ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 17, Issue, 09, pp.34623-34632, September, 2025
DOI: https://doi.org/10.24941/ijcr.49567.09.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

SOCIO-ENVIRONMENTAL AND DEMOGRAPHIC IMPACTS OF NON-FUNCTIONAL DAM IN NORTH EASTERN STATE OF INDIA: A STUDY ON KHUGA DAM, CHURACHANDPUR, MANIPUR, INDIA

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ARTICLE INFO

Article History:
Received 20th June, 2025
Received in revised form
24st July, 2025
Accepted 29th August, 2025
Published online 30th September, 2025

Keywords:

Geospatial Analysis, Land use Change, Socio-Environmental impact, Dam, Policymakers.

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ABSTRACT

This study presents an integrated Geospatial and Socio-Environmental and Demographic assessment of the profound impacts of a non-functional dam. Utilizing an advanced geospatial workflow with Landsat 7 and Landsat 8 satellite imagery, analysed through ArcGIS 10.8, it accurately quantified two decades of physical transformations in the area's land use and land cover. The analysis conclusively demonstrated severe negative environmental consequences, including a significant reduction in vegetation cover and a drastic shift away from traditional, sustainable agricultural landscapes. This remote sensing data was critically complemented by a comprehensive on-site field survey. Using structured questionnaires, the gathered first-hand data on the direct human consequences, specifically examining the impacts on local livelihoods, population stability, educational opportunities and settlement patterns. This qualitative and quantitative survey data was also cross-referenced with the 2011 Census of India to provide a robust demographic baseline. The empirical findings, meticulously presented in tabular format, unequivocally show that the dam has caused more long-standing harm than benefit, creating grievances that far outweigh its intended advantages. This research provides concrete, data-driven insights for policymakers and governing bodies. The goal is to inform and guide the development of effective, equitable policies and interventions necessary to mitigate the socio-economic and environmental challenges that have burdened the affected communities for years.

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Citation: Haokip, T. L., Dr.T.K. Prasad, Dr. P. Lienzapau Gangte, Dr. Md. Baharuddin Shah, Rajeev S. and Sushama S. 2025. "Socio-Environmental and Demographic Impacts of Non-functional dam in North Eastern state of India: A study on Khuga dam, Churachandpur, Manipur, India.". *International Journal of Current Research, 17, (09), 34623-34632.*

INTRODUCTION

Dams are critical infrastructure projects designed to harness water resources for electricity generation, irrigation, drinking water supply and flood control (Abdullah, A. N., & Rahman, S. 2021). In India, dams play a vital role in supporting agriculture, industry and urban development, contributing significantly to the nation's energy and food security. However, while many dams have successfully driven economic growth, several projects have faced challenges due to poor planning, environmental concerns and governance failures (Bharti, M. K., Sharma, M., & Islam, N. 2020). Issues like siltation, displacement of communities and ecological damage have raised questions about their long-term sustainability. Cases like Manipur's Khuga Dam where cost overruns, corruption and unmet promises led to complete failure highlight systemic problems in dam construction and management (Haokip, T.L. and Gangte, P. Lienzapau and Prasad, T.K. and Haokip, Khaiminlun and Shah, Md. Baharuddin, 2025). As India continues to invest in hydropower, balancing development with environmental protection and social justice remains a pressing challenge. A study analysing 178 major dams in India found that many dams struggle with flood mitigation due to high antecedent reservoir storage (often exceeding 90% capacity), which limits `their ability to manage inflows during extreme weather events. This inefficiency is projected to worsen with climate change. Examples of dams that exacerbated floods due to poor management include Pandoh (Himachal Pradesh), Kaddam (Telangana), and Sardar Sarovar (Gujarat) in 2023, where sudden releases caused downstream flooding. Dams have a dual impact on climate change. While they provide renewable hydroelectricity, their reservoirs release significant amounts of methane, a potent greenhouse gas, and can destroy natural carbon sinks (Bussi, G., Darby, S. E., Whitehead, P. G., Jin, L., Dadson, S. J., Voepel, H. E., ... & Nicholas, A. 2021). Dams are critical infrastructure for water storage, hydropower and flood control, but many fail to deliver their intended benefits post-construction (Zhang, A. T., & Gu, V. X. 2023). Globally, sedimentation is a leading cause of non-functionality, with reservoirs losing 13–19% of storage capacity by 2025, projected to reach 23–28% by 2050. For example, Japan's dams have lost 39% of capacity, while the U.S. faces 34% losses, rendering some reservoirs ineffective for irrigation or power generation1. Design flaws and poor maintenance also contribute. Ghana's Bui Dam disrupted ecosystems and failed to meet irrigation targets due to unplanned land-use changes. In Manipur, India, the Khuga Dam never generated electricity due to corruption and engineering failures, leaving 15,000 hectares unirrigated (Pradhan, A., & Srinivasan, V. 2022). Climate change exacerbates risks. Droughts have crippledhydropower output, as seen at Zimbabwe's Kariba Dam, which dropped to 1% capacity in 2024, (Luo, Z., Shao, Q., Zuo, Q., & Cui, Y. 2020) causing blackouts8. Similarly, aging infrastructure like the U.S.'s Oroville Dam (2017 spillway collapse) requires costly repairs to avoid failure. Solutions include sediment management (e.g., dredging) and dam removals, as seen in Europe's Hiitolanjoki River, where dismantling restored salmon populations. However, 1,249 large dams still operate in protected areas, worsening ecological harm (Sayektiningsih, T., & Hayati, N., 2021). Addressing these issues demands better planning, maintenance, and alternatives like solar and wind energy.

Study Area

The study area for the Khuga Dam is located at Mata Village, situated in Manipur, India. The dam's coordinates are approximately 24°18'N latitude and 93°40'E longitude, placing it within the UTM Zone 46N. The site is located about 8 kilometres south of Lamka town (also known as Churachandpur), which is the district headquarters. The study area includes not only the dam itself but also the surrounding regions and the communities that have been affected by its construction and operation (Haokip, T.L. and Prasad, T K, 2025). This area encompasses the dam's reservoir, the river course and nearby villages.

Background: The Khuga Dam, located in Mata Village, Churachandpur District, Manipur, is a stark example of a failed hydroelectric and multipurpose project. Initially conceived in 1980 with an estimated cost of ₹15 crores, the dam's construction began in 1983 but faced prolonged delays due to ethnic violence and budget overruns. By the time it was inaugurated on 12 November 2010 by Sonia Gandhi, the project's cost had ballooned to ₹433.91 crores, with further expenditures pushing the total beyond ₹600 crores by 2025 312. Despite these massive investments, the dam has failed to deliver on its core promises: hydropower generation, irrigation and drinking water supply.

The dam was designed to generate 1.5 MW of electricity, irrigate 15,000 hectares of farmland, and supply 5 million gallons of drinking water daily to Churachandpur town and surrounding areas. However, as of 2025, not a single unit of electricity has been produced due to the absence of a functional powerhouse (Singh, O., & Kumar, M. 2017). The irrigation canals, built without proper environmental clearances in the Dampi Reserve Forest, frequently breach, leaving only 300 hectares irrigated far below the target. Drinking water supply has also been dismal, with only 0.83 million gallons per day (MGD) reaching communities, a fraction of the promised capacity 912. The dam's failure has had devastating socio-economic and environmental consequences. Over 16 villages, primarily inhabited by Kuki-Zo tribal communities, were displaced without adequate rehabilitation (Doungel, T., Purkayastha, S., & Haokip, T. L. 2025). Compensation ranged from a meagre ₹20,000 to ₹50,000 per household, forcing many into poverties.

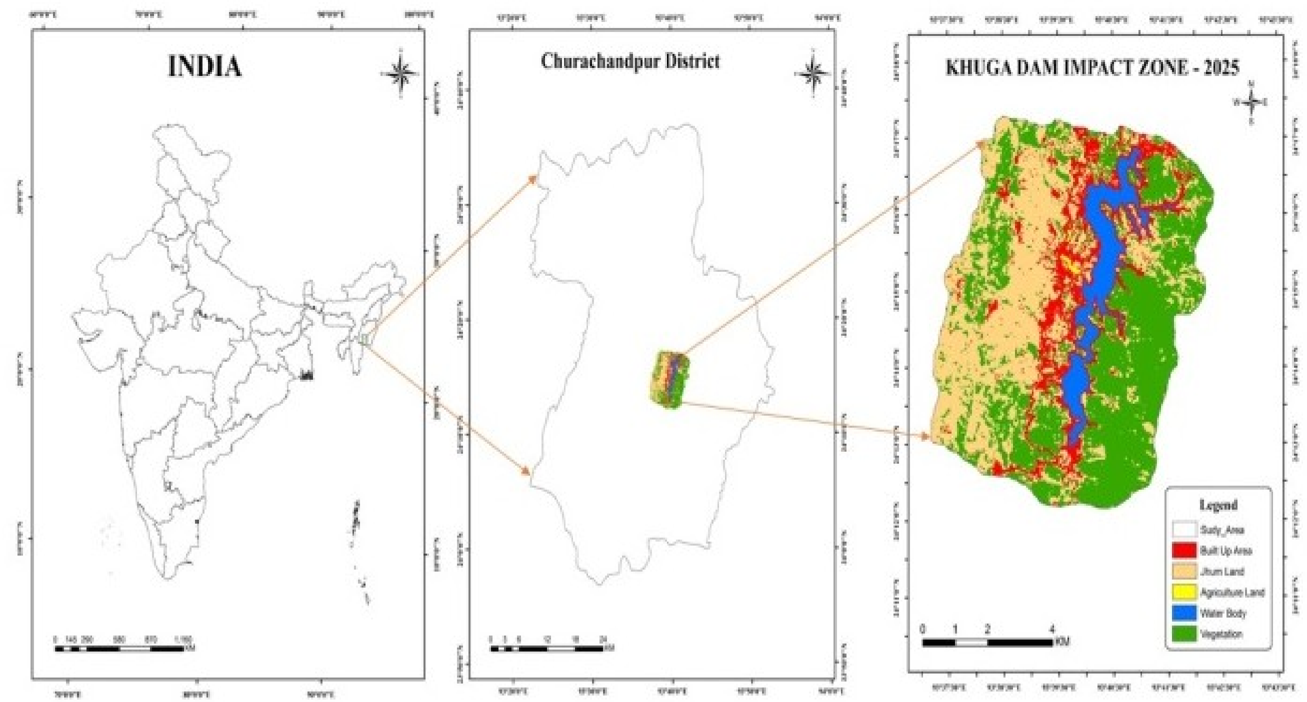

Figure 1. Locational Map of Study Area

Table 1. Promised Benefits versus Reality of Khuga Dam

Component	Target	Actual Status
Hydropower	1.5 MW (initially 7.5 MW planned)	Zero generation. Powerhouse incomplete; turbines auctioned off .
Irrigation	15,000 hectares	300 hectares served. Canals repeatedly breach due to poor construction .
Drinking Water	5–10 million gallons/day	1.2 MGD claimed, but disputed by locals. Treatment plant non-functional

Women, who traditionally managed agriculture, fishing, and forest-based livelihoods, have been disproportionately affected. With submerged lands and polluted water, they now struggle to access clean drinking water and face increased domestic burdens, including longer walks to fetch water and reduced income opportunities. School dropout rates, particularly among girls, have surged as families prioritize survival over education. Corruption and mismanagement have plagued the project. Investigations reveal that ₹1.5 billion was misappropriated, while salaries for 193 employees cost ₹3.6 crores monthly despite zero operational output. Security forces have also been implicated in violence, including a 2005 massacre where three villagers were killed during protests against inadequate compensation. The dam site remains heavily militarized, exacerbating risks for women, who report harassment and abuse by security personnel. Environmental damage includes the submergence of 250+ hectares of forest and farmland, disrupting local ecosystems and worsening water scarcity. Downstream, the Khuga River's flow has been erratic, affecting fisheries and agriculture in villages like Saipum. Meanwhile, the stagnant reservoir water has become contaminated, forcing communities to rely on distant or purchased water sources. Despite its complete operational failure, the Khuga Dam continues to drain public funds without delivering any benefits. The Manipur government has not held anyone accountable, leaving displaced communities in perpetual hardship. This case underscores broader issues in India's dam projects poor planning, corruption, and neglect of environmental and social impacts highlighting the urgent need for reforms in infrastructure governance (Thatte, C. D. 2011).

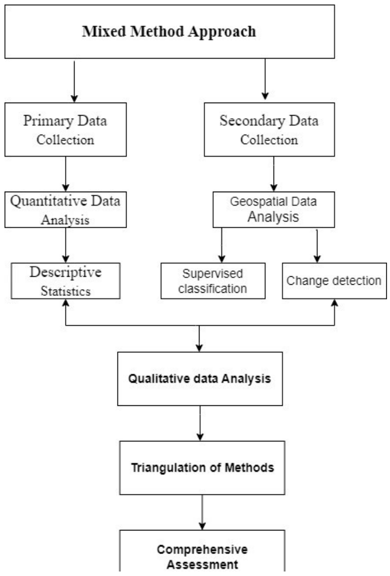

Figure 2. Framework of Methodological Process

To analyse Land Use and Land Cover (LULC) changes, Landsat 7 (2005) and Landsat 8 (2015, 2025) satellite imagery were processed using ArcGIS 10.8. Supervised classification and change detection techniques were applied to assess spatial transformations over two decades. Quantitative data from questionnaires were analysed using descriptive statistics, while qualitative insights were derived from open-ended responses, providing deeper contextual understanding. The integration of geospatial analysis with socio-economic data allowed for a comprehensive assessment of environmental and human dynamics. This triangulation of methods ensured robust validation of findings, enhancing the reliability and depth of the study. The combined approach facilitated a holistic understanding of the interlinkages between LULC changes and community impacts.

Table 2. Details of Multi-temporal dataset: USGS earth explorer.

Sl. No.	Date of Image	Sensor	Sensors	Resolution	Band	Band Name	Bandwidth (µm)
1	22-04-2005	Landsat 7	ETM+	30	8	1-Blue 2-Green 3-Red 4-NIR 5-SWIR 1 6-TIR 7-SWIR 2 8-Panchromatic	0. 45 - 0. 52 0. 52 - 0. 60 0. 63 - 0. 69 0. 77 - 0. 90 1. 55 - 1. 75 10. 40 - 12. 50 2. 09 - 2. 35 0. 52 - 0. 90
2	13-03-2015	Landsat 8	OLI	30	9	1-Costal/Aerosol 2-Blue 3-Green 4-Red 5-NIR 6-SWIR 1 7-SWIR 2 8-Panchromatic 9-Cirrus	0. 43 – 0. 45 0. 45 – 0. 51 0. 53 – 0. 59 0. 64 – 0. 67 0. 85 – 0. 88 1. 57 – 1. 65 2. 11 – 2. 29 0. 50 – 0. 68 1. 36 – 1. 38
3	05-03-2025	Landsat 8	OLI	30	9	1-Costal/Aerosol 2-Blue 3-Green 4-Red 5-NIR 6-SWIR 1 7-SWIR 2 8-Panchromatic 9-Cirrus	0. 43 – 0. 45 0. 45 – 0. 51 0. 53 – 0. 59 0. 64 – 0. 67 0. 85 – 0. 88 1. 57 – 1. 65 2. 11 – 2. 29 0. 50 – 0. 68 1. 36 – 1. 38

METHODOLOGY

This study employed a mixed-methods approach, integrating both qualitative and quantitative techniques. Primary data was collected through structured questionnaires administered to affected respondents, focusing on impacts on education, livelihood and other socio-economic parameters. Secondary data included population statistics from the Census of India 2011, obtained at the CD block level.

Non Functional Dams in Manipur: The Thoubal Dam, a multi-purpose project, was commissioned in 2017 for irrigation and water supply. It is officially functioning. However, the project is not fully operational due to land acquisition issues and protests from displaced villagers. This has limited its intended benefits, particularly for irrigation, despite its operational status. The Khoupum Dam, constructed for irrigation and flood control, is currently not functioning at full capacity. The reason is that the dam's gates and canals have been severely damaged due to years of neglect and lack of maintenance. This has rendered the project ineffective for its intended purpose. The Singda Dam is an earth-filled dam primarily intended to provide drinking water to Imphal. It is fully functioning. The reason is its crucial role in the capital's water supply system, which has ensured regular maintenance and upkeep, allowing it to serve its purpose effectively since its commissioning. The Khuga Dam is a multi-purpose project for irrigation, power generation, and flood control. It is not fully functioning. The reason is due to damaged canals and faulty components that have prevented the dam from distributing water for irrigation as intended. The project provides limited benefits to the surrounding areas. Despite the huge structure standing the low lying area under the dam is still under occasional flood during monsoon burst, which does not even fulfil a single objective (Wang, Y., Fu, Z., Cheng, Z., Xiang, Y., Chen, J., Zhang, P., & Yang, X. 2024).

It examines the interplay of three key factors: birth rates, death rates, and migration, which includes both immigration (people moving in) and emigration (Kirchherr, J., & Charles, K. J. 2016). The balance between these forces determines a population's trajectory. For instance, when births and immigration outpace deaths and emigration, the population grows. If the reverse is true, the population will shrink. This dynamic is not static; it's also shaped by external influences like resource availability, disease, and climate events. A critical concept is carrying capacity, which represents the maximum population size an environment can sustain indefinitely. Understanding these dynamics is vital for managing ecosystems and planning urban development. In the provided data, the total population across the 15 villages in 2001 was 4,004 people.

The overall population is nearly split between genders, with 2,020 males and 1,984 females, representing a slight male majority. The size of these villages varies significantly. The largest village is Ngoiphai, with a population of 564, followed by Geljang with 416 residents. In contrast, the smallest villages are Hiangdung and Phaibem, with populations of only 73 and 75 respectively.

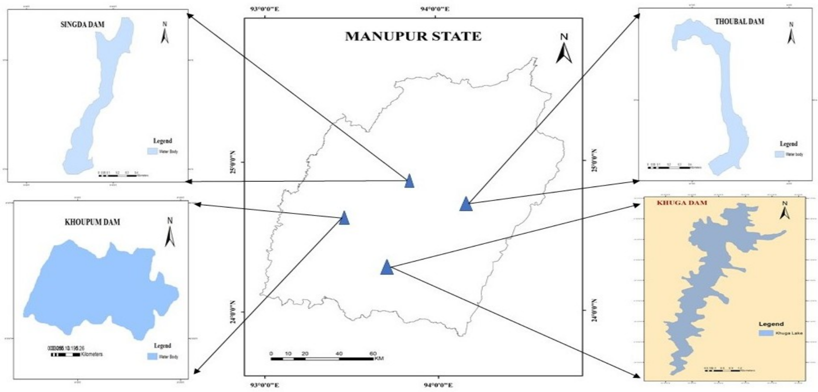

Figure 2. Locational map of Dams in Manipur

Dams in India

Table 3. Represent the State-wise List of Non-Functional or Underperforming Hydroelectric Dams in India

State	Dam/Project	Capacity (MW)	Issues
Manipur	Khuga Dam	1. 5	Never generated electricity since its inauguration in 2010; the power machine never installed, canal breaches and corruption allegations.
	Singda Dam	0. 75	Defunct since 1995; failed irrigation and power generation.
	Mapithel Dam (Thoubal)	7	Displaced communities without compensation; unmet irrigation and power promises.
Sikkim	Teesta III Dam	1,200	Destroyed by 2023 glacial flood; non-operational for nearly two years.
	Teesta V Dam	N/A	Damaged in same event; remains defunct.
Jammu & Kashmir	Salal Hydro Project	690	Underperforms due to sediment build up, requiring frequent flushing.
	Baglihar Dam	900	Reduced efficiency from silt accumulation.
Gujarat	SardarSarovar Dam	1,450	Failed flood control and irrigation promises; displaced villages without adequate rehabilitation.
Himachal Pradesh	Bhakra Dam	1,325	Siltation rates 140% higher than projected, shortening lifespan.
	Pandoh Dam	N/A	Mismanagement caused downstream flooding in 2023.
Telangana	Kaddam Dam	N/A	Poor flood management led to sudden releases, worsening downstream flooding.
Kerala	Idukki Dam	780	Aging infrastructure and siltation reduce capacity; exacerbates flood risks.

RESULTS AND DISCUSSION

Population Dynamics: Population dynamics is the study of how and why the number of individuals in a population changes over time.

While the total population has a balanced gender ratio, individual villages show slight variations in their male-to-female distributions. Notably, the village of Belbing has an exactly equal population of 50 males and 50 females. Based on the provided data in table 5, the total population of the 15

Table 4. Total Population, 2001 Census.

Sl. No.	Village Name	2001 Population	Male	Female
1	Ngoiphai	564	289	275
2	Geljang	416	204	212
3	Phaibem	75	41	34
4	Zoumun	254	135	119
5	Lamjang	458	235	223
6	Mata Mualtam	472	231	241
7	Sehken	300	149	151
8	Kullian	115	51	64
9	M. Lunmual	106	55	51
10	Hiangdung	73	33	40
11	Panglian	276	149	127
12	M. Tanglian	399	209	190
13	S. Munhoi	138	61	77
14	Belbing	100	50	50
15	S. Geltui	258	128	130
Total		4004	2020	1984

Source: Census of India 2001.

villages in 2011 was 3,551. The gender distribution was almost equal, with 1,773 males and 1,778 females, indicating a slight majority of females.

This trend is notable as it differs from the male-dominated demographics often seen in similar regions. The data projects a consistent increase in population, with a total projected population of 4,178 for 2021 across all villages. This represents a growth of approximately 17.66% over the decade. Village sizes vary considerably. Mata Mualtam was the most populous village in 2011 with 474 residents and is projected to remain the largest, reaching 558 people by 2021. In contrast, Zoumun was the least populated with 66 people, with a projected population of only 78 by 2021.

Overall, the data illustrates a steady and uniform population growth trend across all villages, with each village experiencing an increase in its population over the decade. The provided data reveals a significant overall population dynamic across the 15 villages. The collective population experienced a notable decline of 453 people between 2001 and 2011, dropping from 4,004 to 3,551, an overall decrease of approximately 11.3%. However, the data projects a strong rebound, with the total population projected to reach 4,178 by 2021, a figure that surpasses the 2001 total. This indicates a major reversal of the demographic trend. Individual village trends during 2001-2011 were highly erratic. While some villages saw marginal growth (Mata Mualtam gained just two people), others faced severe population losses.

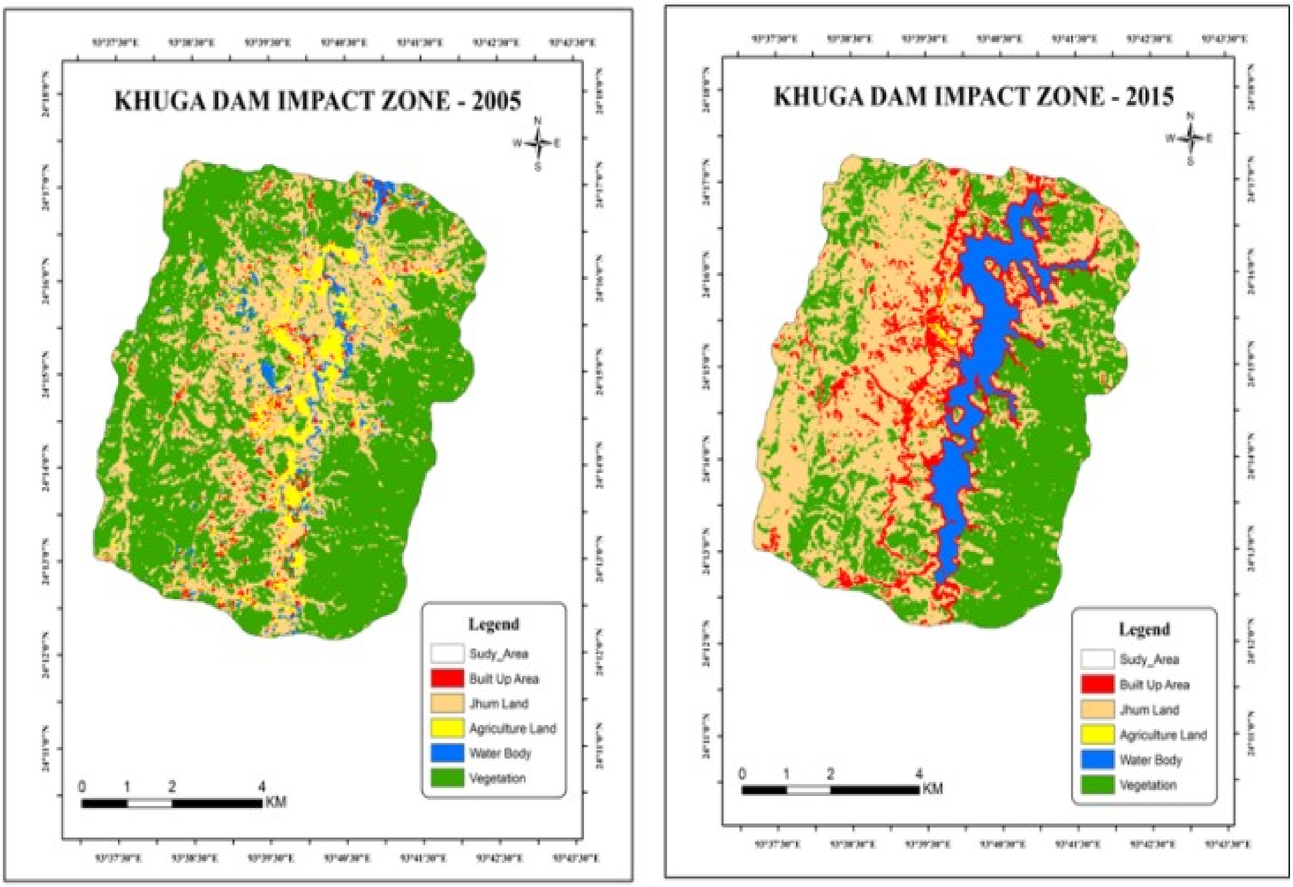

Figure 3. Map showing Khuga dam Impact areas.

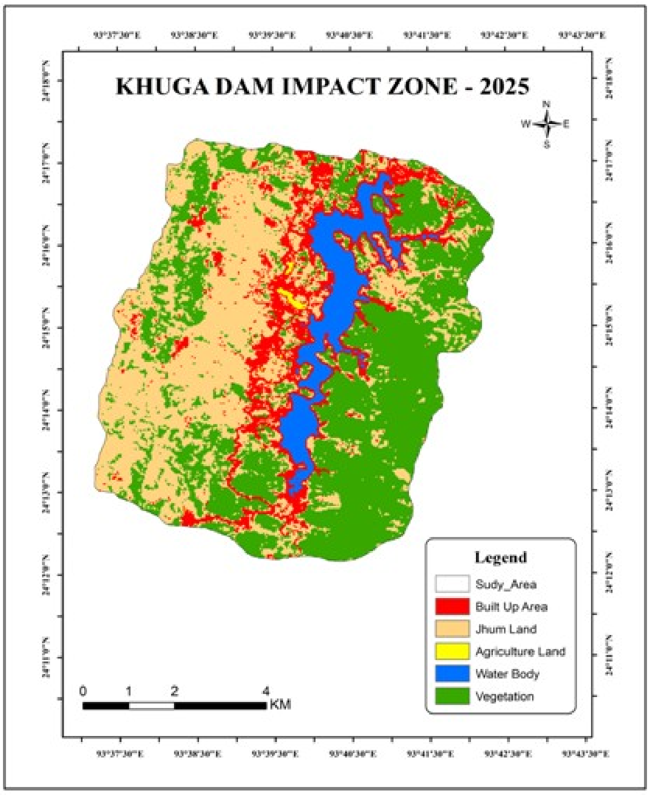

Figure 4. Latest Impact Areas of Khuga Dam

Zoumun faced the most dramatic decline, losing over 74% of its residents. Ngoiphai and Lamjang also saw significant decreases of 45.39% and 29.69% respectively. In stark contrast, several villages experienced explosive growth: Phaibem's population more than doubled, increasing by an astounding 160%, while Kullian surged by over 122%. The 2021 projections, however, paint a uniform picture. Every single village is predicted to increase its population from its 2011 level, regardless of its previous performance. The growth is substantial for previously declining villages and steady for those that were already expanding. This collective and widespread growth implies a positive shift in the region's demographic patterns, indicating a period of robust recovery and expansion after a decade of mixed fortunes. The table documents a period of significant demographic change and village resettlement. It highlights that the village of Zoumun was lost or abandoned, possibly linked to a shift to Mata Mualtam. The data shows that four new villages were established. Other shifts led to the creation of new villages with different names: Ngoiphai's resettlement resulted in M. Saljang, and Phaibem's shift created Zoutuinuam. The remaining listed villages also underwent a shift or resettlement, though their new locations are not specified.

Environmental Impact

Land Use Land Cover Change: Land use and land cover change (LULCC) refers to the modifications of Earth's terrestrial surface by human activities. Land use describes how humans manage and modify the land, such as for agriculture, residential areas, or industry (Alla Y. M. K., & Liu, L. 2021).
and cover refers to the biophysical materials on the surface, including forests, grasslands, water bodies, and concrete. Land Use Land Cover Change is a critical component of global environmental change, significantly impacting ecosystem services and biodiversity (Eslami, V., Ashofteh, P. S., Golfam, P., & Loáiciga, H. A. 2021). Key drivers include urbanization, deforestation for farming, and the expansion of infrastructure. For example, converting a forest (land cover) into a city (land use) replaces trees with buildings, leading to habitat loss, altered local climate patterns and increased carbon emissions. Understanding and monitoring these changes is essential for sustainable development, climate modelling and natural resource management. The provided data illustrates significant and complex land use changes between 2005 and 2025. The most dramatic shift occurred between 2005 and 2015, when Vegetation and Agricultural Land saw sharp declines. Vegetation cover fell by over 20%, while agricultural land nearly vanished, plummeting from 5.67% to just 0.36%. This loss of land primarily contributed to a significant expansion of Jhum Land and Built Up Area. Jhum land grew from 31.93% to 42.65%, becoming the dominant land use, while the built-up area increased more than fourfold, reflecting rapid urbanization. The projections for 2025 indicate a changing dynamic. While the built-up area continues to grow, both Jhum Land and Water Bodies are expected to decrease. This allows for a modest recovery of Vegetation cover, suggesting a trend towards stabilization. The data portrays a fundamental shift from a natural landscape to one increasingly shaped by human development and activity (Haokip, T.L. and Prasad, T.K. and G, Jayapal, 2025) The data reveals a dramatic two-phased land use change. Between 2005 and 2015, the area underwent rapid development driven by aggressive land conversion. Built Up Area saw an explosive growth of over 347%, while Jhum Land and Water Bodies also expanded significantly. This came at the expense of natural cover, with Vegetation declining by over 35% and Agricultural Land nearly disappearing with a catastrophic loss of 93.68%. The projected changes for 2015-2025 show a different, more stable trend. While Built Up Area continues to grow, its rate of increase slows considerably. Crucially, the trends for other categories reverse. Jhum Land and Water Bodies are projected to decrease (Haghighi, A. T.,

Table 5. TotalPopulation, 2011.

Sl. No.	Village Name	2011Population	Male	Female	Projected Population for 2021
1	Ngoiphai	308	139	169	362
2	Geljang	287	136	151	338
3	Phaibem	195	95	100	229
4	Zoumun	66	34	32	78
5	Lamjang	322	165	157	379
6	Mata Mualtam	474	232	242	558
7	Sehken	305	150	155	359
8	Kullian	256	123	133	301
9	M. Lunmual	128	67	61	151
10	Hiangdung	90	51	39	106
11	Panglian	266	140	126	313
12	M. Tanglian	289	152	137	340
13	S. Munhoi	122	57	65	144
14	Belbing	123	70	53	145
15	S. Geltui	320	162	158	377
Total		3551	1773	1778	4178

Source: Census of India 2011

Table 6. Changes in Population 2001 – 2011

Sl. No.	Village Name	2001population	2011Population	Difference	% of Diff.	Projected Population for 2021
1	Ngoiphai	564	308	-256	-45. 39	362
2	Geljang	416	287	-129	-31. 01	338
3	Phaibem	75	195	+120	+160. 00	229
4	Zoumun	254	66	-188	-74. 02	78
5	Lamjang	458	322	-136	-29. 69	379
6	Mata Mualtam	472	474	+2	+0. 42	558
7	Sehken	300	305	+5	+1. 67	359
8	Kullian	115	256	+141	+122. 61	301
9	M. Lunmual	106	128	+22	+20. 75	151
10	Hiangdung	73	90	+17	+23. 29	106
11	Panglian	276	266	-10	-3. 62	313
12	M. Tanglian	399	289	-110	-27. 57	340
13	S. Munhoi	138	122	-16	-11. 59	144
14	Belbing	100	123	+23	+23. 00	145
15	S. Geltui	258	320	+62	+24. 03	377
Total		4004	3551			4178
Total Difference		-453				

Source: Census of India 2011.

Table7. Village Shifted to higher ground/Resettlement & Lost

Sl. No.	Village Shifted/Resettlement	New established Villages	Village Lost
1	Mata Mualtam	Village Name	Zoumun
3.	Ngoiphai	V. Bethel	
4	Phaibem	M. Saljang	
5	Lamjang	Zoutuinuam	
6	M. Lunmual		
7	Kullian		
8	Hiangdung		
9	M. Tanglian		
10	Panglian		
11	S. Munhoi		
12	Belbing		
13	Sehken		

Source: Field Survey

Marttila, H., & Kløve, B. 2014), allowing for a notable rebound in Vegetation cover. This indicates a shift from a period of aggressive exploitation to a more sustainable land use pattern. The provided data reveals significant land use and land cover changes over a twenty-year period, from 2005 to 2025. The most striking trend is the explosive growth in the Built Up Area, which is projected to increase by over 416%, adding more than 1,600 acres of developed land. Similarly, Jhum Land (shifting cultivation) and Water Bodies are also set to expand, indicating increased human activity and modification of the landscape (Haokip, T.L. and T K, Prasad, Gangte, P. Lienzapau, Shah, Md. Baharuddin and G, Jayapal, 2025). This growth comes at a considerable cost to natural and traditional land uses. Agricultural Land is projected to suffer a catastrophic loss, decreasing by over 95%, while Vegetation cover is expected to shrink by nearly 30%. This dramatic shift portrays a landscape moving away from its natural and agricultural state toward one dominated by urbanization and alternative cultivation practices, fundamentally altering the region's land resources.

Impact on Socio Economic and Livelihood: Based on the data, the region's occupational landscape is projected to undergo a fundamental transformation between 2005 and 2025. The most dramatic shift is the complete disappearance of wet paddy cultivation, which accounted for 80% of occupations in

Table 8. Land Use Land Cover of 2005 – 2025

Sl. No.	Category	Area in Acres					
		2005	%	2015	%	2025	%
1	Built Up Area	390	2. 59	1,744	11. 58	2,014	13. 37
2	Jhum Land	4,808	31. 93	6,423	42. 65	5,839	38. 77
3	Agricultural Land	854	5. 67	54	0. 36	37	0. 25
4	Water Body	410	2. 72	1,322	8. 78	1,087	7. 22
5	Vegetation	8,598	57. 09	5,517	36. 63	6,086	40. 41
Total		15,060					

Source: ArcGIS

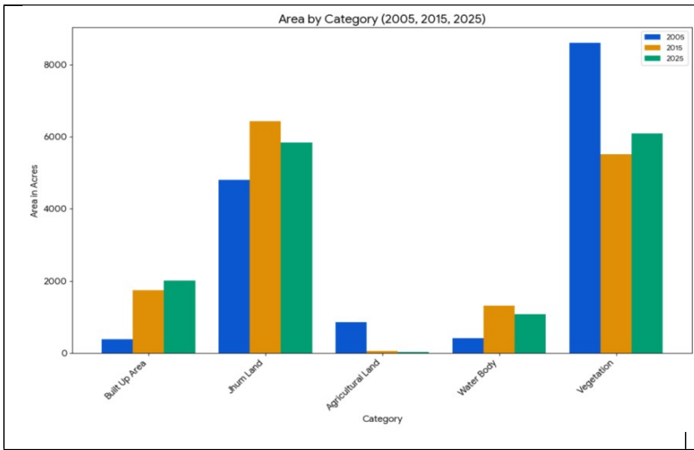

Figure 5. LULC, 2005 - 2025

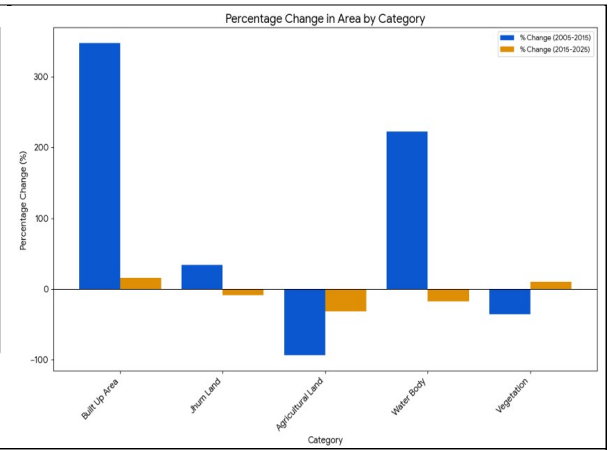

Figure 6. Changes in percentages of LULC (2005 – 2025)

Table 10. LULC difference from 2005 – 2025

Sl. No.	Category	Area in Acres		Differences	
		2005	2025	Acres	%
1	Built Up Area	390	2,014	+1,624	+416. 41
2	Jhum Land	4,808	5,839	+1,031	+21. 44
3	Agricultural Land	854	37	-817	-95. 67
4	Water Body	410	1,087	+677	+165. 12
5	Vegetation	8,598	6,086	-2,512	-29. 22
Total		15,060			

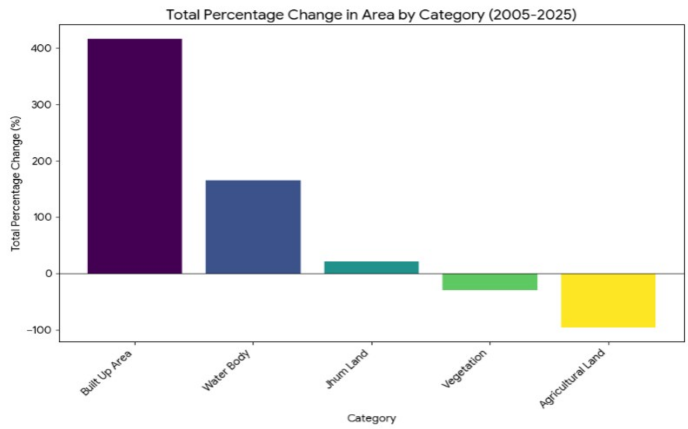

Figure 7. Total Area Changes (2005 – 2025)

Table 11. Occupational Shift

Types of Occupation	(%) in 2005	(%) in 2025
Wet paddy cultivation	80	4. 33
Jhum cultivation	6. 1	44. 5
Forest products (wood and charcoal)	6. 4	50. 5
Farming (livestock)	4. 5	3. 3
Others	3	1. 7

Source: Field Survey

2005. The majority of the workforce has shifted to two new dominant occupations: Jhum cultivation and forest products. Jhum cultivation is projected to grow exponentially from 6.1% to 44.5%, while forest-related work will increase even more, from 6.4% to 50.5%. Both farming (livestock) and business are projected to experience a slight decline, indicating a move away from traditional small-scale enterprise towards forest-based livelihoods. This profound change highlights a major socio-economic and environmental transition. Based on the provided data, a significant number of students at all levels are unable to continue their education.

Figure 8. occupational Shift of the people

Table 12. Impact on Education

Class level	2005	2025	Not able to continue
Below class 10	710	467	243
10 + 2	320	197	123
Graduate & above	220	146	74
Total	1250	810	440

Source: Field Survey

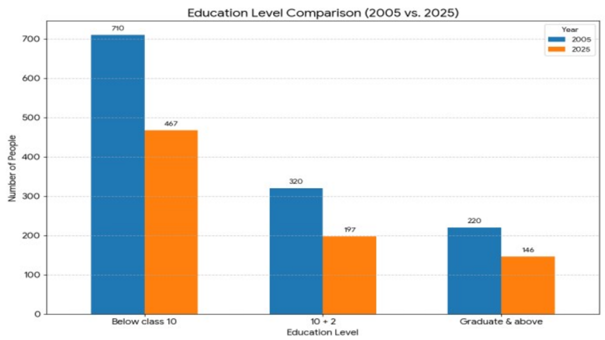

Figure 9. Changes in student strength

Over the two decades from 2005 to 2025, there is a clear and concerning trend of educational attrition. The most severe dropout is seen at the Below Class 10 level, with 243 students projected to not continue their education. This represents the largest group of students unable to progress. The trend continues into higher education, with 123 students at the 10+2 level and 74 students at the Graduate and above level also unable to continue. This data highlights a consistent challenge with educational progression across all academic stages in the region.

CONCLUSION

The study on the Khuga Dam reveals a profound case of a development project causing more harm than benefit. The project, intended for hydropower and irrigation, has largely failed its objectives, leaving a trail of significant negative impacts on the environment, demography and socio-economic life of the affected communities. From an environmental perspective, the dam's failure is evident in the dramatic land use and land cover change (LULCC). Geospatial data clearly showed a sharp reduction in original vegetation or forest cover and a catastrophic decline in agricultural land. This was paralleled by an unsustainable increase in Jhum land (shifting cultivation) and deforestation, as displaced people resorted to alternative, less stable livelihoods. The socio-demographic impact has been equally severe. Communities have faced displacement, a complete disruption of their traditional livelihoods and persistent grievances over inadequate compensation (Kondolf, M., & Yi, J. 2022). The non-functioning canals and the lack of a reliable water supply have exacerbated these problems, creating a vicious cycle of poverty and resource scarcity. The government's own sources and reports from local media confirm these failures, including issues with the dam’s power generation and irrigation capacity, which have led to a lack of public trust. To address these issues, immediate and decisive measures must be taken. The government needs to prioritize the repair of key infrastructure, particularly the power house installation and irrigation canals, to restore the livelihoods of farmers. Furthermore, it is essential to establish a transparent, community-led framework for resettlement and rehabilitation. This includes providing fair compensation, alternative livelihood training and proper infrastructure in resettlement areas. Finally, policymakers should engage in direct, sustained dialogue with the affected communities to address their long-standing grievances and ensure that future development projects are planned with a focus on people-centric, sustainable outcomes.

ACKNOWLEDGEMENT

The authors wish to express their sincere and profound gratitude to the principals, teachers and especially the students of the higher secondary schools in Churachandpur district, Manipur, India. Their willing participation, invaluable support and cooperation were instrumental in the successful acquisition of the data that forms the basis of this study.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial or not for profit sectors.

Conflict of Interest: There are no ethical issues, conflicts of interest associated with the writing and submission of this article.

Publication Ethics: The authors confirm that this study was conducted in full compliance with ethical standards. No animals or plants were used or harmed in the course of this research.

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