IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CONCERNS OF DAM AND WATER MANAGEMENT IN TRIBAL AREAS OF NORTH EAST INDIA: A CASE STUDY OF KHUGA DAM CATCHMENT OF CHURACHANDPUR DISTRICT, MANIPUR.

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ABSTRACT

The dual impact of dams and reservoirs, acknowledging their benefits in flood control, water supply and energy generation while emphasizing their significant negative effects on the environment and communities. This study seeks to establish a methodological framework for assessing, predicting and mitigating these adverse impacts, with a focus on environmental preservation and sustainable alternatives for affected communities. The negative consequences include environmental degradation, habitat destruction, altered ecosystems and community displacement leading to social upheaval and livelihood losses. The study underscores the importance of sustainable and inclusive planning on environmental aspects and socio-economic, highlighting long-term challenges like shifting cultivation, deforestation and spatial advocacy for comprehensive approaches integrating sustainable land use practices and community-focused development strategies and provide insight to planners to draw the best mitigation measures to cope with the long-term post-effect of dam towards the environment and people.

Keywords: Dam catchment, Environmental sustainability, Displaced communities, Shifting cultivation, Inclusive planning.

Manuscript Information

- **ISSN No:** 2320-2882
- **Received:** 15-02-2025
- **Accepted:** 08-03-2025
- **Regd. ID**: IJCRT282120
- **Paper ID**: IJCRT2504539
- **Published:** 12-04-2025
- **IJCRT:**13(4); 2025: 638-648

- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes
- **DOI:** http://doi.one/10.1729/Journal.44688
- **Corresponding Author: T.L. Haokip***

INTRODUCTION

The water management in Manipur focuses on harnessing its abundant water resources effectively. The state utilizes various strategies such as rainwater harvesting, construction of check dams, reservoir and watershed management programs to conserve water and ensure sustainable usage (Sivanappan, R. K. 2006, November). The state face water scarcity during the severe winter season. The Loktak Lake, a significant freshwater lake, plays a crucial role in water storage and regulation (Mayanglambam, B., & Neelam, S. S. 2022). Additionally, initiatives like community-based water management projects and others means of reservoir were initiated and promoted for efficient irrigation techniques which are implemented to address water scarcity issues and improve agricultural productivity (Tiwari, A. K., Mishra, H., Nishad, D. C., & Pandey, A. 2023). The government, along with local communities continuously works towards balancing water demand with conservation efforts to safeguard Manipur's water resources for future generations.

Manipur's water management is crucial due to its unique geographical and climatic conditions. The state employs a network of reservoirs and dams to address water supply, irrigation and flood control (Singh, K. J. 2018). Key infrastructures include the Loktak Lake, the largest freshwater lake in the north eastern region, managed by the Loktak Development Authority. The Ithai Barrage regulates the lake's water level, aiding in hydroelectric power generation at the Loktak Hydroelectric Project.

Other significant dams include Khuga Dam, Thoubal Dam, Khoupum dam and Singda Dam. The Khuga Dam supports irrigation and drinking water supply in the Churachandpur district. Thoubal Dam, located on the Thoubal River, enhances agricultural productivity and provides potable water to Imphal. Singda Dam, situated near Imphal, serves as a critical water source for the city. These reservoirs and dams collectively improve water availability, agricultural output and flood mitigation in Manipur (Arora, V., & Kipgen, N. 2012), supporting the state's socio-economic development while addressing environmental challenges.

STUDY AREA

The state Manipur is one the north-eastern state of India, it is known for its scenic landscapes and rich cultural heritage. Physically, it is characterized by its green and fertile valleys, surrounded by hills and mountains. Located strategically in the easternmost part of India, Manipur shares its state borders with Nagaland, Mizoram and Assam, international boundary with Myanmar to the eastern and southern parts of the state. The state's drainage is primarily governed by the Barak Rivers system and Manipur Rivers system, which flows in the western and eastern parts of the state respectively. These rivers are crucial for irrigation, transportation and supporting the diverse ecosystems of the region.

The Khuga Dam, located in the Churachandpur district of Manipur, serves as a crucial source of irrigation in small quantity as it stands and supply for drinking water. The catchment area is surrounded by two hills ranges known as, Haopi range to the west and Haosapi range to the east which runs in parallel formation. The indigenous people, primarily the Kuki communities with its sub-tribes belonging to Thadou, Paite, Zou, Vaiphei, etc. inhabited the areas. Churachandpur, known for its scenic landscapes and cultural diversity, is a district that reflects the rich heritage of Manipur. The district is a hub of tribal culture, where traditional customs and modernity coexist harmoniously.

MATERIALS & METHODS

Data collection for the study involved several comprehensive methods to ensure accuracy and depth. Primary data was gathered through structured and opinion-based questionnaires administered to chief residents of 15 villages, predominantly aged over 50. Prior to fieldwork, tasks included site selection, preparation of questionnaires and data gathering from sources such as census reports, journals, Google Maps and topographic maps. The use of GPS technology facilitated precise mapping of the study area. Post-fieldwork activities comprised processing and analysing the collected data, creating cartographic representations to illustrate changes and drafting a detailed report. The process emphasized aiding understanding through clear maps and explanations. By integrating both quantitative and qualitative techniques, the study employed surveys, mapping and statistical analysis, enhanced by the residents' insights and demographic data to provide a comprehensive view of the area's dynamics.

DAMS IN MANIPUR:

Dams in Manipur play a crucial role in the state's water resource management for drinking water, irrigation and hydroelectric power generation. These structures strategically built across various rivers, aid in controlling floods, providing irrigation water to vast agricultural lands and ensuring a steady supply of electricity to support local communities and industries. Notable dams such as the Khuga dam, Singda dam, Khoupum dam and Thoubal dam exemplify the blend of engineering and natural resource utilization in the region. Besides their practical benefits, these dams also contribute to the beauty of Manipur, offering potential for eco-tourism and promoting sustainable development in the state.

The motives for constructing dams in Manipur encompass a range of economic, social and environmental objectives:

1. Irrigation: Dams provide a consistent water supply for agricultural lands, improving crop yields and ensuring food security for the local population.
2. Hydroelectric Power Generation: By harnessing river water for electricity production, dams help meet the energy needs of the state, promoting industrial growth and improving living standards.
3. Water Supply: They ensure a reliable supply of potable water for both urban and rural communities, essential for daily consumption and sanitation.
4. Flood Control: Dams mitigate the impact of seasonal floods, protecting lives, property, and farmlands from water-related disasters.

5. Tourism and Recreation: Scenic dam sites attract tourists, contributing to the local economy and providing recreational opportunities.
6. Environmental Management: Dams aid in managing water resources effectively, supporting biodiversity, and maintaining ecological balance.

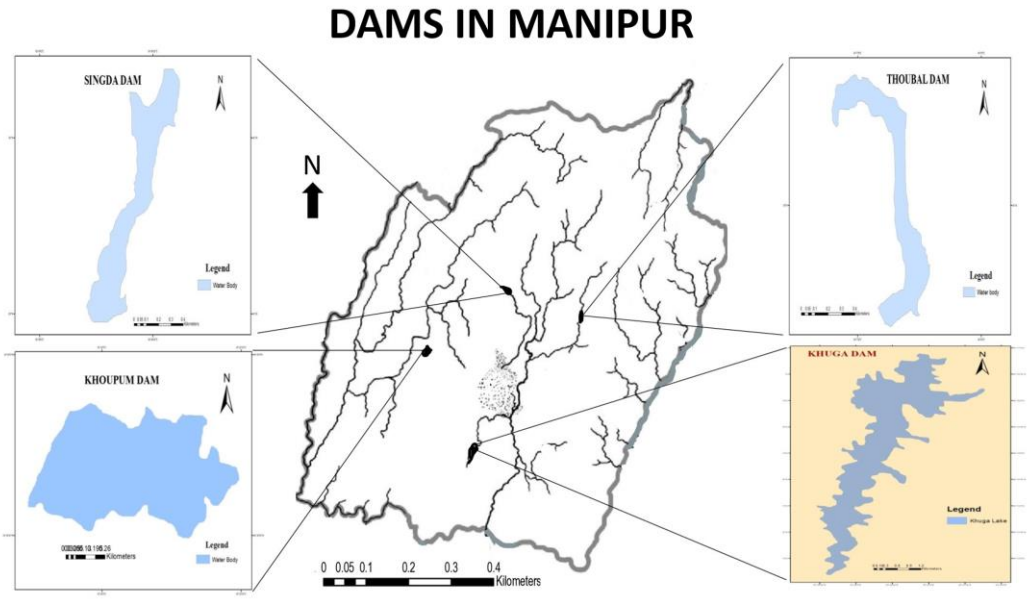

Figure 1. Sites of dams in Manipur.
Source: Google earth & Arc GIS

SINGDA DAM:

The Singda Dam, situated near Imphal in Manipur, holds significant importance for the region. Primarily constructed for irrigation purposes, it supports the agricultural activities of surrounding areas by providing a reliable water source, thereby enhancing crop yields and stabilizing local food production. Additionally, the dam serves as a vital water supply for Imphal, ensuring the city's residents have access to potable water. The Singda Dam also contributes to flood control, mitigating the impact of seasonal floods on nearby communities. Besides its negative impact on environment and the people, it is also one of the popular spots for tourism and recreation, fostering local tourism and contributing to the state's economy. The dam's multi-faceted utility underscores its pivotal role in Manipur's development and sustainability.

KHOUPUM DAM:

The Khoupum Dam is located in the Khoupum Valley of Noney district, Manipur, is a significant infrastructure project aimed at improving the region's water management. Primarily serving as an irrigation source, it enhances agricultural productivity by providing a steady water supply to surrounding farmlands. Additionally, the dam helps in flood control, reducing the risk of water-related disasters in the valley. The reservoir created by the dam also supports local fisheries, contributing to the livelihood of nearby communities. Beyond its practical uses, the scenic beauty of the Khoupum Dam area attracts tourists, fostering eco-tourism and offering recreational opportunities for visitors. Among all dams in Manipur, Khoupum dam is one of the smallest dams constructed in Manipur.

THOUBAL DAM:

The Thoubal Dam, located in the Thoubal district of Manipur, is a pivotal project for the region's water management and development. Primary motive was for irrigation, the dam supplies water to vast agricultural lands, boosting crop production and ensuring food security. Additionally, it plays a crucial role in providing potable water to nearby communities, addressing both domestic and industrial needs. The Thoubal Dam also aids in flood control, protecting the region from seasonal floods and associated damage. The reservoir created by the dam enhances local fisheries and contributes to the livelihood of surrounding villages. Its scenic location also attracts tourists, promoting eco-tourism and recreational activities in the area.

KHUGA DAM:

The Khuga Dam, located south of Churachandpur town in Manipur, India, was commissioned in 2007 and inaugurated by Sonia Gandhi on November 12, 2010. This multipurpose project, situated along the Khuga River, was intended to generate 7.5 MW of hydroelectricity, provide irrigation to 15,000 hectares of agricultural land, control floods and supply drinking water. However, despite construction beginning in 1983 and facing delays until 2002, the dam has failed to achieve these objectives. Completed in 2006, the dam submerged agricultural land, forests and settlements, displacing many inhabitants. Environmental and social research highlights the disruptions to ecosystems and communities, emphasizing the need for better planning and consideration of affected populations.

The dam's construction forced the relocation of villages along the Khuga River's left and right banks. From Mata-Mualtam in the north to S. Geltui in the south, these communities, situated in diverse landscapes ranging from fertile plains to rugged mountains, adapted to their new environments. Villages like Ngoiphai and Lamjang, with extensive wet paddy lands, have particularly benefited from the river's resources. On the right bank, villages such as Khianglam, T. Kotlian, M. Tanglian and Belbing underwent relocation, balancing environmental and socio-economic needs. Despite the challenges, these communities have maintained their cultural heritage and resilience, continuing to thrive along the river's dynamic course.

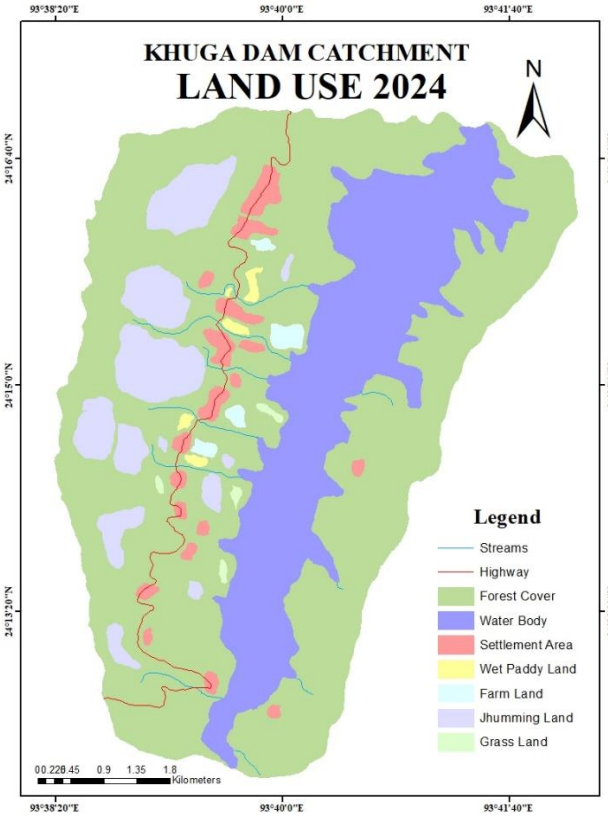

Figure 2. Land use land cover change of Khuga dam affected area.

Across the diverse geography of affected regions, including the Khuga River basin and beyond, a series of large-scale infrastructure projects such as the Ithai Barrage, Khoupum Dam, Maphou Dam, Singda Dam, Thoubal Dam and Dolaithabi Barrage have left profound imprints on both the environment and local communities. Like Khuga Dam, these ventures while surpassing it in scale, have yet to realize their potential for electricity generation. Despite their imposing presence, they stand dormant in terms of power production highlighting a stark disparity between ambition and achievement. Environmental degradation, loss of biodiversity and disruptions to hydrological patterns echo across these regions, paralleling the challenges witnessed along the Khuga River. Furthermore, the displacement of communities, disruption of traditional livelihoods and socio-economic upheavals persist, underscoring the shared impact experienced despite variations in project size and scope. The collective experience underscores the imperative for comprehensive assessments, sustainable mitigation strategies, and inclusive decision-making processes in large-scale water resource projects. As these projects navigate the intricate terrain of geography and governance, addressing both environmental concerns and the well-being of affected communities remains paramount for fostering resilience and sustainability in the face of complex development challenges.

Results and Discussions

In this section, the research findings and analysis of the results are discussed. The impact of the Khuga Dam is examined, revealing both positive and negative topographical and ecological effects on the environment and local communities. Positively, the dam has provided small portion of water supply for irrigation, which somehow helps the local farmers during bad monsoon season. It has also created opportunities for aquaculture, promoting local economic development. However, the negative environmental impacts are significant. The construction and operation of the dam have disrupted local ecosystems, leading to habitat loss and a decline in biodiversity. Communities have faced displacement and changes in water flow have impacted traditional livelihoods, particularly fishing. The quantity and quality of water issues have also emerged, affecting both human health and aquatic life. Balancing these outcomes requires a comprehensive approach to ensure sustainable development and minimize adverse effects on both nature and people. Some major findings and discussion are as below.

1. Impact on Environment:

The environmental repercussions of dam construction were examined through a field survey, revealing significant impacts such as land submergence, loss of forest cover and agricultural depletion. Findings from a field survey aimed at assessing the environmental impact of the dam construction project unveiled several noteworthy results. The construction of the dam has resulted in the submergence of vast tracts of land, leading to the depletion of forest cover, agricultural fields and farming land, among other related biodiversity in the affected areas. Overall, the findings highlight the complex and wide-ranging environmental impacts associated with dam construction, underscoring the importance of careful planning and mitigation measures to minimize adverse effects on ecosystems and communities

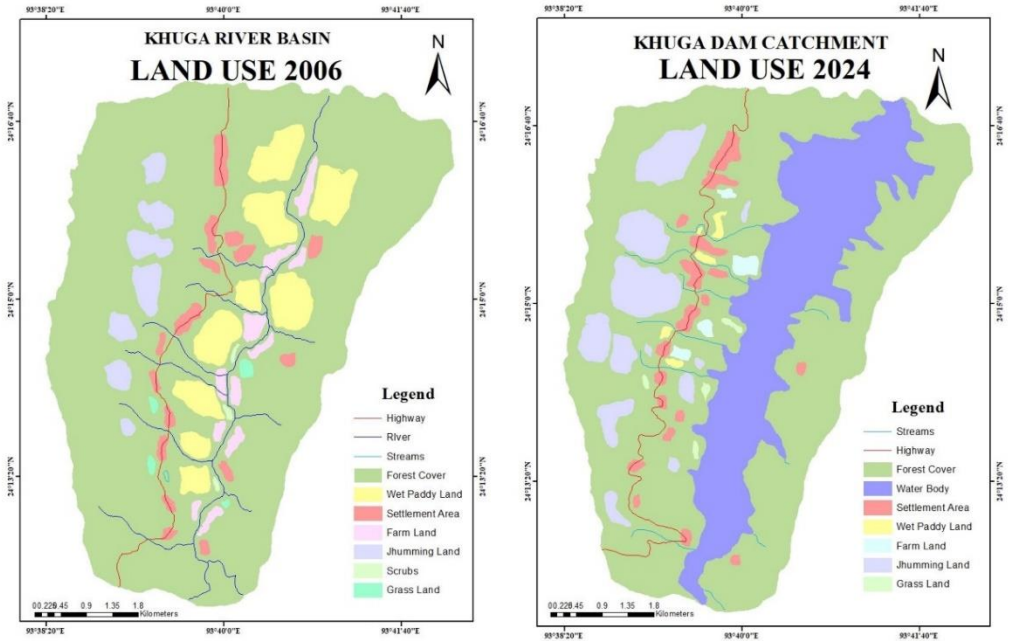

Figure 3. Land use change from 2006 to 2024.

Table 1. Land use/land cover change from 2006 to 2024 (in acre).

Village Name	Forestland			Agriculture Land			Farm Land		
	2006	2024	Area decreased	2006	2024	Area decreased	2006	2024	Area decreased
Mualtam	1,28	580	-984	678	130	548	60	0	0
Lamzang	220	180	-40	120	7	-113	50	20	-30
M.Lunmual	140	18	-122	80	0	0	40	0	0
S.Geltui	350	250	-100	36	0	0	44	0	0
Ngoiphai	100	30	-70	760	40	-720	185	0	0
Geljang	480	420	-60	70	30	-40	100	0	0
Hiangdung	289	194	-95	14	0	0	30	0	0

S. Kullian	1,500	1,460	-40	40	0	0	120	0	0
S. Munhoih	160	100	-60	20	4	-16	50	0	0
Phaibem	100	70	-30	116	10	-106	35	05	-30
Total	4,867	3,257	-1,610	1,934	257	-1,543	714	25	-689
Decrease in percentage			-33%			-86%			-96%

Note: '0' represents the submerged areas.
Source: Field Survey, 2024

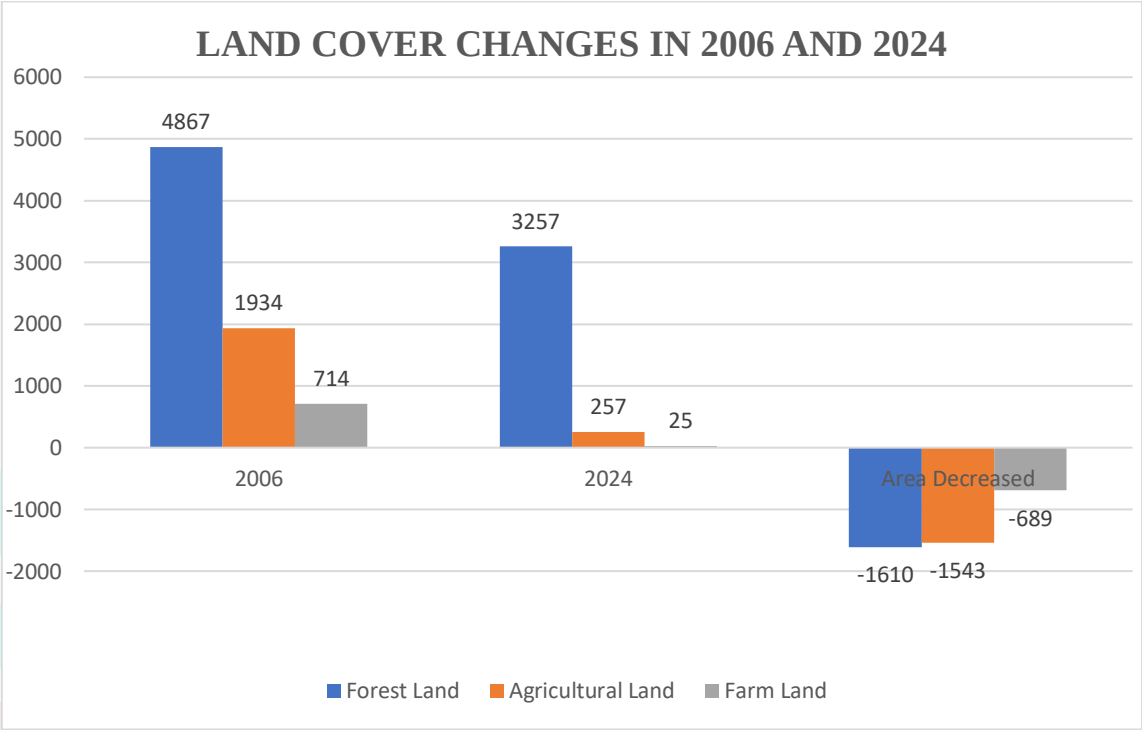

Figure 4. Land use change from 2006 to 2024.

The collected data indicates significant alterations in agricultural and farm lands, alongside a notable 33% reduction in forest cover. Specifically, agricultural land has suffered 86% loss, while farm land has incurred a staggering 96% reduction. These changes directly stem from the construction of the Khuga Dam, adversely affecting the community. The dam's presence has precipitated the substantial loss of fertile agricultural and farm lands, exacerbating the community's socio-economic challenges. Moreover, the depletion of forest cover underscores environmental degradation, further intensifying the impact on local ecosystems and livelihoods. This data underscores the pressing need for comprehensive mitigation strategies and support measures to address the multifaceted consequences of dam construction on the affected community.

2. Impact on Community:

The construction of the Khuga Dam has had significant impacts on the surrounding communities. Displacement of residents from their ancestral lands due to the reservoir's formation has disrupted traditional ways of life, leading to social upheaval and loss of cultural identity. Displaced families have faced challenges in resettlement, often experiencing economic hardships and difficulties in adapting to new environments. Furthermore, the loss of agricultural land has affected local livelihoods, worsen the poverty levels in the region. These socio-economic disruptions underscore the need for comprehensive planning and support measures to address the adverse effects of dam construction on affected communities. According to the data collected from field survey 2024 statistical data given in table 2. Data collected amongst the affected areas has a total population of 4,621 with the total household of 728 before the construction of the dam. While the population reduced to 3,380 and household to 610, leaving 3,210 people from 540 households were displaced. And 170 peoples from 70 households still inhabited their permanent village amidst the rising of the water level.

Table 2. Population changes from 2006 to 2024.

Item	2006	2024	Shifted to different places	Relocated to higher ground	Not Shifted
Population	4,621	3,380	-1,241	3,210	170
Household	728	610	-118	540	70

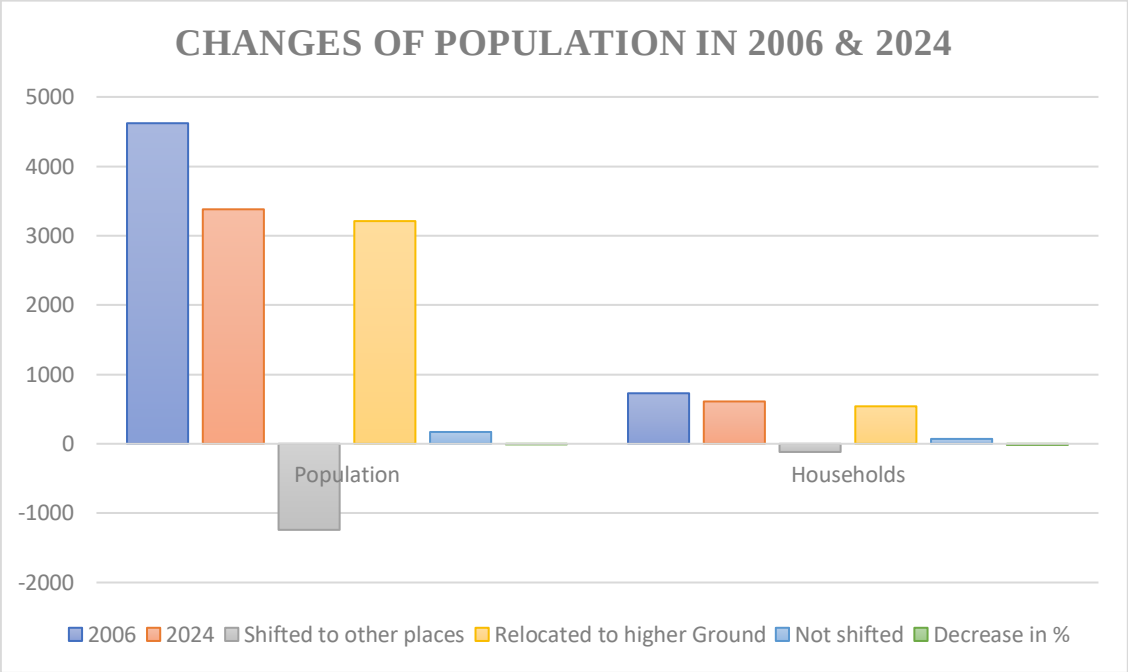

Figure 5. Change in Demography, 2006 and 2024.

Before the specified event or time period, the population was recorded at 4,621 individuals, which decreased to 3,380 individuals after the event. This indicates a displacement of 3,210 individuals as a result of the event. Additionally, there was 170 individuals who settled in their permanent village till today. Similarly, before the event there were 728 households, which decreased to 610 households after the event. This signifies a displacement of 540 households. Moreover, there were 70 households which does not shift, this suggested that it has a significant change in population distribution and household numbers as a consequence of the event, with a notable number of individuals and households being displaced and shifted.

3. Impact on occupation of the affected Community

The construction of the Khuga Dam has had a profound impact on the occupation of the affected community. Initially, the dam project offered employment opportunities, stimulating the local economy. However, the subsequent flooding of land for reservoir creation led to displacement of residents, disrupting traditional occupations like farming and fishing. Many were forced to seek alternative livelihoods, causing economic instability and social upheaval. While some found employment in dam-related activities, others faced unemployment and poverty. Additionally, environmental changes resulting from the dam altered agricultural patterns, further impacting the community's occupation. Overall, the Khuga Dam's construction has reshaped the occupational landscape, with both positive and negative consequences.

Table 3. Changes in occupation of the affected community.

Types of Occupation	(%) in 2006	(%) in 2024
Wet paddy cultivation	80	0
Jhum cultivation	6.1	44.5
Forest products (wood and charcoal)	6.4	50.5
Farming (livestock)	4.5	3.3
Business	3	1.7

Source: Field Survey 2024

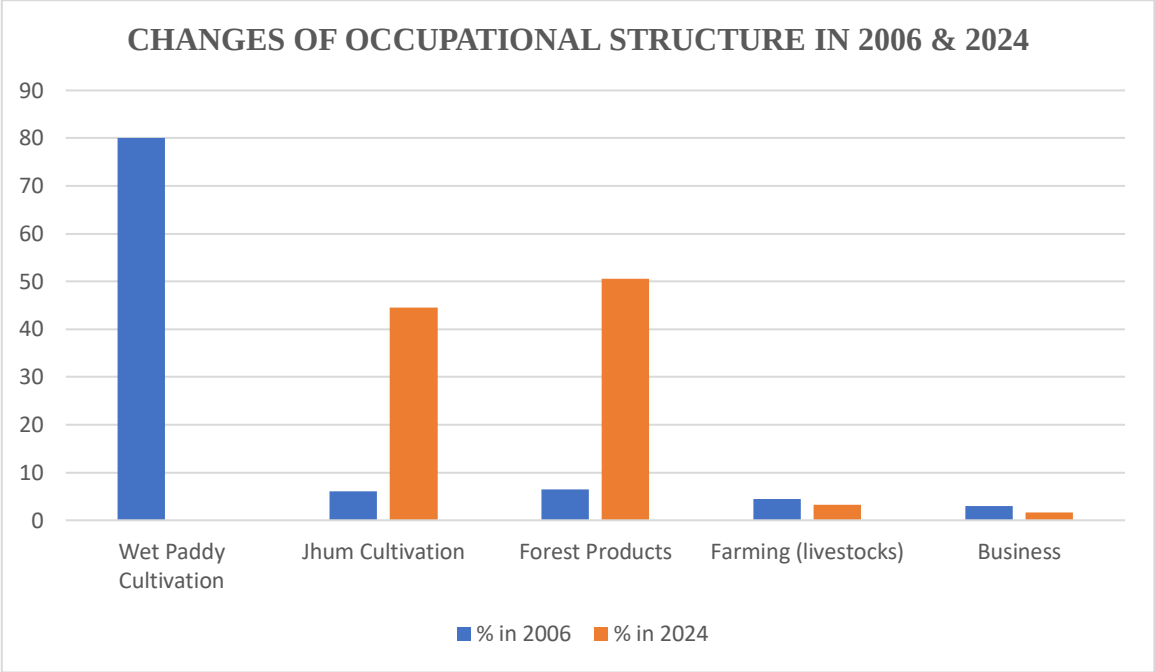

Figure 6. Drastic change in occupation of the affected people.

The collected data underscores the adverse effects on the occupation of the affected populace, revealing a significant shift among paddy cultivators towards Jhum cultivation and reliance on firewood and charcoal for sustenance. This transition not only poses a direct threat to the environment but also exacerbates challenges for the community. The increased reliance on unsustainable practices like Jhum cultivation and the extraction of firewood and charcoal not only degrades the environment but also undermines the socio-economic well-being of the people, highlighting the urgent need for sustainable alternatives and support mechanisms.

4. Impact on Education:

The construction of the Khuga Dam has significantly impacted the education of the affected community. Initially, the influx of workers and resources for the project may have provided some opportunities for education and skill development. However, the subsequent displacement caused by the dam's reservoir flooding has disrupted access to education for many. Displaced families often face challenges in accessing schools due to relocation, inadequate infrastructure and financial constraints. Children may be forced to travel longer distances to reach schools leading to increased dropout rates. Moreover, the loss of land and livelihoods can exacerbate poverty, making it difficult for families to afford education-related expenses such as books, uniforms and school fees. Overall, the Khuga Dam project has had a detrimental impact on the education of the affected community, highlighting the need for comprehensive support and mitigation measures.

Table 4. Changes in number of students of the affected community**.**

Class level	2006	2024	Not able to continue
Below class 10	710	467	243
10 + 2	320	197	123
Graduate & above	220	146	74

Source: Field Survey 2024

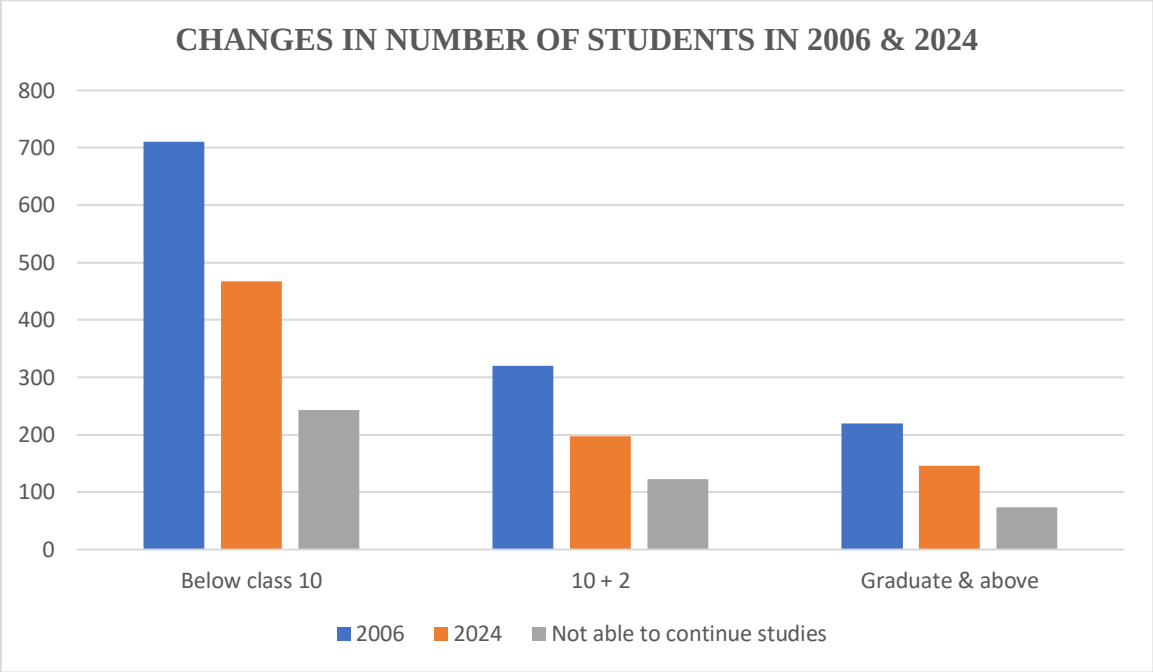

Figure 7. Negative impact on education of the affected communities.

Following the complete blocking of the river and submergence of the affected areas, 243 students below the standard class level have ceased schooling due to their parents' inability to afford the expenses without the support of agricultural land, representing approximately 62% of the total affected student population. Additionally, 123 students from 10+2 classes have discontinued their education, accounting for about 31% of the affected students and 74 students with graduate and higher qualifications have halted attending college and university, comprising around 19% of the affected students.

Positive impact of Khuga Dam

The Khuga dam which is known to the affected community as a dead dam also provide some livelihood sources to the affected community and also to the people of Lamka town. Although the displaced people might not enjoy the irrigation facility, it may be ensured that when the irrigation supply is channelized in future, those residing in the downstream can practice double cropping in a year.

Table 5. Benefits of Khuga Dam (in %)

Item	Benefits in Percentage (%)
Recreation	08
Fishing	15
Drinking Water	12
Irrigation	17
No benefits	52
Total	100

Source: Field Survey 2024

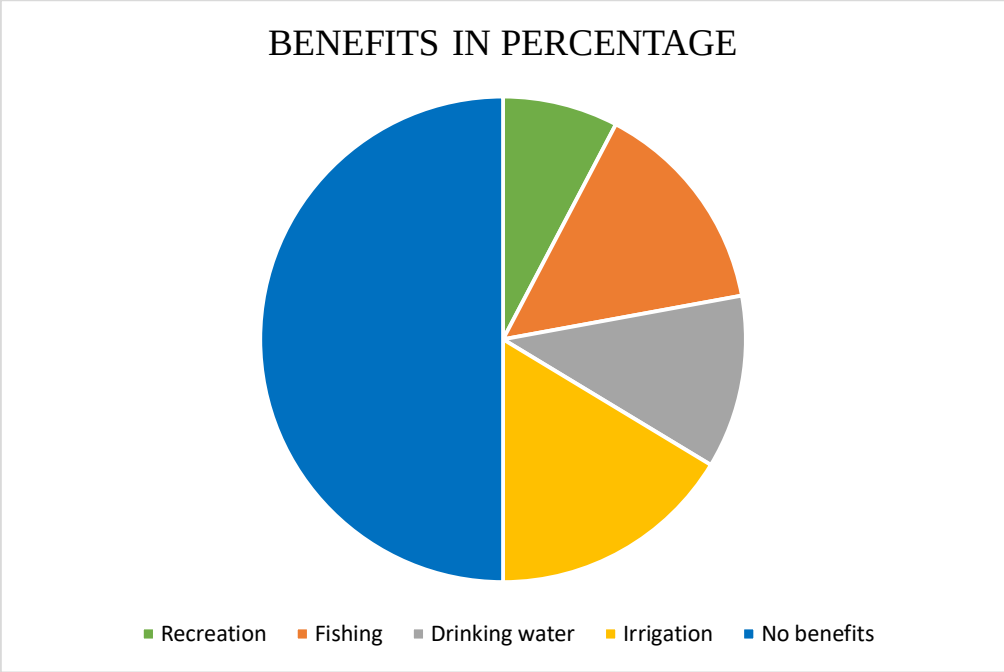

Figure 8. Benefits of Khuga dam in percentage.

According to the data provided in table 5, the percentages represent the distribution of purposes for which dams are used. This suggests that a significant portion 52%, of the dams surveyed serve no specified purposes. The data indicates a diverse range of functions for dams, including recreational activities, fishing, drinking water supply and irrigation with a majority having no designated purpose listed. The data suggests that while some dams are utilized for recreational activities, fishing, drinking water supply, irrigation and substantial portion of 52% serve no specified purpose.

CONCLUSION

The profound impacts of Khuga Dam construction on the community underscore the urgent need for sustainable solutions. Loss of agricultural land and forests threatens ecosystems and socio-economic stability. Displacement worsen poverty and disrupts traditional livelihoods, leading to environmental strain and cultural erosion. Holistic approaches prioritizing sustainable development, livelihood diversification, education and culturally sensitive settlement planning are imperative. Programs promoting sustainable agriculture, alternative income sources, education and skill development can empower individuals and preserve social bond. Thoughtful settlement planning, incorporating community input can preserve traditional practices. By prioritizing sustainability, the affected community can foster resilience and prosperity amidst the challenges of dam construction.

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