Traditional Ecological Knowledge and Flood Coping Strategies in Wetland Communities: A Qualitative Study in Islampur Union, Bangladesh

***Md. Sarwar Zahan*[1]**
***Atiza Dill Afrose*[2]**

ABSTRACT

Flooding is a common hazard in Bangladesh, occurring every year and affecting almost all regions of the entire country. The Islampur union of Sunamganj district is located in the north-eastern part of the country and close to the world's rainiest place, Meghalaya. Therefore, it faces significant rainfall, making it one of the most adversely hit locations. In order to survive, the locals in this union have accumulated an incredible amount of Traditional Ecological Knowledge (TEK) pertaining to floods. This research seeks to comprehend TEK's function in handling disasters associated with flooding in that particular area. The study has two objectives: one is why flood-affected wetland communities use local knowledge, and another is how TEK is used and transmitted in their everyday lives. The study follows two questions: firstly, what purpose does local knowledge serve for the flood-affected rural north-eastern communities of Bangladesh? And secondly, what are the uses of TEK, and how does it become a shared cultural practice in everyday life? Data were collected from four distinct villages of Islampur Union in the Sunamganj district, Bangladesh. Primary data were collected using semi-structured questionnaires and the KII method. To understand the emic perspective, the study involved the case study method on a specific phenomenon. Data was descriptively analysed following a qualitative approach. This study found essential connections between traditional knowledge and flood coping mechanisms in the study area. It has also found that TEK and the resilience of wetland communities are intertwined through the practices of everyday life. This study attempts to explain the importance of TEK in dealing with various flood-related adversities in north-eastern Bangladesh. The significance of this finding is that it demonstrated the importance of the integration of traditional knowledge systems alongside scientific and official methods in constructing inclusive and culturally relevant disaster governance.

JEL Classifications: Z10, Q01, Q54
Keywords: Traditional Culture, Flood Coping, Traditional Ecological Knowledge, Wetland Community, Northeastern Bangladesh.

INTRODUCTION

Flooding is a prevalent disaster in Bangladesh, occurring annually and impacting almost all regions of the entire nation. Floods impact more severely in the north-eastern part of the country and bring socio-economic challenges for thousands of people (Bhuiyan, Paul, & Abdussabur, 2024; Mondal, 2022). As this region is situated within wetland and floodplain ecosystems, it makes it vulnerable to chronic and devastating floods. Therefore, to survive, people of this area developed informal culture-based knowledge, and for generations, this knowledge has helped them cope with flood disasters. (Hossain, Ajiang, & Ryakitimbo, 2019). Though such traditional ecological knowledge (TEK) work is an important method for community resilience all over the world and before the advancement of modern disaster risk reduction strategies, it played the most crucial role, in academia, especially in Bangladesh, it remains an under-represented and often overlooked phenomenon (Haque & Etkin, 2012; Mondal, 2022).

[1]Department of Folklore, Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh, Bangladesh.
[2]Department of Folklore, Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh, Bangladesh.
Corresponding Author's Email Address: sarwarzahan298@gmail.com
Article History: Received: 31 August 2025**; Accepted** 27 January 2026**; Published online** 21 May 2026

TEK comprises cumulative bodies of informal cultural knowledge of local communities, which are shaped through prolonged interaction with the local environment and transmitted across generations via social interactions, rituals, and practices (Anik & Khan, 2012; Berkes, 2012; Mondal, 2022). It includes approaches to sustainable resource management, ecological balance, and adapting to environmental change (Baker and Ghimire, 2003; Gomez-Bagethun, Corbera, and Reyes-Garcia, 2013). Valuation studies also highlighted that natural areas provide multiple benefits for human well-being, reinforcing the importance of TEK for ecosystem services (Kawsar et al., 2015; Rasel et al., 2022). The efficacy of TEK has been observed across diverse global contexts, offering valuable insights into how communities all over the world perceive, respond to, prepare for, and recover from hazards (Alcántara-Ayala, 2025; Kelman, Mercer, & Gaillard, 2017). From the forests of Ecuador to the arctic herding grounds of Finland or from the savannahs of Botswana to the mangroves of the Sundarban, TEK remains a cultural resource to face natural calamities (Becker & Ghimire, 2003; Ketlhoilwe & Jeremiah, 2016; Mondal & Das, 2022; Terrado et al., 2023). Hence, when integrated with science, policy, and other official knowledge, TEK can be a potential global approach toward environmental sustainability and justice (Mercer et al., 2010).

Recent geospatial analysis in other regions of Bangladesh shows that anthropogenic land-use change and groundwater dynamics substantially modify local hydrological regimes, which in turn influence climate-related risks (Rasel et al., 2022). For instance, in their study, Al Mamun and Pavel (2014) explained how indigenous coping strategies in flood-prone areas contribute directly to climate adaptation. The flooding possibility in the north-eastern area of Bangladesh, particularly in Sylhet and Sunamganj, is fundamentally connected to its geographical and climatic situation. It is located very close to Meghalaya, India, famously known as one of the rainiest places in the world. Frequent floods in various localities of Sunamganj, such as Islampur Union, bring difficulties to sustainable livelihoods and cause human casualties every year. Despite the fact that there remains a noteworthy flood coping mechanism plan for this region, it still is vulnerable to recurring floods. The following are thought to be the causes:

A. Too much dependency on top-down strategies that neglect community-based indigenous knowledge, where this bottom-up approach has the geographical, cultural, and historical value on the flooding adversity.
B. Another source of concern is inadequate maintenance of modern technologies, such as undragged rivers and poorly managed embankments.
C. Destruction of natural barriers for the sake of livelihood improvement and agricultural demands (Alam & Hossain, 2022; Bhuiyan, Paul & Abdussabur, 2024; Haque, 2016).

This is consistent with broader evidence from Bangladesh that inclusive rights-based approaches and equitable attitudes towards marginalised groups are critical for disaster risk reduction (DRR). Moreover, TEK frequently improves the fortitude of people living in flood-prone areas (Mercer et al., 2010; Haque & Etkin, 2012; Mondal, 2022; Kalam et al., 2024). Again, the connections between financial condition and broader economic growth in the SAARC region highlight how restricted financial systems can indirectly limit investment in resilience and adaptation. Considering these factors, it can be said that, for countries like Bangladesh, TEK-based disaster management can be a new key, as it is simultaneously sustainable and low in cost.

The flood-affected people of the country have developed innovative ways to minimise and overcome the damages of disasters (Al Mamun & Pavel, 2014; Chowdhooree, Sloan, & Dawes, 2019; Datta, Kairy, & Hurlbert, 2024). But their informal way of predicting and tackling floods has insufficiently been discussed in the TEK-DRR literature. Therefore, this study investigates TEK-based flood coping strategies among four villages of Islampur Union of Sunamganj District of Bangladesh. Employing a qualitative, community-centred explanatory approach, the present study aims to explain the importance of TEK in dealing with various flood-related adversities in that region. It also wants to bridge its findings within the broader debates on disaster adaptation and risk reduction. In doing so, the study hopes to contribute to an emerging body of interdisciplinary discourses that emphasise the merging of

TEK alongside scientific and official methods in constructing inclusive and culturally relevant disaster governance.

RESEARCH OBJECTIVES AND QUESTIONS

The purpose of this study is to enquire about existing traditional knowledge regarding flood coping mechanisms of the north-eastern rural communities of Bangladesh. It also tries to understand its role in adapting to flood-related crises. It has the following objectives:

- To understand why north-eastern flood-affected wetland communities use traditional knowledge.
- To contextualise how TEK is used and transmitted in their everyday life.

This study has the following questions:

- What purpose does traditional knowledge serve for the flood-affected north-eastern rural communities of Bangladesh?
- How does TEK become a shared cultural practice in everyday life?

LITERATURE REVIEW

Theoretical Framework of TEK

Traditional ecological knowledge is a discourse that is preserved by intergenerational practice (Gómez-Baggethun, Corbera, & Reyes-García, 2013; Martin et al., 2010). It's transmitted verbally and non-verbally (Bang, 2024). It is not only information related to nature but also an integrated form of human environmental experience, cultural practices and beliefs (Berkes, Colding, & Folke, 2000; Pierotti & Wildcat, 2000). TEK often comes up in the natural and environmental resource science and policy literature (Houde, 2007). Ecologist Fikret Berkes defines TEK as the following:

> *A consistent set of knowledge, practices and beliefs, developed through processes of adaptation and culturally transmitted from generation to generation, relating to the interrelationships of living beings (including humans) and their environment" (Berkes 1999).*

Researchers often understand TEK as a form of collective indigenous knowledge that is preserved and transmitted from generation to generation culturally (Martin et al., 2010). It is also about the relationships that living things develop with each other and with their environment (Whyte, 2013). TEK is logical and reliable knowledge which local people have developed through generations of close relationships with their land (Mauro & Hardison, 2000). This knowledge is usually reserved for people in less technological societies, who are directly dependent on local resources (Kimmerer, 2002). It is applied as a combination of knowledge and skills which are formed through an individual's cultural history and education and are expressed in the regulation and use of components given the prevailing environmental conditions (Charnley et al., 2008). In general, traditional environmental knowledge is essentially a featured system of knowledge, manners and beliefs. Berkes believes TEK has the following three key components:

(a) *Factual knowledge – which provides an understanding of environmental factors and processes.*
(b) *Knowledge put into practice – which refers to applications related to the use of environmental resources.*
(c) *Cultural values, ethics, and philosophies – which determine the relationship of humans with nature. (Berkes, 2008: 7)*

To discuss the findings, this study will follow Berkes's framework to gain an in-depth comprehension of how wetland communities' TEK has evolved through their experience, observation, and interaction with other knowledge systems. In addition, it will also explain how their TEK helped them to adapt to changing environmental conditions over time.

Disaster and TEK in the Global Context

Natural disasters have always caused trouble for mankind. But with time, humans also invented various methods to tackle these problems. The advancement of science and technology has made natural disasters more and more manageable. In parallel, traditional knowledge related to disaster management has also made a long-standing contribution to risk reduction during disasters. Despite the dominance of modern approaches, such traditional ecological knowledge still remains significant all over the world. For example, research conducted in Botswana and India shows that TEK is convenient for holistic, sustainable, and integrated environmental conservation (Joshi, 2023; Ketlhoilwe & Jeremiah, 2016; Mondal & Das, 2022).

Blending TEK with scientific tools again enhances communities' abilities to generate, adapt, transmit, and apply ecological knowledge (Gómez-Baggethun, Corbera, & Reyes-García, 2013). The success of such a combination was explored by Terrado et al. (2023) in Finland. They found that reindeer herders co-produce climate services with scientists to enhance resilience in a changing Arctic context. Similarly, in Ecuador, synergy between TEK and Western conservation science altered local people's forest-use patterns, which were reducing their water supply, and established a community-based conservation effort that preserved ecosystem services and biodiversity (Becker & Ghimire, 2003).

Within Bangladesh, TEK has been particularly explored in relation to its functionality for climate adaptation. For instance, Al Mamun and Pavel (2014) documented how indigenous crop cultivation techniques in flood-prone areas directly contribute to agricultural resilience. This knowledge is part of a larger cultural heritage and informal livelihood system, which is not only important for community survival but also decreases the risk of shocks, as observed by researchers during the COVID-19 pandemic (Al Mamun & Uddin, 2021). Integrating TEK with disaster risk reduction (DRR) is consistent with the larger evidence that inclusive, rights-based approaches are essential for building sustainable communities (Kalam et al., 2024). However, existing literature reviews in this area are often descriptive, lacking a clear synthesis of the debate or specific identification of contextual information, particularly regarding how TEK operates within specific socio-ecological systems such as the wetland or *haor* basins of Bangladesh.

Flood Crisis and Resistance in Wetland Area of Bangladesh

Natural hazards are common phenomena in Bangladesh due to its geographical position. The impact of various hazards in the country has been reflected in the global climate risk index of 2021, where Bangladesh is positioned 7th on the list of the most damaged and affected countries by natural disasters in the world in the last 20 years. Among the different forms of disaster the country faces each year, flooding is one of the most persistent and destructive ones. According to the INFORM Sub-National Risk Index 2022, jointly released by the Ministry of Disaster Management Relief and the United Nations Resident Coordinator's Office, Chhatak Upazila of Sunamganj is one of the country's most vulnerable regions regarding floods (Ministry of Disaster Management and Relief & United Nations Resident Coordinator's Office, 2022). The report assigns the area a score of 6.2, which places it in 11th position among 553 upazilas reviewed nationwide. The field area of this study, Islampur Union, belongs to this Upazila. Being located in a highly vulnerable area means that Islampur Union not only faces frequent natural disasters but also faces serious social and economic challenges that increase the overall fragility of the people of this area. Such vulnerabilities are often shaped by environmental mismanagement. Recent geospatial analyses, such as those for the Barind tract, show that anthropogenic land-use change and changes in hydropower systems significantly alter climate-related risks (Rasel et al., 2022), which is equally relevant for the wetland region (Shafie & Rahman, 2009). Therefore, it is important to know how people are coping with climate risks in their everyday lives, often caused by an elite form of their own species.

Like all over the modern world, Bangladesh also has two types of resistance systems regarding flood-related natural adversity. One of which is the traditional knowledge that comes from the beliefs and experiences of the community, and another is the modern or scientific approach. Over time, people have developed a number of tactics to tackle floods. For example, many elderly people in a village can forecast weather as well as the different types of floods and therefore can take necessary precautions. Surprisingly, their prediction often matches the modern forecasting data (Shafie & Rahman, 2009). Understanding the

usefulness of TEK in disaster management, Sohini Bose and Nathu Anna Saji (2020) developed the concept of Community-Based Disaster Risk Reduction (CBDRR), which emphasises engaging traditional knowledge to reduce disaster risk and formulate strategies for the risk level at the community level. Among South Asian countries, Bangladesh was the first to adopt CBDRR after the deadly cyclone of 1970. In Bhola the cyclone resulted in a devastating flood that caused the death of around 300,000 to 500,000 people (BIGD, 2019). CBDRR gained further significance after the floods of 1998, referred to as the 'flood of the century'. Previous research on DRR frameworks has further emphasised that effective policies need to leverage traditional and local knowledge to be truly adaptive and sustainable (Paudel et al., 2024; Bang, 2024). Furthermore, studies highlight that community-led strategies and a detailed understanding of local wetland ecosystems are crucial for flood disaster preparedness (Datta, Kairi, & Hurlburt, 2024). These research studies emphasise that TEK is not just a daily practice but a systemically important resource for resilience to the environment and livelihoods (Rahman et al., 2015; Rahman et al., 2013).

The north-eastern region of Bangladesh, especially the Sunamganj district, has historically been prone to devastating floods and faces adverse destruction and calamities. The cloudburst streams from Cherrapunji run down into the Surma River to the Kushiyara River channel, flowing within the low-lying fields of this region before they empty into the Bay of Bengal. During the yearly monsoon, many parts of the country become flooded due to heavy rains. But not all floods are similar, nor do all floods lead to disaster. Some examples that brought severe damage are the floods of 1988, 1998, 2004, 2007, 2017, and 2020. All these floods caused lasting harm on a personal and financial level. For instance, the 2017 flash flood spoilt the rice harvest in Sylhet. Omar Zahid (2022) mentioned in detail in his article the frequency of floods for several decades in that region as well as the related adversities. Another example is the floods of 2020 that influenced 33 districts and lingered on for more than 40 days while the country was fighting the COVID-19 pandemic and many people had lost their jobs or income sources for that reason. Again, Tuli, Rashid, and Akter (2024) noted that the 2022 flood in Sylhet and Sunamganj caused severe infrastructural and economic damages in that region. The inversion wiped out nearly 106,727 water sources, ruined 283,355 latrines, and inundated around 254,251 hectares of cropland, while also resulting in considerable livestock losses. Humanitarian reports corroborate these findings, further pointing out that roughly 30,000 people were displaced and over 1.6 million individuals were left in highly vulnerable situations (ReliefWeb, 2024). The reasons why floods have been so devastating in recent times have drawn the attention of many investigators. Their explanations for this complex question come down to a combination of climate change, deforestation, destruction of hills, unauthorised and unplanned development works in the wetland, and the massive loss in navigability in the rivers in the Meghna basin (Dewan, Nishigaki, & Komatsu, 2003; Islam & Sado, 2000; Islam, 2024; Zahid, 2022).

Flood Dynamics and Local Adaptation in the Sylhet-Sunamganj Wetland Basin

Flooding in the Sylhet-Sunamganj wetland basin has been studied from many angles, and researchers often point to a few common causes. One major problem is that rivers like the Surma and Kushiyara are not dredged regularly. Because of this, their depth has gone down over the years, and during the monsoon, they cannot hold as much water as before, which leads to overflow (Alam & Hossain, 2022). Another important issue is the loss of natural wetlands or *haors*. In the past, these wetlands acted as vast reservoirs, holding excess rainwater. However, over the years, their area has shrunk due to agricultural expansion and unplanned cities, so they are no longer able to absorb water as they once did (Alam and Hossain, 2020). In fact, many scholars have warned that unless haors are restored, their ability to act as natural shields against floods will continue to weaken (Byomkesh, Nakagoshi, and Shahedur, 2009; Siddiqui and Haque, 2025; Smith et al., 2021). Floods are also shaped by rainfall that happens outside of Bangladesh. The Indian states of Meghalaya and Assam, lying just a few kilometres upstream of Sunamganj, receive extremely heavy rain during the season. That water flows directly into the haor basin. Research has shown that when Meghalaya receives around 200 mm of rain and Sylhet gets about 400 mm within a short stretch of time, the result can be devastating floods across the wetland areas of Bangladesh (Islam & Sado, 2000; Mirza, 2002).

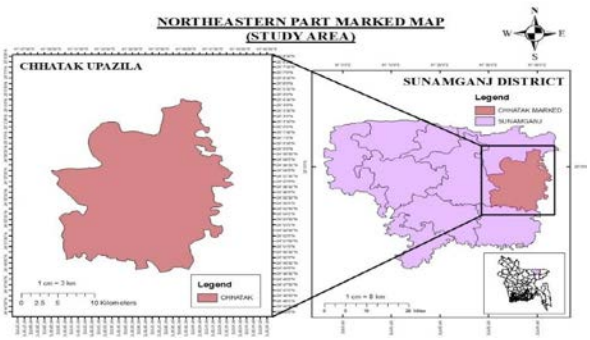
The extent of damage is reciprocal from year to year, but the question remains: what are the preventative ways? Barua and Rahman (2018) point out that traditional ecological knowledge (TEK) is basically the set of local strategies and practices people have built over generations to deal with floods. Existing literature shows that such knowledge provides many informal ways to tackle the flood-related crisis in Bangladesh, such as knowing the seasonal flow of water, making small but adaptive forms of infrastructure, and using farming and natural resources in ways that lower risk during floods (Ahmmed, 2015; Al Mamun & Pavel, 2014; Barua & Rahman, 2018). Though there are valuable insights regarding the issue, significant gaps still remain in this literary field. For example, most of the existing work on TEK in Bangladesh, although original, is scattered and lacks a cohesive narrative showing how it functions within the unique environment of the haor region, especially in the north-east, where it faces complex interactions of climate, hydropower, and socio-economic pressures. Recent research on haor livelihoods has confirmed their acute vulnerability, describing how flood risk is linked to poverty and limited access to resources (Haq, Raha, & Hossain, 2021; Haq, 2016). Furthermore, the role of TEK is gendered; women often have specialised knowledge related to water, food security, and household preparedness, yet their contributions to formal disaster risk reduction (DRR) planning are often overlooked (Chishti et al., 2021). Insights into traditional water technologies show how access to water is linked to gender resilience (Salauddin, Sarkar, & Al Mamun, 2022), suggesting that TEK should also be studied from a gender perspective. Broadly, household disaster preparedness is influenced by a complex combination of knowledge, perceptions, and direct experiences (Karim, 2024), which, although shaped by TEK, have not been fully explored in the context of the wetland region of Bangladesh.

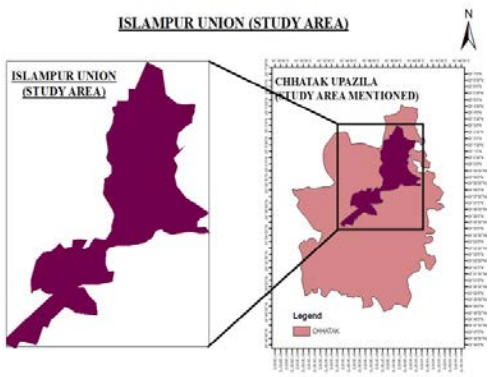
So, examining such traditional knowledge can not only develop the understanding of disaster management but also contribute to more inclusive and context-specific flood adaptation policies. The goal of this study is to fill these related gaps. It attempts to provide a well-structured analysis of the TEK of the flood-prone Islampur Union of Sunamganj District to present how such knowledge is effectively applied and transmitted and creates variations within the wetland community. Situated within a broader debate on sustainable livelihoods, environmental services, and inclusive governance, this study aims to clarify how TEK contributes to community resilience. This research will explore the potential for linking TEK and scientific DRR frameworks to contribute to culturally sensitive and more equitable adaptation policymaking. In doing so, it will build on and extend previous research on local agricultural adaptation (Al Mamun and Pavel, 2014; Pavel, Chowdhury, and Al Mamun, 2014). It will also be consistent with the fundamental idea that integrated implementation of DRR in socio-cultural contexts is essential for achieving genuine community-based resilience (Graveline et al., 2025).

MATERIALS AND METHODOLOGY

Islampur is a Union of Chhatak Upazila, located in the northeast of Bangladesh under the administration of Sunamganj district of Sylhet Division. The Chhatak Upazila is situated 36.3 km east of the Sunamganj district. The first map displays the Sunamganj district on the right image and Chhatak Upazila highlighted on the right. In the right image, the legend is showing a sign of the structure of the map.

GEOGRAPHICAL MAP OF STUDY AREA: 01





Source: Developed by Researchers

GEOGRAPHICAL MAP OF STUDY AREA: 02

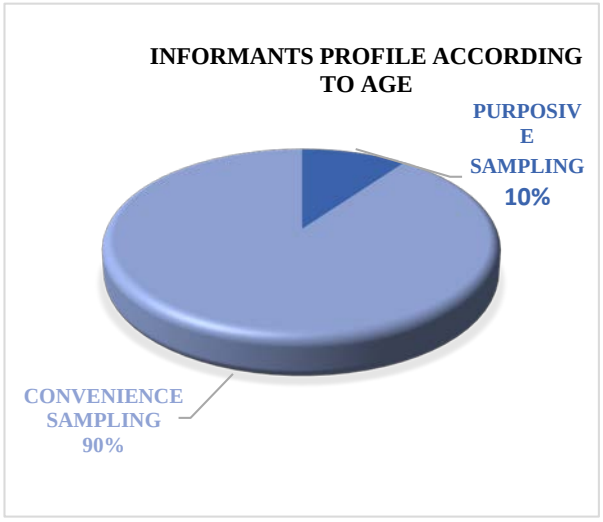
In this study, Islampur Union of Chhatak Upazila was selected as the study area. The Surma River and Piayain River flow around the union. The selected four villages under

Islampur Union are located at the very front of other villages, and consequently, these villages face flash floods earlier than others. Also, in terms of vulnerability, these villages get an earlier focus than others. The Kushiyara, Piayain, and Surma Rivers are used to carry water from the northern upstream of Bangladesh. The second map shows Chhatak Upazila on the right side, and the Islampur union is shown on the left side of the map. Islampur Union Parishad is located to the northeast, 2.5 km from Chhatak Upazila Zero Point.

Source: Developed by Researchers

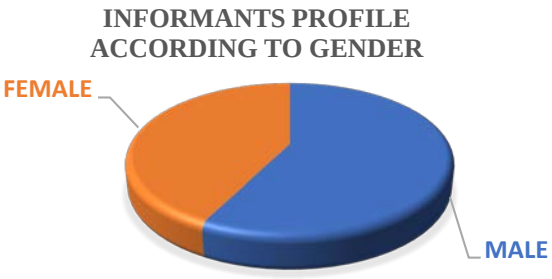
Sampling Technique and Determination

FIGURE 01: FIGURE OF SAMPLING CRITERIA



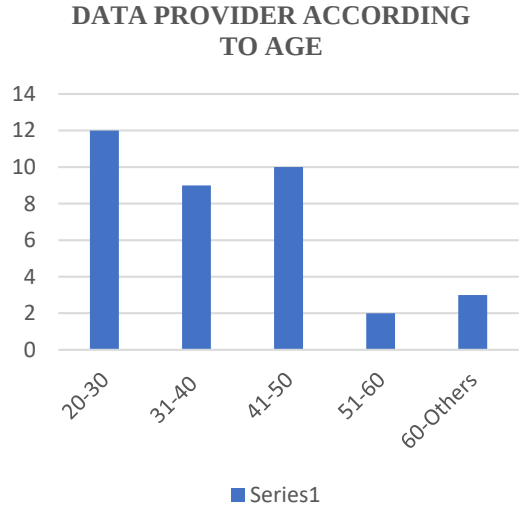
Primary data was collected from four villages of Islampur Union. This study attempted to gather information using both the convenience sampling method and the purposive sampling method (See: Figure 01). The aim of selecting the convenience sampling method was to obtain initial and primary data related to the selected topic. However, while collecting data, the researcher noticed that, although this method is convenient in terms of time, there is a risk of data reliability. Many respondents, when asked about flood coping knowledge, would encourage contacting local elders, but they provided general information. As a result, for KII information and experiential data related to the topic, the present study collected specific information from local elders and key informants. Thus, this study emphasised the purposive sampling method, focusing on purposive persons such as Ward members and union Parishad members.

FIGURE 02: FIGURE OF SAMPLING CRITERIA



A substantial portion of data was collected from local rural males, accounting for 60 percent of information, while local females contributed significantly from their perspective, accounting for 40 percent involvement. The number of women informants was less than that of men due to household responsibilities during the data collection period. The pie chart (See: Figure 02) illustrating the percentage of information provided by local women and men accompanies the study's findings.

FIGURE 03: FIGURE OF SAMPLING CRITERIA



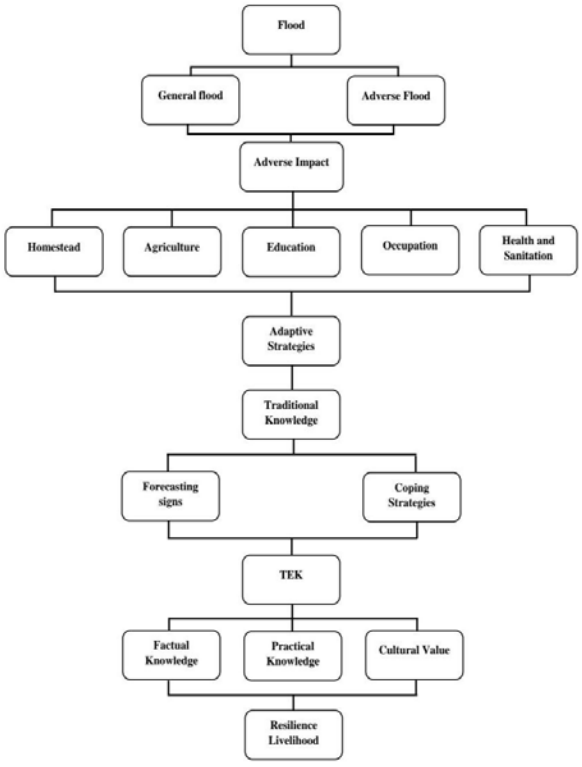
During the data collection period, the present study emphasized the importance of age-specific information regarding flood coping mechanisms (See: Figure 03). Individuals aged 20-30 were the largest group of contributors, accounting for 12 respondents, while the next most significant contributor was those aged 31-40, totalling 9 respondents. The next group were examples of flood coping strategies based on their relevant experiences. Furthermore, purposive sampling included senior citizens aged 40 to 60 and local ward members and chairpersons, who provided important insights into

the crisis. Respondents aged over 30 were also notable, with 9 more participants providing valuable information. Respondents aged 41-60, a total of 12 respondents, played an active role in the study, increasing participation in disaster-related research related to floods.

Data Collection Tools

As this study followed a qualitative research approach, it emphasised fact-finding and thematic analysis. A semi-structured questionnaire was conducted to collect field data to get an open-ended view about the concerning matter. As mentioned earlier, the field was conducted in four villages in the Islampur Union of the Sunamganj district. To document responses, the researcher maintained the pen-and-paper method, as researchers wanted to document and analyse those findings for research purposes. To understand deeply involved and responsible informants, three KIIs were performed. To understand past and present situations, it has also employed the case study method on the selected topic. The study procured the dependent variable (DV) as adaptive strategies (i.e., forecasting signs and coping strategies), while the independent variable (IV) was procured as traditional ecological knowledge (i.e., factual knowledge, practical knowledge, and cultural values). Overall, well-mannered behaviour was maintained while collecting data from the informants to ensure credibility and ethical consideration.

FIGURE 04: VISUALIZE PROGRESSION OF RESEARCH DESIGNED



Source: Developed by Researchers

Study Design

In the north-eastern part of Bangladesh, studies show that floods almost always come every year. Normally there are regular floods, but quite often the situation turns into severe flooding as well. The negative effects of such floods on the daily life of people are shown in the visual below (See: Figure 04).

From this outline, it becomes clear that when floods (adverse, general) occur, people suffer in many ways, starting from their homesteads to agriculture, education, jobs, health, and even their very survival. In those hard times, the wetland communities try to depend on their traditional knowledge and practices, which help them to make life a bit more resistant against the disaster.

Ethical Consideration

The researcher maintained ethical integrity throughout the study by getting all participants' prior informed consent, preserving the confidentiality and anonymity of their responses, and engaging with communities in a respectful manner. Data collection was conducted using non-intrusive methods (pen and paper), and the study prioritised participants' dignity and expertise, avoiding disrespect while honouring and crediting their traditional ecological wisdom as a major component of the research.

RESEARCH FINDING

To acquire an open-ended view of the concerning matter, a semi-structured questionnaire was conducted. The field surveyed four distinct villages of Islampur Union. Information about every village is presented with a table as the collected data is needed to maintain a particular sequence. From table 05 to table 08, researchers tried to show village-wise detailed findings one by one.

TABLE 05: GOALGAON (FLOOD COPING KNOWLEDGE)

NAME	AGE	GENDER	OCCUPATION	KEY INFORMATION / TRADITIONAL KNOWLEDGE
JASHIM UDDIN	41	Male	Boatman	*Flood occurs May-Oct; the river rises 15-20 ft; dark clouds over Meghalaya hills forecast floods; a phenomenon called **"Gula"** unties boats.*
MAINUDDIN BULU	42	Male	Fisherman	*Flood starts in May; dark hills mean flood; learnt forecasting from father; case: man died from lightning during the flood.*
ASHRAF HOSSAIN	28	Male	Job holder	*Believes snakes near houses mean a flood is coming; knowledge from grandmother.*
RASHEDA BEGUM	55	Female	Housewife	*A rainbow in the east-north-south direction means a flood is near.*
AFAZ MIA	38	Male	Fisherman	*Ants building nests higher than usual indicates heavy rain/flooding.*
LAFIFA BEGUM	32	Female	Housewife	*Numerous insects near homes mean a flood is likely.*
ASHIK MIAH	45	Male	Boatman	*Wind against river flow causes a rise; case: May 27, 2024, a hilly wave untied a boat and lost his livelihood.*
AZMOL HOSSAIN, DINA BEGUM, AKRAM HOSSAIN, SUMA BEGUM (FGD)	24-35	M/F	Businessmen & Housewives	*Problems: snakes, food scarcity, wet clothes, illness, no electricity; Solutions: garlic water for snakes, nets, stockpiling food (pumpkin, potatoes, puffed rice, and biscuits), portable stoves, rainwater storage, and kerosene lamps.*

TABLE 06: ISLAMPUR (FLOOD-COPING KNOWLEDGE)

NAME	AGE	GENDER	OCCUPATION	KEY INFORMATION / TRADITIONAL KNOWLEDGE
GAYES MIAH	42	Male	Fisherman	*A flood in Jaishtya-Ashad; dark clouds in the northern mountains forecast rising floods.*

SHAMIM MIAH	41	Male	Fisherman	*Two types: sudden Gang swelling & heavy monsoon rain. Coping: built houses with soil, made small boats, and went fishing for income.*
RUYEL MIAH	26	Male	Day labourer	*Frogs call overnight, and an overcast sky means a flood; snakes near the house also indicate a flood.*
REHANA, PARVIN, SARIFUL, TAMIMA (FGD)	25-41	Female	Housewives	*Problems: education disruption, waterborne diseases, destroyed houses, crop loss, price hikes, and child drowning. Solutions: rainwater storage, boats for school-going children, house raising, stockpiling food, and teaching swimming. Case: 2012 - two children drowned.*

TABLE 07: PATHARIPUR (FLOOD COPING KNOWLEDGE)

NAME	AGE	GENDER	OCCUPATION	KEY INFORMATION / TRADITIONAL KNOWLEDGE
HAFSA, PARVIN, NASIMA, MUSAMMA (FGD)	28-55	Female	Housewives	*Problems: transport issues, education disrupted, paddy loss, child drowning. Solutions: build houses above the danger line, teach swimming, make wooden boats, and ferry people for income.*
NAZMUL HOSSAIN	26	Male	Nurse	*Adaptation: storing food before a flood; Forecast: immobile black clouds mean heavy rain & flood; knowledge from father.*
SAYMOL HOSSAIN	25	Male	Fisherman	*Cause: Gang Gula; Forecast: Impure, cold, muddy river water causes heavy rain in mountains & flooding.*

TABLE 08: RAHMATPUR (FLOOD COPING KNOWLEDGE)

NAME	AGE	GENDER	OCCUPATION	KEY INFORMATION / TRADITIONAL KNOWLEDGE
ZAKIR MIAH	47	Male	Businessman	*This village floods first as it is near the river; the forecast is weeks of monsoon rain, which means floods.*
JOYNAL ABEDIN	41	Male	Businessman	*Coping: keeps food, furniture, and books safe; books are stored high on a shelf ("sunset" place).*
PARUL AKTER	45	Female	Housewife	*Problems: insects, snakes; Solutions: net + chalk ash for insects, garlic water for snakes.*
SHAKLEN MIAH	35	Male	Day labourer	*The flood recedes when the rain stops, the sky clears, frogs call less, and insects burrow.*

Table 09 is showing information given by the key informants. Specifically, representatives of Islampur Union Parishad Md. Salik Miah, Kamal Miah and Md. Abdul Hafiz shared their significant views on concerning matters that researchers presented in table 09 by analysing qualitatively.

TABLE 09: UNION PARISHAD REPRESENTATIVES

Name	**Age**	**Gender**	**Representative village/occupation**	**Ward No.**	**Key Insights on Flooding & Indigenous Practice**
MD.	38	Male	Representative of	06	Floods cause serious annual damage;

SALIK MIAH			Islampur Union Parishad, assigned for Goalgaon & Islampur		adaptive capacity is unequal. Intergenerational knowledge helps residents survive well during flood periods. Problems: (a) Education and work are disrupted; (b) Sudden water flow of the Piyain River damages crops, houses, livestock, and vehicles. Conventional solutions: (1) Chapra Bil (Gualgaon), (2) Boro Bil (Islampur) functions as a natural reservoir. ➢ *Silt deposition reduces the depth of the Bil → decreases its water-holding capacity. Annual community-based fishing helps remove some silt. To improve resilience, community efforts are needed to restore the Bil's navigability.*
KAMAL MIAH	40	MALE	Representative of Islampur Union Parishad, assigned for Rahmatpur	05	Floods have both positive and negative impacts. ➢ *Floods are divided into normal and excessive floods. Villages located in high areas → are generally less affected. During excessive floods, Rahmatpur gets isolated; communication is disrupted. Normal floods increase fish availability from nearby haors, bringing economic benefits.*
MD. ABDUL HAFIZ	45	MALE	Representative of Islampur Union Parishad, assigned for Patharipur	08	The villagers have a deep connection between their livelihoods and water. 60% depend on fish farming; 20% depend on agricultural businesses. Normal floodwaters are beneficial to the majority. A sudden rise in floodwaters creates severe problems. ➢ *Traditional system: Narula Haor protects the village by serving as the main water reservoir. Excessive*

	cultivation is reducing navigability. After the major floods of 2022 and 2024, immediate restoration of Narula Haor is crucial for future flood protection.

Table 10 is illustrating traditional flood-forecasting methods of wetland communities. While Table 11 is providing traditional flood-coping strategies.

TABLE 10: INFORMAL FLOOD PREDICTION METHODS

TRADITIONAL KNOWLEDGE / FORECASTING SIGN	INFORMANTS MENTIONED	% OF INFORMANTS (≈36 TOTAL)	VILLAGES REPORTED
Dark clouds on Meghalaya/northern hills mean a flood is coming.	6	~17%	Goalgaon, Islampur, Patharipur
Continuous rainfall for days/weeks indicates a flood.	4	~11%	Goalgaon, Rahmatpur
Snakes near houses indicate a flood.	3	~8%	Goalgaon, Islampur
Ants'/insects' movement (higher nests, many insects) means flood.	4	~11%	Goalgaon, Rahmatpur
Frogs calling overnight means a flood is coming.	2	~6%	Islampur, Rahmatpur
'Rainbow' (east-north-south) means a flood.	1	~3%	Goalgaon
Wind direction against river flow equals flood rises.	1	~3%	Goalgaon
Cold, muddy river water means a flood is coming.	1	~3%	Patharipur
Lightning clearing clouds indicates water recedes.	2	~6%	Rahmatpur
A clearing sky and sun mean a flood is decreasing.	2	~6%	Rahmatpur

Table 10 gives an idea about how local people in the northeastern villages predict floods and also what they do to face the problems during floods. Most of the signs they notice come from nature. For example, some villagers said when dark clouds gather on the Meghalaya hills, flood water usually follows. Others mentioned that too much rain for many days, snakes coming closer to homes, or even ants and insects moving strangely are taken as signs of flooding. A few people also shared that frog sounds at night, cold muddy water in the river, or the wind blowing against the river flow mean that flood is coming soon.

TABLE 11: TRADITIONAL FLOOD COPING STRATEGIES

FLOOD PROBLEM	TRADITIONAL PRACTICE	INFORMANTS REPORTED	VILLAGES
SNAKES AROUND HOUSES	*Garlic water is sprinkled, and nets are kept around homes.*	~12%	Goalgaon, Rahmatpur
SCARCITY OF FOOD	*Stockpiling potatoes, pumpkin, puffed rice, biscuits, and jaggery before the flood.*	~20%	Goalgaon, Islampur,
SCARCITY OF DRINKING WATER	*Rainwater collection: storing in large drums.*	~10%	Goalgaon, Islampur
EDUCATION	*Hand boats for children, teaching*	~8%	Islampur, Patharipur

DISRUPTION	*swimming.*		
LOSS OF HOUSES/FURNITURE	*Raising houses with soil, keeping books on high shelves, repairing homes.*	~15%	Islampur, Patharipur, Rahmatpur
ILLNESS FROM DIRTY WATER	*Store rainwater and boil water.*	~8%	Goalgaon, Islampur
ELECTRICITY OUTAGE	*Use kerosene lamps.*	~5%	Goalgaon
LOSS OF INCOME / WORK	*Temporary fishing, ferrying people on boats.*	~10%	Islampur, Patharipur
CROP LOSS (PADDY/VEGETABLES)	*Early harvesting of stock vegetables (pumpkin, potato).*	~7%	Islampur, Patharipur
CHILD DROWNING	*Teaching swimming from an early age.*	~5%	Islampur, Patharipur

DISCUSSION

Factual Knowledge in Study Area: Environmental Observation and Indicators

The people in the study area have their own ways of reading nature when it comes to floods (See Table 12). Clouds are one of the first things they notice. When dark clouds sit still over the Meghalaya hills, villagers believe heavy rain will continue and floods will appear within a week. The condition of the river is also checked; if the water turns muddy and cold, it is taken as a sign of upstream rainfall and a possible rise in water level.

TABLE 12: FACTUAL KNOWLEDGE

NATURAL FLOOD FORECASTING	Cloud Patterns: *Residents observe dark, stationary clouds over the Meghalaya hills (north) as a sign of prolonged rainfall and imminent flooding within 7 days (Nazmul Hossain, Patharipur).* River Conditions: *Cold, turbid river water indicates upstream rains and rising water levels (Saymol Hossain, Patharipur).* Animal Behaviour: *Ants building elevated nests signal heavy rain and flooding (Afaz Mia, Goalgaon).* *Frogs croaking excessively overnight represent the warning of morning floods (Ruyel Miah, Islampur).*
HYDROLOGICAL KNOWLEDGE	Gula Phenomenon: Annual river overflow ("Gula") during monsoon (May-October) is linked to heavy rainfall and upstream water surges (Jashim Uddin, Goalgaon). Wind-River Dynamics: Winds opposing river flow correlate with rising water (Ashik Miah, Goalgaon). Winds aligning with river flow signal receding floods (Shaklen Miah, Rahmatpur).

Animal behaviour plays a big role too. Ants making nests on higher ground are thought to mean a big flood is near. Similarly, frogs croaking all night long is believed to be a warning of water rushing in by the morning. Besides this, people also observe the “Gula” phenomenon, which happens every monsoon when rivers overflow due to heavy rainfall and hill water. They even link the wind with flood behaviour. If the wind blows against the river, they expect the water to rise. When the wind goes in the same direction as the river, they think the flood will soon go down.

Practical Application in Study Area: Adaptive Strategies

The communities don't just rely on signs; they also prepare themselves with different strategies (See: Table 13). For houses, some raise the floors with soil so that water cannot enter easily, while others build on higher ground. Boats are treated like lifelines there, used not only for travel but also for fishing and during emergencies.

TABLE 13: PRACTICAL APPLICATION

INFRASTRUCTURE ADJUSTMENTS	*Elevated Housing: Raising homes above flood levels using soil (Shamim Miah, Islampur) or building on hills (Zakir Miah, Patharipur).*	*Boats as Lifelines: Small wooden boats for transportation, fishing, and emergency use (Shamim Miah, Islampur; Ashik Miah, Goalgaon).*
RESOURCE MANAGEMENT	*Food Storage: Pre-flood stockpiling of non-perishables like jaggery, puffed rice, and sweet pumpkins (FGD Group, Islampur).*	*Water Conservation: Collecting rainwater in drums for drinking during floods (FGD Group, Islampur).*
ECOLOGICAL SOLUTIONS	*Bils and Haors: Community-managed wetlands (e.g., Chapra Bil, Narula Haor) absorb flood surges. Siltation from annual floods reduces their capacity, prompting communal desilting efforts (Md. Salik Miah, Islampur).*	*Natural Repellents: Garlic paste to deter snakes and chalk-ash-coated nets to block insects (Parul Akter, Rahmatpur).*
RISK MITIGATION	*Swimming Training: Teaching children to swim to prevent drowning (Rehana et al., Islampur FGD).*	*Emergency Protocols: Sheltering in neighbouring villages during storms (Mainuddin Bulu, Goalgaon).*

Food is stored in advance, mostly items that don't spoil quickly, like puffed rice, pumpkins, and jaggery. Rainwater is collected in big drums and saved for drinking since tube-well water becomes unsafe. Ecological knowledge is also part of survival. Villagers take care of their local wetlands, as they usually absorb floodwater. But when these wetlands fill with silt, people join together to clean them. For protection from snakes, they sometimes use garlic paste; on the other hand, chalk ash is applied to nets to keep insects away. Risks during floods are also managed in a practical way. Children are taught to swim at an early age so that they can avoid drowning. When floods turn very bad, families temporarily move to nearby villages, often to their relatives', for safety. These strategies may look simple, but they show how closely people adjust their lives with nature.

Cultural values in Study Area: Intergenerational Transmission

Flood-related knowledge is not only practical but also tied with cultural values (See Table 14). Many villagers believe that rainbows seen in the east, stretching north to south, are a sure sign of floods. Snakes appearing close to houses are also treated as flood omens, and people avoid killing them because of taboos.

TABLE 14: CULTURAL VALUES

BELIEF SYSTEM	Omen-based warnings: *Rainbows in the eastern sky (north-south axis) foretell floods (Rasheda Begum, Goalgaon).* *Snakes near homes are seen as flood omens; killing them is taboo (Ashraf Hossain, Goalgaon).*

ETHICAL STEWARDSHIP	Respect for Ancestral Wisdom: *Forecasting methods (e.g., cloud observations) are passed down through generations and treated with reverence (Nazmul Hossain, Patharipur).* Community Cooperation: *Collective efforts to de-silt Bils/Haors and share boats during crises reflect communal responsibility (Md. Abdul Hafiz, Patharipur).*
SPIRITUAL NARRATIVE	Angry Clouds: *Stationary dark clouds are interpreted as nature's wrath, requiring preparedness (Nazmul Hossain, Patharipur).*

Knowledge of forecasting, for example, through watching clouds, is a very common activity among wetland communities. It is passed down from older generations and respected as ancestral wisdom. Alongside this, community life is shaped by cooperation. People share boats during crisis times and also work together to de-silt wetlands. Such activities are seen as a collective responsibility. Some explanations are connected with spiritual meaning. For example, stationary dark clouds are often described as "angry clouds", which villagers interpret as nature's warning. These cultural phenomena show that flood knowledge is not only about survival but also about beliefs, heritage, and the spirit of community.

The Importance of Traditional Environmental Knowledge in Sustainable Livelihoods

Active Adaptation: Basic Systems and Predictive Approaches

Traditional environmental knowledge helps communities to predict floods through natural signals, which enables timely preparation and risk reduction. For example:

Cloud Observation:

According to locals like Jasim Uddin of Goalgaon, the sighting of dense, stationary black clouds in the Meghalaya hills and northern parts of Islampur Union indicates that there will be rain in the hills and, hence, flooding. It can predict floods with indirect indications of heavy rainfall and flooding within 7 days. Moinuddin Bulu (Goalgaon) recalls how his father's cloud warnings once saved them from a storm. On the contrary, fisherman Abdur Rahim died in a lightning strike, which was a terrible consequence of ignoring natural signals, Moinuddin Bulu (Goalgaon) points out.

Rivers and Animal Behaviour:

River behaviour: Saymol Hossain of Patharipur said that if the river water is cold and impure, it indicates an upward flood or an increase in flooding.

(a) Ants and frogs: Afaz Miah of Goalgaon, seeing the ants building high nests, believed that floods were the result of heavy rains, and according to Ruel Miah of Islampur, excessive calls of frogs were indicators of impending floods.

*(b) Snakes***:** As per the teachings of Ashraf Hossain's grandmother of Goalgaon, seeing a snake near the house is a warning sign of a flood. As a result, if a snake comes near the house, it is better to drive it away without killing it.

These signals prompt flood preparedness measures such as stockpiling food, building manual or motorboats and protection (i.e., evacuation to a safe place). For example, the family of Moinuddin Bulu of Goalgaon took shelter in Bangathila village after seeing a dark cloud which protected them from the deadly lightning.

Utility-Orientated Coping:

TEK emphasises community-driven strategies that are readily available within the respective communities, cost-effective and adaptable. For example:

Infrastructural Ecological Knowledge:

(a) **Settlement:** Shamim Mia of Islampur raises his house annually with soil to prevent floodwater and tries to keep his house above the flood danger level. Zakir Mia of Rahmatpur has built his house on the highest place possible, i.e., on the side of the hill, so as not to be in danger of floods.

(b) **Manual and Engine Boats:** Handcrafted manual wooden boats of fishermen like Goalgaon's Ashik Miah and engine boats provide transportation and temporary livelihood during floods.

Natural Remedies:

(a) **Garlic Paste:** The tradition of Parul Akter of Rahmatpur uses garlic paste to repel snakes.

(b) **Chalk-ash netting:** Burnt portions of chalk, including ash and ash netting, protect food and shelter from insects.

Food and Water Management:

(a) (Islampur FGD team) Stockpiles of food with good shelf life like jaggery, puffed rice, biscuits, potatoes, sweet pumpkin (Islampur FGD team) when floods inundate markets.

(b) The stakeholders ensure clean water during floods by storing rainwater in drums.

(c) These solutions, however, reduce dependence on external aid. For example, Ashiq Mia's boat was swept away by the 2024 "Pahari dhal" flood, but community-shared boats aided in movement and livelihoods.

Cultural Practices: Intergenerational Knowledge and Collective Efforts

TEK is based on cultural transmission and collective values, which sustain survival strategies from generation to generation:

(a) Traditional education: Elders like Moinuddin of Goalgaon village teach the youth about clouds and lightning to encourage them to be vigilant. Fishermen like Moinuddin learnt flood forecasting from his father, highlighting the importance of experiential knowledge.

(b) Community-based practices: Wetlands absorb floodwater and bring awareness to adverse situations. Villagers in Goalgaon, Islampur and Patharipur collectively removed silt from Chapra Beel and Narula Haor to restore floodwater-holding capacity (Source: Md. Salik Mia, Islampur Union Parishad Member, Ward 06).

(c) Swimming training**:** According to the findings of FGDs conducted with Rehana and others in Islampur, children are taught to swim from an early age, which reduces the risk of children drowning.

Cultural taboos and beliefs:

(a) Killing snakes is prohibited, as they are seen as predictors of floods (Ashraf Hossain, Goalgaon).

(b) A rainbow in the eastern sky (along the north-south) is interpreted as a divine warning, which means there is a possibility of another flood (Rasheda Begum of Goalgaon village).

(c) Such practices build community cohesion and tolerance. A combination of proactive adaptation, resource-based adaptation and cultural practices highlights the essential role of TEK in flood prevention. By interpreting environmental cues, using local resources, and preserving ancestral knowledge, communities like Goalgaon, Islampur, Patharipur, and Rahmatpur not only cope with floods but also maintain their cultural identity.

RECOMMENDATIONS

(a) The first suggestion is for future studies. This study suggests future scholars focus on hybrid flood forecasting systems. Hybrid forecasting should be seen as a combination of traditional indicators (e.g., cloud patterns and animal behaviour) and modern technology (e.g., satellite weather data and river monitoring systems).

(b) Another recommendation is to prioritise wetland restoration in policy practice. This study recommends considering community-led actions such as releasing wetland silt into governmental and NGOs' policymaking.

(c) Community empowerment and alternative livelihood practices can enhance local institutions, such as union councils, in leading flood prevention efforts. So, strategies should be taken to ensure equal distribution of resources for local government sectors and reduce dependence on central authorities.

(d) The flood-fighting traditions of Goalgaon, Islampur, Patharipur and Rahmatpur demonstrate the effectiveness of traditional environmental knowledge (TEK) as a coping mechanism and in building resilience. By incorporating traditional knowledge along with scientific techniques, vulnerable communities cannot only resist flood crises but also thrive in the face of climate uncertainty. This study, therefore, found the significance of conserving and advancing traditional ecological knowledge as a fundamental aspect of sustainable development and resilient livelihoods in flood-prone areas.

CONCLUSION

This study highlights the important role of traditional ecological knowledge (TEK) in flood coping among rural communities in four villages of Islampur Union of Sunamganj District in Bangladesh. The findings figured out three key aspects of flood coping: (1) proactive adaptation, (2) low-cost solutions, and (3) cultural continuity. Community members predict floods by observing natural signs such as cloud formation, river behaviour, and changes in animal activity and prepare accordingly by storing dry food, building houses, and securing boats. By using readily available materials such as soil for house construction or garlic for pest control and following community practices such as wetland management and boat sharing, they reduce the impact of floods in a cost-effective and environmentally friendly way. The transfer of knowledge from generation to generation helps keep these adaptive strategies effective, while culturally embedded beliefs, which include interpreting snakes as evil or rainbows as warning signals, reinforce social unity and collective preparedness. Despite these positive outcomes and strengths, challenges such as wetland sedimentation, climate unpredictability and isolation during extreme floods persist. These issues emphasise the need to integrate TEK with modern innovation to enhance long-term resilience. Therefore, this study recommended prioritising wetland restoration and focusing on hybrid flood forecasting systems along with the cultural practice of wetland communities. It also gives a pathway for lessening reliance on administration only and guaranteeing equitable resource distribution for local government sectors. It should be mentioned that there are a few drawbacks to this study. For example, the sample size and study area were insufficient to accurately reflect the entire population and flood-affected area. Again, the results may not be applicable to other wetland regions with distinct social and cultural environments because traditional ecological knowledge and its connections to other social factors may vary between regions or situations. In any case, examining TEK can provide us with culturally significant, environmentally friendly, and inexpensive ways to tackle the flood crisis in Bangladesh. The results of this study also point to a number of areas for further investigation. For instance, future researchers could study this issue from gender or economic points of view. Again, studies can examine the impacts of implementing culture-specific TEK along with the scientific method. Moreover, one can also investigate why TEK is still a neglected phenomenon in policymaking and practice. On the other hand, the present study could be a source of secondary data for such future research. Another significance of this study is that it showed the importance of TEK in constructing inclusive and culturally relevant disaster governance. Overall, future policies and research should engage local communities like the wetland

communities of north-eastern Bangladesh as active partners, ensuring that initiatives for inclusive development and disaster management are in line with culturally appropriate coping strategies that have proven effective over time.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to the respondents for their invaluable information; the reviewers as well for their perceptive opinions and healthful suggestions which has significantly enriched this study.

FUNDING

The study receives no funding.

ABOUT THE AUTHORS

Md. Sarwar Zahan is an MSS student at the Department of Folklore, Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh, Bangladesh. He completed his BSS Honours from same Department. He has been actively engaged in research since his second year and is currently continuing his thesis. His research interests include Cultural Resilience in Environmental Phenomenology and Ecology-Oriented Occupational Practice, alongside ethnographic work on Tribal Communities in Bandarban and Sylhet hill region. He can be reached at sarwazahan298@gmail.com. **Atiza Dill Afrose** is an associate professor in the Department of Folklore at Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh, Bangladesh. She also worked as an editorial board member for the Research Journal of Folklore. Her principal areas of interest are children's folklore, human rights, gender, political discourse, medical folklore, and folk narratives.

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