Areas. IOSR Journal of Humanities and Social Science, 22(11), 11-17.*
9. *Space Application Centre, ISRO. (2009). National Wetland Atlas: Manipur. Ahmedabad: Space Application Centre (ISRO). https://vedas.sac.gov.in/vedas/downloads/atlas/Wetlands/NWIA_Manipur_Atlas.pdf*
10. *Thakur, J. (2020). The Ithai Barrage of Manipur: To Decommission or Not. Observer Research Foundation, 364. https://www.orfonline.org/research/the-ithai-barrage-of-manipur-to-decommission-or-not-66917/*
11. *The Eastern Mirror. (2017, September 7). Villagers Demand Government Remove Ithai Barrage in Manipur. The Eastern Mirror.*
12. *The Sangai Express. (2002, August 23). Flood Fury Link to Late Opening of Ithai Barrage. The Sangai Express.*
13. *Yumnam, J. (2020). Dams and Indigenous Peoples Rights in Manipur. New Delhi: Forward Books.*
14. *Wetland International. (2003). Loktak (Vol. 3). New Delhi: Wetland International. https://south-asia.wetlands.org/wp-content/uploads/sites/8/dlm_uploads/2017/11/Loktak-Newsletter-Vol.-3.pdf*