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## **Downstream Consequences of Large Dam project: Environmental Degradation and Social Vulnerability in the downstream of Mapithel Dam, Thoubal River, Manipur**

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### **Abstract**

Large dam projects in India are commonly evaluated through upstream displacement and infrastructural benefits, while the downstream impacts remain poorly documented. This study examines the environmental, livelihood and health consequences experienced by downstream communities of the Mapithel Dam on the Thoubal River, Manipur. Primary data were collected from 200 respondents across 20 downstream villages using structured field surveys. The findings indicate a marked deterioration in river water quality following dam construction, characterised by increased turbidity, stagnation, odour and reduced natural flow. These changes have significantly altered patterns of river water utilization with sharp declines in drinking, cooking, and bathing, alongside reduced agricultural productivity. Many households reported moderate to severe declines in crop yield. Health impacts, including skin infections and sanitation related illnesses particularly among women were reported. Despite physical accessibility to the river, declining water quality has fundamentally reshaped everyday practices and livelihood security. The study highlights a critical governance gap in dam impact assessments, where downstream effects are excluded from social and environmental monitoring. By highlighting lived experiences and empirical evidence, this paper argues for basin wide impact assessments and inclusive water governance that recognises downstream communities as integral stakeholders in sustainable development planning.

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### **Introduction**

An environmental analysis of the effects of environmental changes on human life has revealed notable trends in health, livelihood, and socio-economic well-being. Pollution cases in coastal and riverine areas provide statistical data of an increase in water-borne diseases, food insecurity and loss of income among fishing based communities. The studies on a large dam projects in India highlights the complex scenario of development, displacement, and ecological unbalance. Sundaram et al. (2023) highlighted the severe ecological disruptions including the loss of forest cover, greenhouse gas emissions, altered aquatic ecosystems, waterlogging, and adverse social outcomes. Such as livelihood insecurity, cultural dislocation, and health risks. Analysing this data, it is possible to state that there is a direct relationship between deteriorating water quality, lower fish supply, and human well-being. It has been a consensus among environmental experts that the construction of the dam has caused changes in the natural river ecosystem causing not only a loss of biodiversity but also ecological imbalance (Ayanda, et al., 2019) Besides, there are climate-related information like temperature increase, extreme weather conditions, which show higher susceptibility of the population in coastal areas. Analysis of demographic and health data also confirms the idea that low-income populations have a higher likelihood of being impacted by environmental degradation. In general, the data under analysis highlights the issue of the conversion of environmental stressors into quantifiable risks of the human population, which supports the necessity of sustainable management and policy-based interventions.



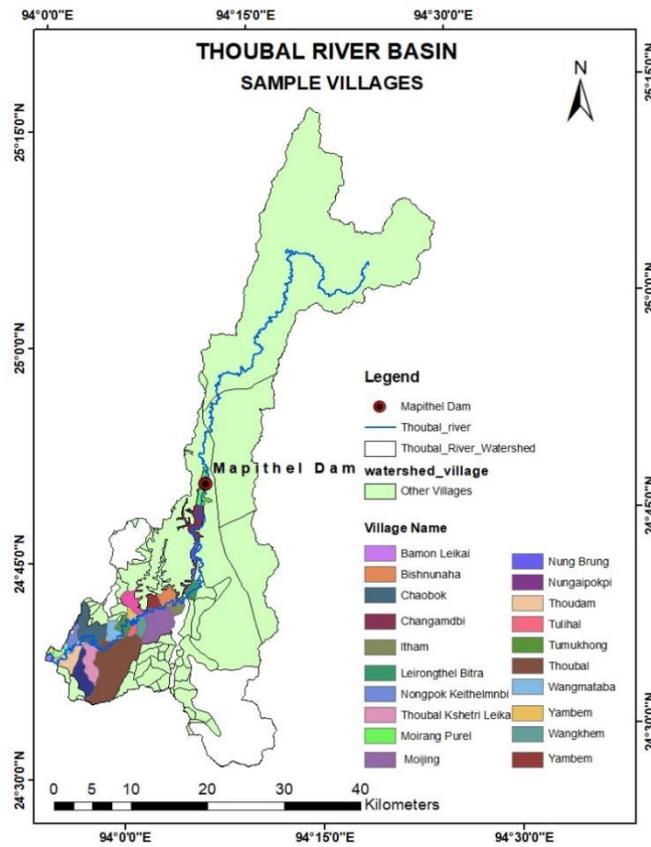
The construction of Mpithel Dam in the Thoubl river was necessary to evacuate the human settlement in the upstream areas due to expected impoundment of water and resulting to the rehabilitation of six affected villages. The six village are namely Phayang, Louphong, Chadong, Lamlai Khunou, lamlai Khullen and Mongbung. The six village comprise of 286 families and having total population 1735 individuals. Asthana (2012) states that development categories included large dams, irrigation projects, urban infrastructure, transportation power plants, etc. While these categories are considered beneficial in the broad development paradigm, it has resulted in fostering social and economic inequalities serving the interests of narrow elite, destroying the environment, displacing and impoverishing people dependent on land. This process not only involved the relocation of peoples their settlement from their previous occupied land but also disrupted the long establish social, cultural and economics networks. “Older people prefer to stay in their homes as long as possible because it provides them with control over their lives; it enables them to keep their identity and well-being.” (Sundaram et al., 2023). The rehabilitated people were expected to provide with alternative housing and others basic amenities. However, the communities faced a big challenges in adapting to the new environment and also faced a lot of controversial even in their entitled compensation. Many of the families loses their traditional sources of livelihood particularly agricultural activities.

Against the broader background of environmental change and development induced disruption, this present paper focus to the downstream areas of the Mapithel Dam on the Thoubal River. A scenario that has been consistently overlooked by the government and concerned agencies. While official assessments and policy responses have largely employed on the upstream displacement, resettlement and compensation but the downstream villages continue to experience the consequences of altered river flow, declining water quality, reduced fish availability and increasing livelihood insecurity with little institutional recognition. This silence in policy and planning reflects a deeper imbalance in development discourse, where impacts that are not easily quantified or formally classified as “displacement” tend to be ignored (Asthana, 2012). Studies on large dams have repeatedly shown that ecological disturbances downstream such as changes in sediment transport, aquatic habitats, and water chemistry directly affect fishing based and agrarian communities, thereby undermining health, income and social well-being (Ayanda et al., 2019; Sundaram et al., 2023). In the case of the Mapithel Dam, the absence of sustained monitoring and support for downstream populations has created a sad and persistent reality in which communities bear long-term environmental and socio-economic costs without adaptive assistance. This paper seeks to challenge the narrow framing of development benefits by highlighting these neglected downstream impacts and to argue for a more inclusive. The paper aims to recognise the lived experiences and vulnerabilities of downstream villages as an integral part of sustainable water resource governance.

### **Study Area**

To study the impacts of Mapithel Dam in the downstream, 20 villages were chosen to conduct extensive field survey. The village-wise distribution of the table indicates that, there is equal representation of all the 20 villages that participated in the study. Every village provide 10 respondents making 5 percent of the total sample size of 200. This even distribution means that one village would not dominate the dataset thus, there would be a good representation of locations. The cumulative percentage is growing steadily by 5 percent, until it reaches 100 percent, which proves the correct data collection and total coverage. This type of balanced sampling design enhances the geographical validity of the study and provides the possibility of reliable comparison between

various villages. It also reduces the bias caused by location and improves the generalizability of the study area findings. Such equal distribution can be viewed as a well thought-out sampling strategy which allows maintaining stable data analysis and effective derivation of the significance of the village-level deviations in the context of the given research.



**Figure 1: Village of the respondents**

**Table 1: Village of the respondents**

Village					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bamon Leikai	10	5.0	5.0	5.0
	Bishnunaha	10	5.0	5.0	10.0
	Changamdabi	10	5.0	5.0	15.0
	Chaobok	10	5.0	5.0	20.0
	Itham	10	5.0	5.0	25.0

Keithelmanbi	10	5.0	5.0	30.0
Khoirom	10	5.0	5.0	35.0
Laikhong	10	5.0	5.0	40.0
Leirongthel Bitra	10	5.0	5.0	45.0
Moijing	10	5.0	5.0	50.0
Moirangpurel	10	5.0	5.0	55.0
Nung Brung	10	5.0	5.0	60.0
Nungaipokpi	10	5.0	5.0	65.0
Thoudam	10	5.0	5.0	70.0
Tulihal	10	5.0	5.0	75.0
Tumukhong	10	5.0	5.0	80.0
Wangkhem	10	5.0	5.0	85.0
Kshetri Leikai	10	5.0	5.0	90.0
Thoubal Wangmataba	10	5.0	5.0	95.0
Yambem	10	5.0	5.0	100.0
Total	200	100.0	100.0	

### Methods and Methodology

This study follows a descriptive and analytical approach to examine the environmental, livelihood, and health impacts of the Mapithel Dam on downstream communities along the Thoubal River. The research is grounded in primary field-based data, supported by systematic observation and contextual interpretation.

The study area consists of 20 villages located at the downstream of the Mapithel Dam. Village selection was purposive and based on a clear spatial criterion, only those villages that physically touch or directly border the river channel were included. Selection began from the immediate downstream of the dam and extended sequentially along the river course. This ensured that the analysis focused on settlements with direct exposure to changes in river flow, water quality and river dependent livelihoods.

Judgmental sampling was adopted to identify respondents with direct or indirect dependence on the river. From each village, 10 respondents were selected, resulting in a total sample size of 200. Respondents included farmers, fishers, agricultural laborers, and household members who regularly used river water for domestic activities. This method was considered appropriate given the study's objective of capturing informed experiences rather than achieving statistical randomness.

Primary data were collected through a structured questionnaire administered during the field survey. The questionnaire covered four broad themes namely changes in river water quality, patterns of river water use

before and after dam construction, impacts on agriculture and livelihoods and health issues associated with river water contact. Questions were framed in simple and locally understandable terms to ensure clarity and reliability of responses.

Collected data were coded and analyzed using descriptive statistical tools such as frequencies, percentages, means and standard deviations. Comparisons between pre- and post-dam conditions were used to assess the extent of environmental and socio-economic change. Ethical considerations were strictly followed, with informed consent obtained from all participants and confidentiality maintained throughout the study.

## Results and Discussion

As shown in the table 2, most of the respondents believe that the current quality of the river water is negative. Of the 200 people surveyed, 93 (46.5) people evaluated the water quality as Worst making 72 people (36) rate the water quality as Bad. The combination of the two groups of people represents 82.5 per cent. of the total number of the responses, which is an obvious sign of the general displeasure and worry about the state of the river. The proportion of respondents who considered the water quality to be moderate was only 25 (12.5%) and the very low percentage of 10 (5) respondents regarded it as good. The cumulative percentage of 100 percent ensures that all data is represented. This distribution clearly indicates that the current water quality of the river is seen as mostly poor and of low quality that cannot be used by ordinary people and domestic purposes.

**Table 2:** How do you find the quality of the river water?

How do you find the quality of the river water?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	72	36.0	36.0	36.0
	Good	10	5.0	5.0	41.0
	Moderate	25	12.5	12.5	53.5
	Worst	93	46.5	46.5	100.0
	Total	200	100.0	100.0	

In the table, it is evident that there is a great difference between the current poor state of the river and the previous high quality of the river before the dam construction. The river water used to be regarded as clean and potable, as well as cooking and bathing among other domestic tasks. Nonetheless, the present data discloses that 82.5 percent of the respondents are currently in the Bad and Worse category which shows a big decline in the water quality. This adverse change is closely connected with the effects of dam construction, i.e. the decrease of natural flow, turbidity, stagnation, and pollution. This has led to the loss of confidence in the water of the river and people do not use it anymore, even in critical domestic applications. The results are a clear indicator of the negative impact of environmental change that resulted in the catastrophic decrease in water quality and trust.

**Table 3:** How often do you come into contact with river water before it was as turbid as today?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	102	51.0	51.0	51.0
	Sometimes in a month	53	26.5	26.5	93.5
	Sometimes in a week	32	16.0	16.0	67.0
	Yearly	13	6.5	6.5	100.0
	Total	200	100.0	100.0	

Table 3 demonstrates that before the construction of the dam, the community's dependence on river water was remarkably high, reflecting the reliability and accessibility of the resource. A substantial 51% used river water daily, suggesting that households considered it safe for routine activities such as drinking, cooking, and bathing. Weekly usage recorded 26.5% individuals, indicating that even those who did not rely on it every day still incorporated the river into their regular domestic routines. Monthly usage stood at 16%, while only 6.5% people used the river water yearly, showing that minimal hesitation existed regarding its quality. These patterns collectively highlight a strong cultural and practical reliance on the river as a primary water source. Before construction, the river was perceived as clean, stable, and integral to maintaining health and household functioning.

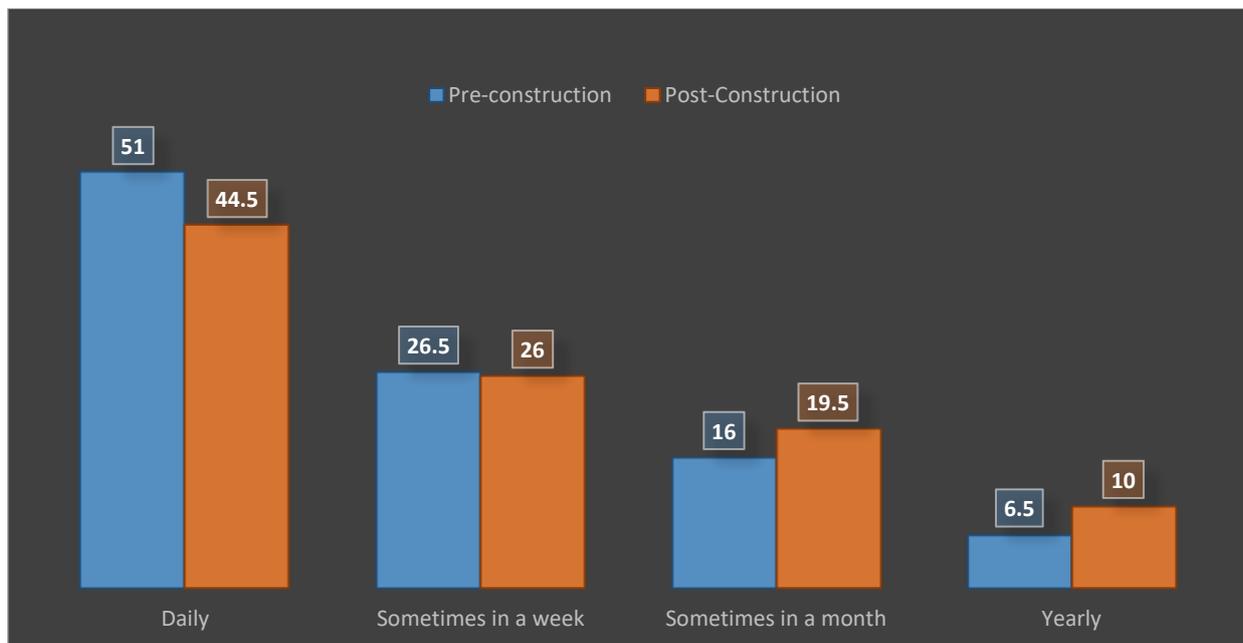
**Table 4:** How often do you use river water during this current time?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	89	44.5	44.5	44.5
	Sometimes in a week	52	26.0	26.0	90.0
	Sometimes in a month	39	19.5	19.5	64.0
	Yearly	20	10.0	10.0	100.0
	Total	200	100.0	100.0	

The table 4 illustrates the frequency of the use of river water by the respondents currently. Among 200 respondents, 89 (44.5) said that they utilize the river water daily indicating that a significant percentage of the population still relies on the river to fulfil their daily needs. Of the respondents, 52 (26%) respondents said that they use the river water occasionally within a week, and 39 respondents (19.5%) respondents said that they occasionally use river water in a month. Fewer numbers (10 percent) of 20 respondents said that they use river water once a year. The percentage of 100%, cumulative takes care of the 100 percent valid responses. On the whole, everyday utilization is the highest; however, the existence of the high weekly, monthly and annual use means that many households have become more dependent on the river water on an irregular basis.

**Table 5:** Uses of River water during the pre and post construction of Mapithel Dam.

Timeframe	Pre-construction		Post-Construction	
	Frequency	Percentage	Frequency	Percentage
Daily	102	51	89	44.5
Sometimes in a week	53	26.5	52	26
Sometimes in a month	32	16	39	19.5
Sometimes in a Year.	13	6.5	20	10
Total	200	100	200	100



**Figure 2:** Graph showing uses of River water during the pre and post construction of Mapithel Dam.

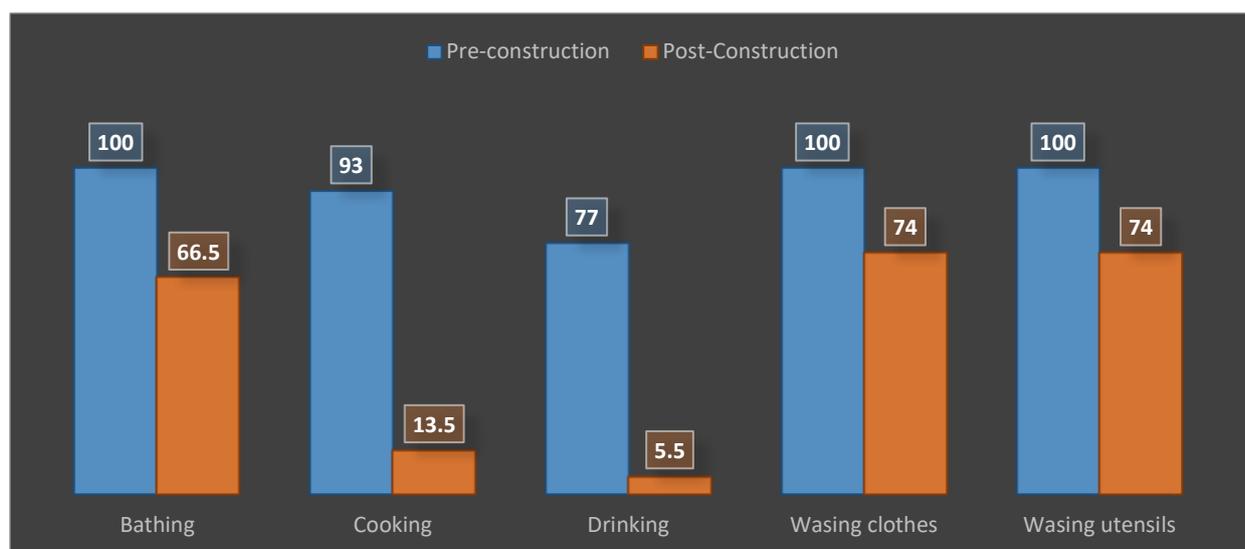
Table 5 demonstrates that after the construction of the dam, the frequency of river water use shifted significantly, reflecting increasing concerns about water quality and safety. Daily use decreased from 51% to 44.5%, indicating that fewer households trusted the river for routine and essential tasks. Weekly usage remained relatively similar at 26%, but monthly usage rose to 19.5%, suggesting that more residents began limiting their contact with the river due to discomfort or perceived contamination. Yearly use increased notably to 10%, highlighting a growing group that avoids the river almost entirely except on rare occasions.

As it is depicted in the figure 2, there was a definite shift in the dynamics of river water utilization compared to the situation before the dam was constructed. Previously, the water was of quality and safe, thus the population relied on the river water to carry out their day-to-day chores. But following the dam development, the

demolishment of the quality of water through turbidity, decreased flow and pollution has compelled the people to at least restrict their frequent use. Even though 44.5 percent continue to do it daily, a significant fraction currently does it on a weekly (26 percent), monthly (19.5 percent) or annual (10 percent) basis, which is a sign of increasingly fearing the health risks. These changes mirror heightened awareness of turbidity, stagnation, and pollution in the post-construction period. The decline in regular usage underscores a shift from reliance to caution, as communities reassessed the safety of the river for maintaining daily health and hygiene. The change demonstrates the dwindling confidence in river water to use it on daily household processes. The statistical data speaks volumes of how the dam construction has had a direct effect of lowering the rate of river water use.

**Table 6:** Frequency of using river water for different household chores during pre and post construction of Dam.

<b>What are the purposes you use river water from the below listed activities?</b>						
<b>Household Chores</b>	<b>Pre-construction</b>			<b>Post-Construction</b>		
	Frequency		Percentage (Yes)	Frequency		Percentage (Yes)
	Yes	No		Yes	No	
Bathing	200	0	100	133	67	66.5
Cooking	186	14	93	27	173	13.5
Drinking	154	46	77	11	189	5.5
Washing clothes	200	0	100	148	52	74
Washing utensils	200	0	100	148	52	74



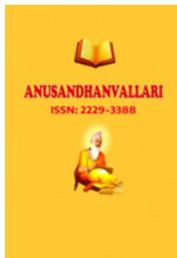
**Figure 3:** Graph showing frequency of using river water for different household chores during pre and post construction of Dam.

The table 6 shows that income of river water was regarded as clean and of high quality before the dam construction and thus was useful in a variety of domestic and everyday activities. The community widely relied on river water for a range of daily household chores. This previous reliance can be seen in the table 6 and figure 3 as 100% of the data reported using river water to wash clothes and to wash utensils. Thereby it demonstrating a high level of confidence in its water's suitability and cleanliness which shows that residents trusted the river water for laundry needs and dishwashing. Cooking (93%) were also widely practiced and this means that people used the river as a source of majority of their basic needs and considered as safety for food preparation. Bathing at 100% reveals that every households considered the river suitable for personal hygiene. Even drinking purposes figured 77%, which is a clear indication that the water was once considered to be safe enough for direct consumption. Taken together, these figures show that pre-construction the river served as a dependable, multifunctional water source supporting hygiene, meal preparation, drinking, cleaning and forming an integral part of everyday domestic life. Overall, the river was a major source of livelihood ahead of environmental transformations which had supported the everyday household chores.

Concurring with Sharma, et al., (2019), the report that the interaction of people with the river has transformed greatly as a result of the deterioration of water quality. Previously, the river was utilized on a daily basis to drink, cook, bathe, and wash implying the high level of trust in the purity (Sloman, and McNeil, 2012). Table 6 demonstrates that after the construction of Dam, there was a marked shift in how river water was utilized within households. With the creation of the dam, river water gradually became worse as natural flow, stagnation and pollution evolved and waste deposited. Consequently, individuals started to stop using river water in performing sensitive activities like drinking and cooking which now record relatively very lower percentages. The least purpose is drinking with only 5.5% meaning that there is a definite loss of confidence in terms of the safety of water. Bathing dropped to 65.5% and cooking to 13.5%, suggesting rising doubts about water quality and safety for personal hygiene and consumption. In contrast, washing clothes (74%) still comparatively high which indicates that the river water remained acceptable for non-consumptive tasks like laundry. Interestingly, washing utensils also remained relatively high with 74%, perhaps reflecting limited alternatives for dishwashing water despite quality concerns. These are those activities that do not demand water with such high quality. This shifting trend is a clear indication of the diminishing quality of water that has minimized the reliance of river water in serving key household demands and communities seek alternative sources that not expose them to harmful effects on their daily lives. Overall, the post-construction pattern shows that while residents still used the river for some domestic chores, they gradually reduced reliance on it for vital functions such as drinking, cooking, and bathing owing to deteriorating water quality and growing health concerns.

**Table 7:** What do you think by how much percentage the yield is decrease?

What do you think by how much percentage the yield is decrease?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-25%	106	80.3	80.3	80.3
	25-50%	17	12.9	12.9	93.2
	50-75%	9	6.8	6.8	100
	75-100%	0	0	0	



	Total	132	100	100	
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Out of the 200 respondents, only 132 respondents are farmer and seasonal agricultural labourer. The table 7 of the 132 respondents illustrates the perception of the respondents with respect to the amount of decrease in yield following the dam construction. Qiu, et al., (2004) is in support of the fact that there is a severe decline in crop yield as a result of low irrigation water quality, sedimentation and irregular water flow occurrence following construction of dams. Farmers are experiencing decreased soil fertility, water logging and more crop failures, which influence food production and income (Reader, 2015). This degradation is also supported by the existence of barren lands. Conversely, Robinson, (2009) proposes that the decrease in yield is also caused by the change in climate, the increase in the cost of inputs, and the use of the old methods in agriculture. Although these aspects definitely contribute to the supporting roles, the regular tendency of decreasing agricultural production in the vicinity of the river gives a strong correlation between the decline in productivity and the worsening of the conditions of irrigation water (Saaristo, et al., 2018). The increased effect of turbidity and river flow transformation and flood irregularity still continues to transform farming activities and sustainability of agriculture in river basins (Sharma, et al., 2018).

Most of the respondents (majority of 106) indicated a yield reduction of 0-25 percent meaning that over a half of the population has declined moderately. This is an indication that the production is not at its original level, even though it is still being done. Moreover, 17 respondents were of the view that there was a decline of between 25 and 50% and only slightly more 9 respondents (6.8%) said that there was a severe decline of 50-75%, which indicates that a large segment of the community is experiencing decline in production.

The yield reduction in the table is linked closely with the change in the environment that took place following the construction of the dam. Prior to the dam, the agricultural and fish production was stable owing to clean water, routine natural flow and fertile riverbanks. These however, have had a direct impact on soil fertility and aquatic productivity following the dam construction, alterations in the flow of water, increased turbidity as well as pollution. The fact that almost 80.3 percent of those questioned gave a 25-50% drop range indicates that there is an economic strain on most households. This has reduced livelihoods in a negative way especially to the farming communities and fishing communities. The results state well that the environmental disturbances caused by dams have significantly contributed to the decrease of yield and endangered sustainable production.

**Table 8:** Descriptive statistics

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Do you run any business or conduct any economic activity by using the product of the river?	200	1.00	1.00	2.00	1.5350	.03536	.50003	.250
Is the river water use for irrigation?	200	1.00	1.00	2.00	1.3850	.03449	.48782	.238



Do you face any problems in the irrigation in current years?	200	1.00	1.00	2.00	1.5250	.03540	.50063	.251
Do you notice any changes in the crop yields?	200	1.00	1.00	2.00	1.3850	.03449	.48782	.238
Do you have any land which you used to do cultivation but now lay barren?	200	1.00	1.00	2.00	1.9550	.01470	.20782	.043
Do you ever experience flood by overflowing river bank?	200	1.00	1.00	2.00	1.3750	.03432	.48534	.236
Do you notice any changes in the intensity of flood?	200	1.00	1.00	2.00	1.3300	.03333	.47139	.222
Do you experience river bank erosion?	200	1.00	1.00	2.00	1.2900	.03217	.45490	.207
Do you agree the turbidity of the river water have been increasing since the completion of Mapithel Dam?	200	1.00	1.00	2.00	1.1100	.02218	.31367	.098
Is the river water is as turbid as nowadays in before years according to your experience?	200	.00	2.00	2.00	2.0000	.00000	.00000	.000
How do you find the quality of the river water?	200	3.00	1.00	4.00	2.6950	.09673	1.36797	1.871
What do you think by how much percentage the yield is decrease?	200	3.00	1.00	4.00	2.0500	.08675	1.22679	1.505
How often do you use river water?	200	3.00	1.00	4.00	2.1750	.08838	1.24987	1.562
Is the river water is easily accessible to you?	200	1.00	1.00	2.00	1.1050	.02173	.30732	.094
Valid N (listwise)	200							

The table 8 shows the descriptive information of the different economic, farming, and environmental variables in relation to rivers using 200 interviewees. The mean of 1.5350 of economic activity based on river implies that a significant percentage of the respondents are yet to be out of business connected to river products. Irrigation use of river water has a mean of 1.3850, which indicates that river water still has significant use in agriculture. Nevertheless, the average of 1.5250 about the irrigation issues indicates that lots of farmers are struggling now.



The average result of 1.3850 of alterations in crop yield establishes observable fluctuations in agricultural productivity. The mean of the barren land was very high at 1.9550 meaning that a big percentage of the arable land is no longer in use. Flood experience (mean 1.3750) and change of flood intensity (mean 1.3300) indicate augmented threats of floods. The fact that the mean of riverbank erosion is 1.2900 also supports physical environmental degradation. The mean of 1.1100 is very much supporting the fact that the turbidity has been increased by the Mapithel Dam. The overall mean of 2.6950 is poor, and the yield decrease mean of 2.0500 is quite moderate in the loss.

The table 8 shows the descriptive statistics of the frequency of water use in rivers and the ease of access to it among 200 respondents. The average of 2.1750 of the variable How often do you use river water? Shows that people use the river moderately, and there could be no signs that people do not use the river often, however, daily usage is lower than it was previously. The standard deviation of 1.24987 is relatively high indicating a significant variation between the respondents in regards to the frequency of using the river water; daily, weekly, or annual. This is a manifestation of shifting dependent trends based on the deterioration of water quality following the construction of the dam. The second variable which is the question, Is the river water easily accessible to you? has a low mean of 1.1050, which implies that the river is physically accessible to the majority of the respondents. The standard deviation of 0.30732 is very low indicating the fact that uniformity is observed in responses and accessibility is not a significant problem. Nevertheless, although they are readily available, less often use implies that individuals are evading river water primarily because of low quality and a higher turbidity as opposed to the physical inaccessibility. This brings out the effect of the environment on human behaviour.

**Health Impacts (Disease and waterborne issues).**

Meyerson, & Mooney, (2007) is firm believers of the fact that the deteriorating water quality of rivers has had a direct impact on human health. The development of turbidity, unpleasant smell, and pollution following the construction of dams is generally linked to skin infections, stomach disorders and other water borne diseases (Leprieur, et al., 2008). People are also exposed to severe health risks, particularly children and the aged, through continuous exposure to contaminated water when bathing, washing, and irrigation (Pelicice, et al., 2021). Nonetheless, Pierrat, et al., (2023) believe that river water cannot be entirely associated with health issues. According to Bolman, & Deal, (2017), unsanitary conditions, bad waste disposal and absence of healthcare services also play a significant role in increasing the level of diseases. Although it is partly true, the fact that health complaints are predominant in river-related regions shows that the deteriorating water quality is still a key contributor to the poor state of the general population (Orr, et al., 2023). The following table illustrates the health impacts in the general public in the downstream of mapithel Dam.

**Table 9:** Descriptive statistics

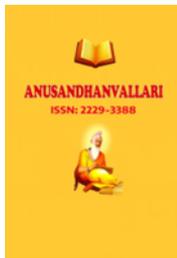
Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Do you use river water for your household chores?	200	1.00	1.00	2.00	1.0650	.01748	.24714	.061



Is river water treated before using anything?	200	1.00	1.00	2.00	1.6200	.03441	.48660	.237
Is your water stored before use?	200	1.00	1.00	2.00	1.3850	.03449	.48782	.238
Does river water have colour?	200	1.00	1.00	2.00	1.0650	.01748	.24714	.061
Does river water have bad smell/odour?	200	2.00	1.00	3.00	1.9600	.05104	.72181	.521
What are the purposes you use river water from the below listed activities.	200	4.00	1.00	5.00	3.1900	.10159	1.43674	2.064
What are the purposes did you used river water before it was as turbid as today?	200	4.00	1.00	5.00	2.9400	.10458	1.47896	2.187
Do anyone of your family member perceive any health problem or suffer from any disease by using the river water?	200	1.00	1.00	2.00	1.7150	.03200	.45255	.205
How often do you come into contact with water?	200	3.00	1.00	4.00	2.0850	.09044	1.27904	1.636
Valid N (listwise)	200							

The table 9 shows the descriptive statistics of household use, household treatment, household storage, the perception of quality, and health effects of river water among 200 respondents. Currently, the contact has decreased and individuals have restricted contact because of fear of contracting the disease and being contaminated (Tayel, et al., 2008). Yet, Vindas, et al., (2017) believe that the availability of alternative water sources that include bore wells, piped water, and storage systems also contributes to reduced river contact. This change has certainly contributed to the decrease in dependency, but this is not the complete explanation of the behavioral change (Walia, et al., 2015). The obvious discoloration, bad scent and increasing health-related issues are strong indications that poor water quality has been the fundamental cause of low daily exposure to river water (Zhu, et al., 2018).

The mean of 1.0650 of household chores is very low meaning that the majority of respondents continue to have contact with river water, but probably in a weak fashion. The average of 1.6200 of water treatment indicates that a significant percentage of it is not treated by water before it is used, which poses a high health risk. The mixed practices are reflected in the moderate mean of 1.3850 of the storage of water. The mean of 1.0650 of water colour is low that means that most of the respondents can visually see discoloration. The mean bad smell of 1.9600 is relatively high which confirms the extensive perception of odour in river water, which is an indication of severe deterioration in quality. The average figures of current usage (3.1900) and past usage (2.9400) show that currently, people utilize river water less frequently in various activities than they did in the past. The health impact mean of 1.7150 indicates that there are observable illnesses associated with water. Lastly, the average



frequency of water contact of 2.0850 indicates moderate and wary contact, and demonstrates behaviour change due to decreasing water quality. The lower stretches of the Thoubal River have increasingly shown signs of contamination due to upstream anthropogenic activities. Local communities relying on this section of the river for daily household use are experiencing growing health concerns. Many residents have reported skin irritations and infections after using the river water for bathing and washing. One of the notable concern is the impact on women's health. Several women have reported experiencing vaginal discomfort and infection after using the river water for sanitation-related purposes. The pattern highlights a pressing need for systematic water quality assessment and improved access to safe sanitation resources. The situation determines the importance of monitoring pollution sources, raising community awareness, and developing appropriate public health interventions to prevent further health risks.

### **Conclusion**

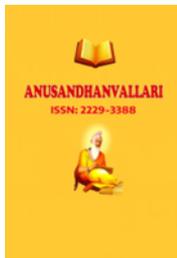
The findings of this study clearly demonstrate that the impacts of the Mapithel Dam extend well beyond the officially acknowledged zones of upstream displacement. Downstream communities along the Thoubal River continue to experience sustained environmental degradation, declining livelihood opportunities and growing public health risks, yet remain largely absent from policy attention and institutional support. The deterioration of water quality, reduced agricultural productivity, and altered patterns of river use observed in this study point to structural shortcomings in current dam governance frameworks, which prioritise physical displacement while neglecting long-term ecological and social consequences.

From a policy perspective, there is an urgent need to expand dam impact assessments beyond narrow spatial and administrative boundaries. Environmental Impact Assessments should incorporate downstream monitoring of water quality, sediment flow, agricultural impacts, and public health outcomes as mandatory components. Compensation and rehabilitation policies must also be re-evaluated to recognize livelihood loss, health vulnerability, and environmental insecurity among downstream populations. Strengthening local water treatment infrastructure, improving access to safe sanitation, and supporting climate-resilient agricultural practices are critical interventions for reducing vulnerability.

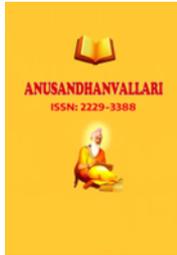
Most importantly, downstream communities must be formally included in decision-making processes related to river management and dam operation. Recognizing their experiences is essential not only for environmental justice but also for ensuring that development interventions achieve long-term sustainability rather than reproducing hidden forms of marginalization.

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