Exploring the Interrelationship between the Local Communities and Ecologically Critical Areas (ECA): Evidence from the Communities of Jaflong-Dawki Riverbank Area, Sylhet, Bangladesh

Md. Ohidur Zaman

Associate Professor, Department of Sociology, University of Barishal, Bangladesh

Doctoral Research Scholar, Department of Sociology, University of Lucknow, U.P., India

DOI: https://dx.doi.org/10.47772/IJRISS.2025.90400305

Received: 14 April 2025; Accepted: 18 April 2025; Published: 12 May 2025

ABSTRACT

According to the 2015 declaration by the Government of Bangladesh, the Jaflong-Dawki River of Sylhet division is the newest ecologically critical area of the country. This river is located in the southern hilly parts of Bangladesh, and natural rocks flow naturally in the river bed. This study seeks to understand the relationship between this ecologically endangered river and the riparian communities. To collect primary data from the study area this study conducted a household survey and Focus Group Discussions. Empirical field data show that local communities are highly dependent on the river ecosystem services for livelihood. They rely on ecosystem services, such as stones, sand, fish, transportation, water for irrigation, and freshwater for household activities in their everyday lives. Despite its ecological vulnerability, locals and traders from nearby towns and cities continue to extract substantial resources without sufficient knowledge of conservation practices. Furthermore, mass illegal resource extraction, corruption among authorities, and inadequate monitoring have made the river increasingly vulnerable. This study suggests that awareness programs, systematic and proper monitoring, and alternative livelihood options could be effective measures to protect this endangered river.

Key Words: Ecologically Critical Area, Conservational Knowledge, Resource Extraction,

INTRODUCTION

The Jaflong-Dawki River is a transboundary river that flows between Bangladesh and India. In India, it is known as the Dawki River, while locally, it is named the Goyain or Jaflong River. This river ecosystem offers several services for human communities. The riverbed naturally transports a significant amount of rocks and sand. Because of such valuable natural resources, the region became a central attraction for unscrupulous traders of stones and sands. Similarly, local communities collect rocks from the riverbed and sell them to local stone-crushing companies. Excessive consumption of such natural resources causes significant damage to this river ecosystem (Ahmed et al., 2022). Degradation in such an ecosystem causes economic, social, and health consequences (Omoloso et al., 2004). In 2015, the Bangladesh government announced this river as one of the ecologically critical areas. Despite such declarations, no government or private institution has yet taken up any visible and functional scheme to protect the ecosystem of this river.

This study considers this river as a Social-Ecological System (SES). At first, Berkes and his colleagues (1989) systematically identified that “delineation between social and ecological systems is artificial and arbitrary” (Folke, 2006, p.231-262). SESs are interconnected, multilayered systems that provide energy, food, and fiber to human societies (Berkes, 2017). As a co-evolutionary process, the ecological system significantly shapes social and economic systems (Chapin et al., 2009). Anderies et al., 2004 defined SES as an ecological entity closely connected to and influenced by several social networks. The framework of SES offers opportunities to develop conservational strategies by providing a greater understanding of the interaction among various interconnected components (Schlüter et al., 2014).

At present, among all the sensitive ecosystems of this globe, the river ecosystem is one of the most vulnerable (Sendzimir & Schmutz, 2018). River ecosystems vary according to the geographical settings and scale, and so do their ecosystem services (Gilvear et al., 2016). River and riverbank human communities jointly generate a complex ecosystem; this type of ecosystem is called the riparian ecosystem. Riparian areas serve as a connector

between aquatic and terrestrial ecosystems and are vulnerable to natural calamities and human activities (Richardson et al., 2007). The protection of these areas is crucial for maintaining global ecological balance and mitigating climate change impacts. Research indicates that habitat destruction, pollution, and climate change are the primary threats to ECAs, leading to species extinction and ecosystem degradation (Brooks et al., 2002). Effective conservation strategies involve legal frameworks, community engagement, and sustainable land-use practices (Chape et al., 2005). Protected areas (PAs) have been a foundation of conservation efforts, yet their effectiveness depends on management quality and enforcement (Geldmann et al., 2013). Studies show that strictly enforced PAs reduce deforestation rates by up to 80% compared to unprotected regions (Nolte et al., 2013). However, conflicts arise when conservation policies disregard local livelihoods, leading to resistance and illegal exploitation (West et al., 2006). Community-based conservation models, such as participatory forest management, have proven successful in balancing ecological and socio-economic needs (Agrawal & Gibson, 1999).

The study area of this research, the Jaflong-Dawki River, is one of the great sources of common-pool resources such as stones, sands, fish, and freshwater in the northeastern part of Bangladesh. Since rocks are the vital natural resource of this area, quarrying and crushing activities are central to the economic source here. Unplanned quarrying can cause several adverse impacts on the environment (Maponga and Munyanduri 1998). Quarrying and crushing plants cause air pollution, sound pollution, water contamination, land degradation, loss of agricultural land, waste run-offs, and many more environmental problems. The unplanned and unauthorized quarrying of rocks hinders the layers of the soil, passages of the rivers, and streams that cause floods and damage firming land. Ahmed and his associate researchers (2020) address that, in the Jaflong area, there is no requirement for environmental impact assessment and environmental clearance for starting quarrying and crushing companies. Also, according to the report of national newspapers of this country, the Bangladesh Environmental Lawyers Association (BELA) recorded 76 deaths with 21 injuries of laborers because of illegal stone quarries in Sylhet district from 2017 to 2020.

This study draws insights from Garrett Hardin's theory of the tragedy of commons. In 1968, Hardin represented a dilemma of commonly owned natural resources. According to him, individuals overlook the community's well-being for personal profit. They always attempt to maximize their profit by utilizing the maximum amount of common-pool natural resources. Such individual actions lead to overconsumption and eventually result in a deficiency of the common-pool resources. When commons become scarce, it results in a tragedy for everyone involved. Hardin proposed two preliminary solutions for avoiding the tragedy of the commons, privatization of common-pool resources and direct government regulation to protect the common-pool natural resources. Although Hardin's theory generated considerable attention, his mentioned solution to avoiding tragedy remained unsuitable to many scholars. Privatization of common-pool resources promotes capitalism and overlooks the rights of the local communities on natural resources. Similarly, government interventions without the engagement of the local communities are a violation of the rights of the locals, and direct governance of common-pool resources from outside the community is ineffective and impossible. After decades of intensive research, Elinor Ostrom (2009) demonstrates that to avoid the tragedy of commons, with external interventions, it is essential to govern common-pool resources by the local resource-dependent communities. Intellectuals in this field, such as Cox et al., 2010 and Basurto et al., (2020), have extended on Ostrom’s principles, proving that successful commons governance often hinges on nested institutional structures, where local, regional, and national actors collaborate rather than compete. Critiques of Hardin’s dichotomy (privatization vs. state control) have further underlined the role of Indigenous and local knowledge systems in sustaining ecological critical areas (Berkes, 2017). Recent studies in Bangladesh (Islam & Chuenpagdee, 2022) indicate that top-down protection policies often fail due to a lack of community trust and participation, reinforcing Ostrom’s argument for collective action. However, emerging debates question whether community-based governance alone can resist external pressures like commercial extraction or climate change (Bennett et al., 2018). This study thus contributes by examining how Jaflong-Dawki’s riverbank communities negotiate these tensions, offering insights into hybrid management models that integrate local stewardship with state and market actors while avoiding the pitfalls of Hardin’s oversimplified solutions. By situating the research within these contemporary discussions, the work advances a more nuanced understanding of commons governance in ecologically fragile, resource-dependent contexts.

This study considers that to avoid the tragic situation of the Jaflong-Dawki River prompt effective policies and programs are crucial. The government of Bangladesh already initiated village communities-based natural

conservation programs in five ECAs. Therefore, it is anticipated that they may implement a community-based river management system to conserve the endangered Jaflong-Dawki River soon. However, in the current situation, this study seeks to understand the interrelationship between the Jaflong-Dawki River and local communities. Also, it attempts to outline the knowledge and practice of local communities regarding the conservation of the Jaflong-Dawki River. This study will contribute to comprehending the local dynamics of river resource usage from a critical point where the river ecosystem is vulnerable, but institutional measures are unavailable to conserve it. It may provide insights to generate a community-based river ecosystem management model. Additionally, the findings of this study will help policymakers grasp the extent of local communities' dependence on the river.

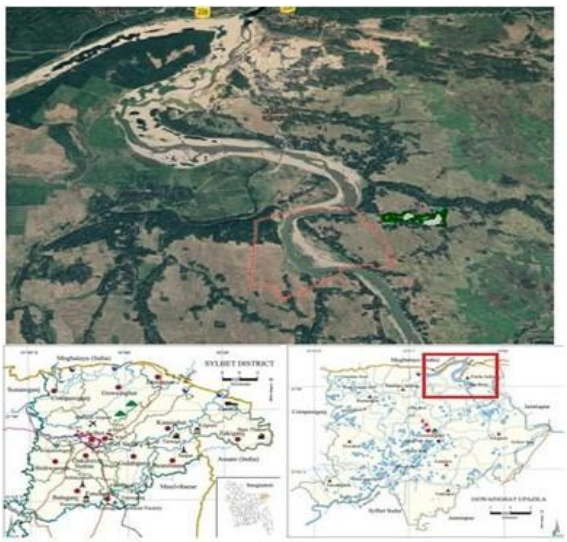
METHODOLOGY

This research adopts an exploratory design to investigate the complex relationship between local communities and the ecologically critical Jaflong-Dawki River in Bangladesh. Given the need to examine both measurable and contextual aspects of this dynamic, the study employs a mixed-methods approach, combining quantitative surveys with qualitative focus group discussions (FGDs) and direct observation. Many communities across different areas depend on this river; the research focuses on the Baurbhag Mouza (a specific land area within a larger administrative division, often corresponding to a village or a group of villages), a strategically selected area consisting of Baurbhag village and Noyaganger Par, situated on opposite banks of the river (see the map). This location was chosen through purposive sampling due to its unique geographical division and the communities' heavy reliance on the river for their livelihoods. The mouza comprises 542 households with a total population of 4,129, providing a representative sample of river-dependent residents.

For data collection, non-probability sampling techniques were applied. A household survey was conducted with 150 randomly selected households using a semi-structured questionnaire to gather quantitative data on resource use, economic dependence, and environmental perceptions. Additionally, two FGDs were organized—one involving locals from diverse professions and another with community leaders—to capture qualitative insights into social dynamics, challenges, and conservation attitudes. Both FGDs were held on the riverbank to contextualize discussions within the natural setting.

Quantitative data were processed using MS Excel and analyzed through descriptive statistics, including tabulation, percentage analysis, and measures of central tendency and dispersion. Qualitative data from FGDs were manually transcribed and subjected to thematic analysis to identify recurring patterns and narratives.

Although the Baurbhag Mouza is one of the most suitable Mouzas that represent the Jaflong- Dawki river resource-dependent communities, this study does not include all the riverbank villages. Due to the limitation of the fund, this study only selects one Mouza from the 20 Mouzas. Such limitations can affect the generalization of the research outcomes. Therefore, to draw a comprehensive scenario of the study area, it is necessary to conduct a longitudinal research project with sufficient funds that cover all the resource-dependent communities of the Purba Jaflong Union.



Map: The location of the study area

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IV April 2025

DATA ANALYSIS AND RESULT DISCUSSION

The primary unit of analysis in this study is the "household," so household heads were interviewed to gather data. In cases where the household heads were unavailable, another adult from the family participated in the household survey. It is noteworthy that only 20% of the household representatives who participated in the survey were women. The respondents' ages varied widely, ranging from 18 to 58 years, with a median age of 40. This study measures the level of education by counting years of schooling completed. The average schooling among participants is 3.30 years, with over 50% not completing primary education. These statistics indicate that the population in this area is generally undereducated. One-fourth of the respondents had no formal education, and fewer than 10% had completed eight years of schooling. On average, households in this area consist of 6.3 members, with a standard deviation of 1.85. This suggests that most households are either joint or extended. Despite the larger family size, 50% of households have only one earning member. This high dependency ratio contributes to economic hardship for many families. In 48% of households, there are two earners; however, in most cases, one member has a permanent job while the other earns income seasonally. Households, where both earning members work full-time, tend to be more financially stable than those with just one consistent income. The following table summarizes the sample statistics, such as sex composition, years of schooling, and age of the samples:

Table-01: Demographic information of the participants

Variable	Description	Statistics
Sex	Male Female	80% 20%
Years of schooling	Mean Lowest Highest	3.30 0 (24%) 8 (8%)
Age	Range Minimum Maximum Median	40 18 58 40
Family Member	Mean Std. Deviation Minimum Maximum	6.30 1.85 3 (2%) 11 (4%)
Earning Member	01 person 02 persons 03 persons	50% 48% 2%

Source: Field Survey, 2023

Interrelationship between the Local Communities and ECA (the Jaflong-Dawki rive)

Participants from both the household survey and focus group discussions (FGDs) indicate that local communities are heavily reliant on river resources for their livelihoods. While people in the study area engage in various occupations, this study categorizes all household heads' occupations into six broad groups. Figure 1 illustrates the variations in these occupations.

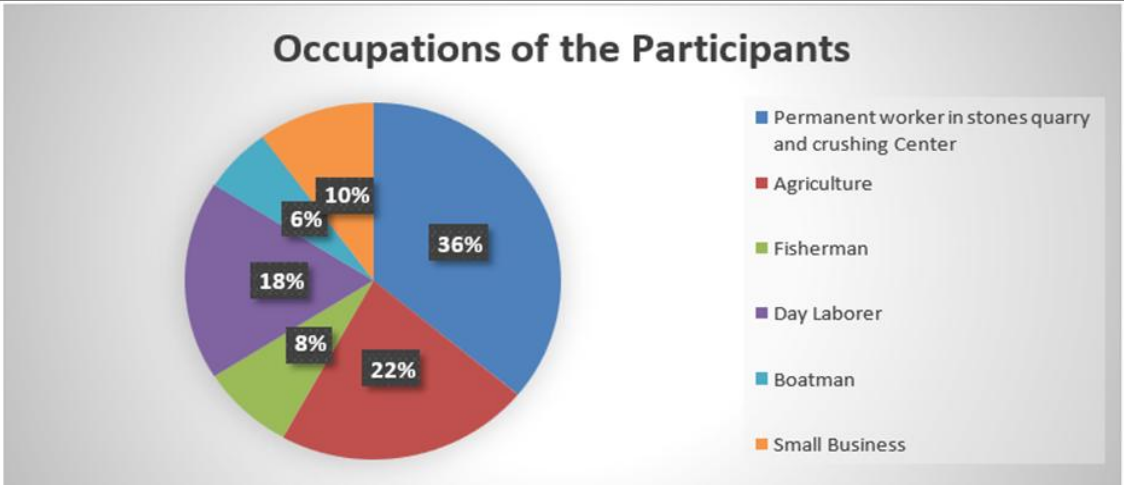


Figure-01: Occupations of the Respondents

Source: Field Survey, 2023

Among all the respondents in this study, 36% of households are directly involved in the local quarrying and crushing industry. An additional 18% rely on the river for their livelihoods. These individuals work as day laborers; during the dry season, they engage in stone quarrying, sand extraction, and digging the riverbed for stones and sand. In the wet season, they work as fishermen and boatmen. Furthermore, 22% of households are engaged in agricultural farming, entirely depending on the river for irrigation. Only 8% of households are solely fishers, who fish from the Jaflong-Dawki River and its adjacent branches. Additionally, 6% of participants work as boatmen. Most of these boatmen transport stones and sand, while others arrange pleasure trips for tourists. Only 10% of participants are not directly dependent on the river; these individuals are small business owners. Some of them recognize that the river and its surrounding areas attract tourists, which directly benefits their businesses. In the household survey, participants indicated whether they were river-dependent or not. Figure 02 illustrates both occupational and resource dependency on the Jaflong-Dawki River. Notably, 62% of households depend on the river for food, while 94% rely on it for their occupational needs. This high percentage indicates that the majority of community members living along the riverbank are almost exclusively reliant on this ecologically critical river for their livelihoods. In other words, nearly every household extract resource from this ecologically vulnerable river.

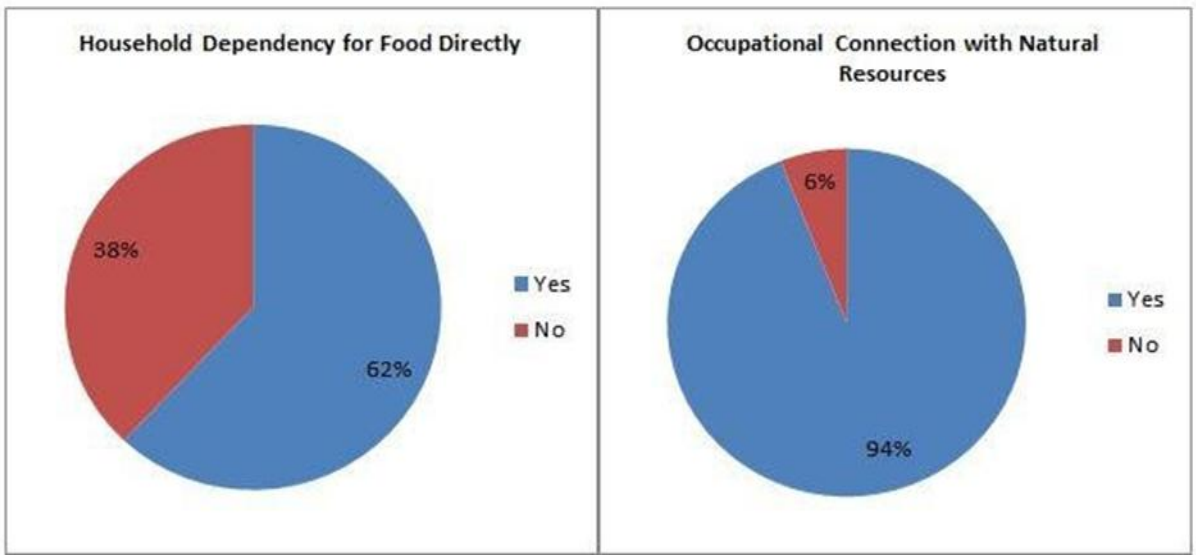


Figure-02: Occupational and Resources Dependency on Jaflong-Dawki River

Source: Field data, 2023

Qualitative data from FGDs also supports the outcomes of the household survey. Local people of this area are traditionally connected with this river. Due to geographical structure, people depend on natural resources. As

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IV April 2025

the residents are not educated enough and do not have liquid capital, they work under many employers who do not live here. One of the respondents from the focus group of the local community said,

"*I have no other resources to support ourselves without a small boat; therefore, sometimes I collect stones, and sometimes I work in quarrying and crushing mills*."

This area is at the border of Bangladesh and India, and as this is a hilly rural area, people are almost entirely dependent on the resources of this river. Many people work in stone crusher mills, and many works as day laborers to extract sand from the riverbed. The households that are not directly dependent on quarrying and crushing activities are engaged in eco-tourism. Every day thousands of people visit this area, and many small businesses are increased by targeting tourism here. Job opportunities increased in the hospitality industry. One participant from the focus group of community leaders said,

"In the past, most households depended on the river for their livelihoods. Now, as education improves and eco-tourism grows, more people are seeking income from other sources."

Moreover, local people mostly depend on river water for their households' activities. There is not enough tube well for the drinking water; many households collect river water for drinking and cooking. Also, for agricultural irrigation, local people depend on the river water.

Current Status of Knowledge and Practices of the river resources-dependent communities

This study attempts to understand the depth of the conservational knowledge of the local people, as well as their river resource extraction practices, from both quantitative and qualitative perspectives. The household survey data represent their level of conservational knowledge in binary(yes/no) modes.

Household survey data show that residents of this riverbank have a low level of conservational knowledge of river resources. And, their resource extraction practices reflect that they are not aware of the ecological degradation of this river. Even no one knows that the government has declared this river as an ecologically critical area. Moreover, local people do not know anything about institutional measures. Even they do not participate in any GO or NGO-organized awareness program. The following table shows (Table 02) the knowledge level of the household heads about consuming river resources:

Table-02: Knowledge of Locals about Overconsumption of Natural Resources

Question	Outcome	Percentage
Do you know, soil erosion occurs due to overconsumption sands and stones?	Yes	48
	No	52
Do you know, overconsumption causes decline of rock flow in the river bed?	Yes	30
	No	70
Do you know, overconsumption of sand and stone causes landslide?	Yes	46
	No	54
Do you know, overfishing causes loss of biodiversity?	Yes	74
	No	26
Do you know, stone crusher causes air pollution?	Yes	70
	No	30

Source: Field Data, 2023

The empirical data show that more than half of the people do not know that overconsumption of river resources (sands and stones) causes soil degradation. The extraction of mineral rocks and stones from the river bed is one

of the most vital sources of income for these local people; however, 70% of the respondents do not know that excessively extracting stones by digging the river bed causes an interruption in the natural flow of rocks and water.

Likewise, more than half of the people (54%) are not knowledgeable that overconsumption of sand and stones causes landslides in the riverbank area. However, many people understand that excessive extraction of sands and stones causes a loss of biodiversity (especially, when local people are aware of declining fish varieties) in the river. About 74% of participants agreed that verities of fish declined over time due to outrageous human activities in the river. Also, local people (70%) understand that stone crushers in the riverbank area cause extreme air pollution.

On the other hand, people are careless when they use the natural resources of this river ecosystem. The following table (Table 03) summarizes the local practices related to natural resources.

Table-03: Degree of Extraction /Usages of River Resources

	Degree of Extraction /Usages of River Resources			
Sectors of Resource Extraction	Almost Never	Sometimes	Often	Almost Always
Degree of Extraction of Stone	48	26	8	18
Degree of Extraction of Sand	54	32	14	0
Degree of Fishing	42	30	16	12
Degree of Using Motor Boat	33	50	6	22
Degree of Using Water for Irrigation	20	0	4	76

Source: Field Data, 2023

The household survey data indicates that most families living along the riverbank do not own any quarries or crusher mills; rather, they work for larger traders based in other towns or cities. Approximately 50% of households reported that they "Almost Never" extract stone, while 18% acknowledged that they extract rocks "Almost Always." A similar pattern is observed with sand extraction: over half of the households stated that they do not extract sand from the riverbed, while 32% mentioned that they excavate sand "Sometimes." In terms of fishing, more than 10% of households "Almost Always" fish from the river, whereas 42% claim to "Almost Never" fish in it. Notably, 30% of households "Sometimes" catch fish from the river for their own consumption. For transportation, locals primarily use motorboats and boats. Half of the participants reported that they "Sometimes" use motorboats, while 22% always rely on boats for their livelihoods. Additionally, 80% of households "Almost Always" use river water for irrigating their farmland, with only about 20% utilizing other sources for irrigation.

The outcomes of FGDs also show similar results regarding the conservational knowledge of the local people. All of the participants from both of the focus groups agreed that people are not aware of the conservation of nature. They do not believe that overconsumption of river resources can cause a tragedy. Many of them think that the flow of natural stones and sand will never decline in the river. One of the respondents from the group of local people said-

"Soil, rocks, and sands cannot be declined because they come through water flows from upstream in every wet season. Environmental degradation is the divine test, not the result of overconsumption."

However, some respondents from the same group disagreed with this mentioned statement. They believe that environmental degradation is the consequence of human activities, but they think illegal traders are responsible for mass resource destruction. They agreed that local people collect stones on a small scale. One of the respondents said as follows:

"Yes, it is true that over-extraction causes a decline in river resources. However local poor people are not

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IV April 2025

responsible because they collect stones from the surface of the river bed. On the other side, rich and big businessmen use machines for large-scale extraction of stones from inside the river bed."

Local people and community leaders believe that if traders from outside the area limit their quarrying and crushing activities, the river will get back its previous natural face. One of the respondents from the group of community leaders said that a syndicate of local power elites controls the overall extraction activities on this river and adjoining area. According to him,

"Local power elites and the syndicate of the quarrying and crushing mills control overall activities here. Even the syndicate splits the river into hundreds of sectors to extract stones and sand separately. Local people do not get much opportunity to collect rocks individually in every place of the river."

Similarly, there is no restriction on the extraction of natural resources. Participants of the FGD mentioned that the syndicate of quarrying and crushing mills maintains secret economic deals with law-enforcing authorities. One of the community leaders said,

"There is a single signboard near the Indian border on the river bank that this river is ecologically endangered; without this, there is nothing for the people from the government agents. Although sometimes government agents come to stop the use of the Boma machine, powerful traders use that machine again after keeping the machine off for a few days."

Many people lack knowledge about the sustainable use of natural resources. Few are aware that the government has designated this river as a critical area, and many do not understand what ecologically critical areas entail. Although several government organizations (GOs) and non-governmental organizations (NGOs) are active in the region, there are currently no specialized projects aimed at enhancing the conservation knowledge of local communities. Some organizations have introduced sustainable livelihood and microcredit programs to help alleviate the pressure on the river ecosystem. Additionally, focus group discussions (FGDs) provide relevant information about the river ecosystem and its relationship with local communities. The following table (Table 04) summarizes the related outcomes of FGDs as follows:

Table-04: Summery of FGDs

Resources of the study area	Stone Sand Fish Water Agriculture
Natural calamities of the study area	Flash Floods Floods Landslides
Ecosystem destructive activities	Overconsumption of Fish Over extraction of Stone Over extraction of Sand Digging hills
River protection program	No effective project
Knowledge of Consumption	Very low

Source: Field data, 2023

CONCLUSION

The study highlights the critical interdependence between the Jaflong-Dawki River and the local communities, underscoring the river's role as a vital source of livelihood and natural resources. However, the overexploitation of stones, sand, and fish, coupled with low conservation awareness, has led to severe ecological degradation. Despite the river's designation as an ecologically critical area, institutional measures to protect it remain inadequate. The findings reveal that local communities, largely undereducated and economically dependent on the river, lack sufficient knowledge about sustainable resource use. While some individuals are aware of the

environmental effects of overconsumption, many tend to blame the degradation on external factors, such as powerful traders and syndicates, rather than acknowledging their own practices.

The tragedy of the commons is evident in the unchecked extraction of resources, driven by short-term economic gains. Although the government has initiated conservation programs in other areas, the absence of targeted interventions for the Jaflong-Dawki River exacerbates its vulnerability. Community-based management, as proposed by Elinor Ostrom, could offer a viable solution by empowering locals to govern resources sustainably. However, this requires raising awareness, strengthening institutional support, and curbing the influence of exploitative syndicates.

In conclusion, the study calls for urgent action to balance ecological preservation with livelihood needs. A key challenge is conflicting stakeholder interests—locals depend on sand mining and tourism, while authorities prioritize ecological protection. Enforcing participatory co-management needs clear institutional frameworks, incorporating local knowledge with government policies. Tangible steps include forming a multi-stakeholder committee (local communities, NGOs, local government, and environmental agencies) to oversee sustainable resource use, enforcing regulations on illegal mining, and promoting eco-friendly tourism. Community awareness programs on ECA importance and alternative livelihoods (e.g., agroforestry, handicrafts) can reduce reliance on harmful practices. Additionally, decentralized governance with defined roles—such as community patrols for monitoring and reporting violations and government agencies providing technical and legal support—can improve accountability. Aligning national ECA laws with local needs through adaptive policy frameworks will ensure long-term sustainability, enabling collaboration between communities and institutions for resilient riverine ecosystems. Only through collaborative efforts can the Jaflong-Dawki River be safeguarded for future generations, ensuring both environmental health and community well-being.

REFERENCES

1. Agrawal, A., & Gibson, C. C. (1999). *Communities and the environment: Ethnicity, gender, and the state in community-based conservation*. Rutgers University Press.
2. Ahmed, Z., Alam, R., Ahmed, M. N. Q., Ambinakudige, S., Almazroui, M., Islam, M. N., ... & Mahmud, S. (2022). Does anthropogenic upstream water withdrawal impact on downstream land use and livelihood changes of Teesta transboundary river basin in Bangladesh?. Environmental Monitoring and Assessment, 194(2), 59.
3. Ahmed, Z., Alam, R., Akter, S. A., & Kadir, A. (2020). Environmental sustainability assessment due to stone quarrying and crushing activities in Jaflong, Sylhet. Environmental Monitoring and Assessment, 192(12), 778.
4. Basurto, X., Bennett, A., Lindkvist, E., & Schlüter, M. (2020). Governing the commons beyond harvesting: An empirical illustration from fishing. PLoS One, 15(4), e0231575.
5. Bennett, N. J., Whitty, T. S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S., & Allison, E. H. (2018). Environmental stewardship: A conceptual review and analytical framework. *Environmental management*, *61*, 597-614.
6. Berkes, F. (2017). Environmental governance for the anthropocene? Social-ecological systems, resilience, and collaborative learning. Sustainability, 9(7), 1232.
7. Berkes, F. (Ed.). (1989). Common property resources. Ecology and community-based sustainable development
8. Brooks, T. M., et al. (2002). Habitat loss and extinction in biodiversity hotspots. *Conservation Biology, 16*(4), 909-923.
9. Chape, S., et al. (2005). Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Philosophical Transactions of the Royal Society B, 360*(1454), 443-455.
10. Chapin III, F. S., Kofinas, G. P., & Folke, C. (Eds.). (2009). Principles of ecosystem stewardship: resilience-based natural resource management in a changing world. Springer Science & Business Media.
11. Cox, M., Arnold, G., & Tomás, S. V. (2010). A review of design principles for community-based natural resource management. *Ecology and Society*, *15*(4).
12. Department of Environment. (2015). Community Based Ecosystem Conservation and Adaptation in Ecologically Critical Areas of Bangladesh: Responding to Nature and Changing Climate. Department of Environment (DoE), Ministry of Environment and Forests, Dhaka, Bangladesh, pp x+122.

13. Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. Global environmental change, 16(3), 253-267.
14. Geldmann, J., et al. (2013). Effectiveness of terrestrial protected areas in reducing habitat loss and population declines. *Biological Conservation, 161*, 230-238.
15. Gilvear, D. J., Hunter, P., & Stewardson, M. (2016). Remote sensing: mapping natural and managed river corridors from the micro to the network scale. River science: Research and management for the 21st century, 171-196.
16. Hinkel, J., Bots, P. W., & Schlüter, M. (2014). Enhancing the Ostrom social-ecological system framework through formalization. Ecology and Society, 19(3).
17. Islam, M. M., & Chuenpagdee, R. (2022). Towards a classification of vulnerability of small-scale fisheries. *Environmental Science & Policy*, *134*, 1-12.
18. Janssen, M. A., Anderies, J. M., & Walker, B. H. (2004). Robust strategies for managing rangelands with multiple stable attractors. Journal of Environmental Economics and Management, 47(1), 140-162.
19. Maponga, O., & Munyanduri, N. (1998). Environmental impact of quarrying on Otere Village. Odeda, South Western Nigeria.
20. Nolte, C., et al. (2013). Governance regime and location influence avoided deforestation success in protected areas. *Proceedings of the National Academy of Sciences*, *110*(13), 4956-4961.
21. Olsson, P., Folke, C., & Hahn, T. (2004). Social-ecological transformation for ecosystem management: the development of adaptive co-management of a wetland landscape in southern Sweden. Ecology and society, 9(4).
22. Richardson, David M., Patricia M. Holmes, Karen J. Esler, Susan M. Galatowitsch, Juliet C. Stromberg, Steven P. Kirkman, Petr Pyšek, and Richard J. Hobbs. "Riparian vegetation: degradation, alien plant invasions, and restoration prospects." Diversity and distributions 13, no. 1 (2007): 126-139.
23. Schlüter, M., Hinkel, J., Bots, P. W., & Arlinghaus, R. (2014). Application of the SES framework for model-based analysis of the dynamics of social-ecological systems. Ecology and Society, 19(1).
24. Schmutz, S., & Sendzimir, J. (2018). Riverine ecosystem management: science for governing towards a sustainable future. Springer Nature.
25. West, P., et al. (2006). Parks and peoples: The social impact of protected areas. *Annual Review of Anthropology*, *35*, 251-277