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Seeds, Water, and Storms: Women's Knowledge as Climate Adaptation in Coastal Bangladesh

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Abstract

Coastal Bangladesh, which has shifting riverine chars, weak islands, and the Sundarbans, is experiencing growing climatic demands such as cyclones, marine inroads, erosions, and unpredictable monsoons. Women are critically important but overlooked in ensuring household and community resilience in these regions, especially in the upazilas of Manpura, Hatiya, and Shyamnagar. They use many generations of indigenous learning to practice such things as growing salinity-resistant crops, collecting rainwater, and reading water and environmental signs to respond to disasters. Although women possess a profound understanding of ecology, their contributions are still largely absent from official plans for adapting to climate change. The present research attempts to seek answers to how women in the three climate-sensitive upazilas embrace indigenous practices in agriculture, water management, and disaster preparedness. It also investigates the way this knowledge is being passed on to generations and adjusted to acute changes in the environment. For 7 ethnographic focus group discussions (FGDs), 8 to 10 women aged 20 and above and stratified by age and occupation were recruited. Drawing together inductive and deductive thematic coding, transcripts and field notes were analyzed with the help of NVivo software. Data were categorized into five themes: (1) domestic agricultural activities, such as seed selection and organic control of pests; (2) rainwater collection in the form of rainwater storage and natural filter; (3) environmental disaster preparedness based on local triggers, i.e. animal behavior; (4) intergenerational transmission of knowledge through stories and informal education; (5) centerpiece innovation, i.e. hybrid innovations, which combines practices and modern tools. Evidence shows that women practice indigenous knowledge that is projective, dynamic, and key in coping with climate issues. This experience can be integrated into a gender-responsive policy by means of seed banks, training, and community water systems, which can increase the sustainability and fairness of adaptation initiatives in vulnerable coastal communities.

Keywords: *Ecofeminism; Indigenous Knowledge; Climate Adaptation; Coastal Bangladesh; Disaster Readiness*

1. Introduction

Located in low-lying areas of islands, riverine chars (resulting from the deposition of sediment), and Sundarbans mangrove fringes, coastal Bangladesh is considered one of the most climate-vulnerable regions in the world, where people have to struggle with a series of environmental pressures continuously (Hossain et al. 2021). Manpura (Bhola), Hatiya (Noakhali), and Shyamnagar (Satkhira) upazilas are examples of such vulnerability, where each of the areas faces different but closely interrelated obstacles. Manpura, an island battered by tidal waves and exposed to salt erosion, has farming lands where plots sparkle under the sun along the salt flats (Bhowmik et al. 2024). The changing river channels, resulting in the building or deconstruction of char lands, require flexibility regarding the varied responses to flooding in the area of Hatiya, as the muddy water ravages the whole landscape overnight (Haque & Jakariya 2023). On the periphery of the Sundarbans, bordering Shyamnagar, salinity, waterlogging, and cyclones are at their catastrophic peak, where mangrove forests became simultaneously a protective measure and a reminder of the power of nature (Sen & Ghorai 2019). These are circumstances that endanger food security, the availability of water, and livelihoods to compel communities to adjust to the situation of resource constraints.

Women contribute to household and community resilience as primary household caregivers, farmers, and individuals who take charge of resource management. In Manpura, women choose the rice varieties tolerant to salinity, such as BRRI dhan 67 or BINA dhan 10, and scan their composting soil contents between fingers to determine if the high salt content is edible or not before they plant them. Instead, in Hatiya, they figure out how to grow short-term (radish and spinach) crops, taking utmost consideration of avoiding end-monsoon flooding of farmlands with murky waters. The floating gardens created by women in Shyamnagar not only provide a source of vegetable food (the red amaranth or chili) but are lattices of fibrous plants: bamboo and water hyacinth that their hands tie to make solid buoyancy platforms that float on floodwaters. These are the long-established behaviors in the local environment that refer to how well women understand the signals of nature, e.g., the feeling of salty soil, a smell of forthcoming rain, or roaming animals (Griffin 2016). This knowledge is functional and dynamic and has evolved over many generations and is characterized by observations, experimentation, and narration, and is low-cost in a situation where elaborate infrastructure, e.g., embankments, breaks down because of cyclones or floods. However, women contribute even when they achieve results highlighted in this long section, but are difficult to capture and include in formal resilience adaptation systems; hence, they cannot be used to address scalable and more equitable coastal resilience. To create community-based sustainable solutions through profound adaptation, it is also essential to acknowledge and increase the presence of women's indigenous wisdom to overcome the mentioned adaptation limitations of the Bangladesh coastline.

The focus of mainstream climate adaptation plans in Bangladesh focuses on technological and infrastructural solutions, including concrete embankments, desalination plants, or genetically modified seeds, over the local, place-based knowledge that women have shared and drawn upon to sustain coastal populations over centuries (Ayers et al. 2014). Such knowledge constitutes a variety of adaptive procedures: pest organic pesticides of neem paste or garlic water, purification of water using charcoal-sand filters or alum, and early warning procedures that depend on ecological factors, such as ants on the top of the house, or dogs barking early prior to storms. The practices play a crucial role in the survival of households in the resource-poor coastal areas where salinity, flooding, and cyclones wreak havoc with agriculture and access to water. But the norms of patriarchy and policy biases with regard to scientific and male-dominated solutions weaken the expertise of women to look at it as informal or secondary. As an example, the methods used by females to preserve seeds, like storing the seeds in clay containers with neem leaves, are never considered or factored into the agricultural extension activity that emphasizes the use of hybrid seeds. Likewise, community-based water management practices by women, such as the pond cleaning days, are not taken into consideration, and instead, infrastructure projects are proposed and implemented, which are expensive. Such exclusion not only feeds the inequities in gender but also, before and after climate stressors, women's labor and knowledge do not count, even though it has been proven that

they have been effective in countering stressors (Doss 2018). The inability to incorporate the indigenous practices of women into the frameworks of adaptation may mean a lost opportunity of establishing sustainable solutions driven by communities and environmentally and socially responsive to the challenges of extreme weather especially in areas where technological provision is not feasible or unavailable in the event of extreme weather occurrences.

Although there are global research findings highlighting the importance of indigenous knowledge in climate adaptation, little research has been found where research is on women's contributions towards adaptation in coastal Bangladesh, and more specifically on Manpura, Hatiya, and Shyamnagar. Available literatures tend to dwell more on male-dominated agricultural activities like growing rice on a large scale or raising shrimps or infrastructural plans like embankment and tube wells, neglecting the gendered and household-level approach that women take to cope with climatic stressors (Ria 2025). An example can be given where salinity-tolerant crops are being researched, such as BRRI Dhan 67, but the contribution of females in the selection, preservation, and sharing of the seeds, which are mostly in the form of glass jars with neem leaves to keep off pests, is not nearly documented. On the same note, most of the policy discussions fail to acknowledge water management by the community of women, including weekly pond cleaning days in Manpura or Lady-only ponds in Shyamnagar (Sultana 2009). The gap in knowledge is addressed by this research, which focuses on the voices of women, records their practices of adaptation in three ecologically different upazilas, and puts forward how they can adapt in relation to refining gender responsive climate policies. The research transcends gender-neutral adaptation discourses, policies, and the replacement of official expertise with technological solutions, which are disempowering to women because they overlook the agency of women in household farming, water management, and disaster preparedness. It believes in the incorporation of the indigenous knowledge of women into the national disaster risk reduction (DRR) and resource management systems that will increase their resilience and promote gender equity. The results give an example to other climate-sensitive areas, as women, by using their experience linking to the local territory and developed over decades, offer sustainable and low-cost solutions to the environmental challenges that are rather complicated.

To this effect, this paper will answer the following research questions:

1. What are the roles played by women in Manpura, Hatiya, and Shyamnagar in adopting local solutions in farming activities, water control, and disaster management to help deal with the consequences of climate change, i.e., salinity, floods, and cyclones, and how do they vary at sites?

2. What is the process of how it is carried/exchanged between generations and within communities, and how is it appropriated to living with increased difficulties of climate change in these upazilas, so as it will be relevant in the volatile changing environment?

2. Literature Review

2.1 Indigenous Knowledge and Climate Resilience

Indigenous knowledge is not only philosophies that have been passed on in an oral tradition about places, people, and experiences, through generations, but a foundation of climate resilience in vulnerable areas, such as in coastal Bangladesh (Chowdhooree 2019). This experience includes the anthropological ecological signals, that is, watching the birds fly, insects, or even the soil feeling when forecasting weather and resource management during environmental pressure. Women make judgments about soil salinity by inspecting the salinity between their fingers to choose crops such as BRRI Dhan 67, BINA Dhan 10 in Manpura, so as to make harvests even with salinization. They also utilize local flora, such as the mangrove leaves, as compost that strengthens the soils in Shyamnagar against the salt intrusion, to maintain agriculture in degraded terrains. In Hatiya, women resort to planting short-cycle crops (such as radish and spinach), which are timed to come into maturity because of late monsoons, in harmony with their seasonal movement. In global practice, indigenous knowledge has been successful in either adapting to changes in

the environment, whether it be drought-resistant agriculture in Sub-Saharan Africa or economic management of floods in Southeast Asia (Ajani, Mgbenka & Okeke, 2013). The knowledge is crucial in cases such as in Bangladesh, where salinity, tidal surges, and cyclones have disrupted wheat production, and wheat can be the only crop that produces returns. It is especially crucial in resource-limited coastal areas where formal infrastructures, such as embankment systems, frequently collapse during extreme weather. Particularities in the contributions of women need attention, but they are hardly ever captured, such as storing seeds in the clay pots with neem leaves, or the use of garlic water to control pest attacks, or crop-rotation as a means of minimizing stress on soil. To fill this gap, this research throws light on the ecological knowledge in women and its importance in the livelihood protection of the community and the provision of a community-based resilience idea.

2.2 Gendered Dimensions of Environmental Knowledge

Gender is considered an important source of influence in the creation, use, and acknowledgement of environmental knowledge (Hayes 2001), where the nature of women as nurturers, farmers, and water managers increases adaptive behavior to recognize household and communal needs. Women in Hatiya keep seeds in glass jars containing neem leaves to keep off pests, and this is an arrangement they have received through mother and grandmother training by hand. In Manpura, they filter pond water through charcoal-sand to clean it or put alum to clear it regularly, assuring safe drinking water in times of saline conditions when wells are polluted. Women in Shyamnagar bury clay pitchers outside the kitchen to ensure the water stays cool, a methodology that works halfway between convenience and culturally specific ideas of cool water. Such practices show the immense knowledge that women have regarding local environments, including the texture of the soil, water quality, and characteristics of plants, as well as resource limitations because women frequently have no access to land or to farming supplies (Mahour 2016). However, patriarchal values undermine such knowledge, which is discussed as unprofessional against some scientific or masculine way in terms of mechanized agrarian or infrastructural works (Shiva 1992). This exclusion has reduced access of women to resources, e.g., ownership of land or to get agricultural extension services, leaving them with no other choice other to take on cheap, native means of production, which is sustainable and productive. For instance, the ingenuity in undertaking the pest-control or cleaning of the community ponds by the women using neem-paste manifested itself in the circumstances of resource-weakness. The acknowledgment of women and their role in the environment helps to break such norms as the role of women as environmental stewards and supports the inclusion of women in the adaptation planning to ensure an equal opportunity and successful resilience strategies.

2.3 Women in Disaster Risk Reduction

According to Alam and Rahman (2018), women have key roles in disaster preparedness and response because of their ability to use their local knowledge to safeguard households and communities against cyclones, floods, and tidal waves. In Shyamnagar, women watch the ants crawling on the roofs and are alert to impending floods, a sight that they have years of experience to decipher their sprinting as an alarm. Before storms, they record the unusual smell and delicate saltiness of the heavy sea breeze in Manpura. In Hatiya, women report a reddish, heavy sky, something to fear as a sign of a cyclone about to come; it is feared because of the eerie color. These environmental indicators which are based on good observation, work with formal warning systems that can often be slow or unavailable due to distance. Preparedness plans are also important: women in Manpura have rope knottings on roofs with nylon ropes to resist cyclonic winds, and their hands can knot ropes easily (Alam 2010). They fill polythene bags with food and water by the door, and thus they have accessories available when evacuating during floods in Hatiya. Solar lights and tools are hung on ceilings by women to keep off the flood waters in Shyamnagar (Md et al. 2022); the light a silent in a night of storm. Such community undertakings are more effective in building resilience, such as in Hatiya, where women paint homes in chalk to signal to volunteers that whoever lives in the homes is either old or pregnant, so that volunteers can go and examine the individuals, the white streaks of chalk grating in contrast with the mud walls. In South Asia, women have roles in disaster risk reduction (DRR) that involve food storage, shelter preparedness, and evacuations; however, their activities

have been ignored for male-led disaster operations or the introduction of technologies such as early warning applications (Kumari & Shah, 2024). In Bangladesh, women's early warning systems and preparedness efforts are key but are not often formalized in DRR policies, and therefore, more attention should be paid to gender-responsive frameworks, which would appreciate their input and maximize their involvement.

2.4 Theoretical Frameworks

This research paper uses the following three theoretical approaches that situate the knowledge of the indigenous women: ecofeminism, political ecology, and decolonial environmentalism. Ecofeminism perceives the impending ecological destruction as having an opposition in the ways and practices by women (Plumwood 2004), e.g., nurturing of crops using neem paste, purification of water using charcoal, or the storage of seeds in a clay pot based on the nurture/care theme depicted by the women. These activities are indicators of symbiotic relationships with the environment, since women ensure people of water security because they develop life in salty soils. Political ecology studies the politics of access to resources and how female marginalization in land titles, agricultural extension practices, or policymaking contributes to their dependencies on less expensive indigenous techniques, such as seed saving or local pond cleaning (Mollett & Faria 2013). In this lens, the structural complexity that women must face to break resource limitations through ingenuity in the patriarchal system becomes visible. On the other hand, decolonial environmentalism is the critique of Westernized forms of adaptation, like expensive desalination plants or foreign hybrid seed delivery, and with the practices of women like floating seedbeds or compost with mangroves, localized, long-sustaining alternatives to colonial traditions of resource plundering and environmental scarcity (Roy & Hanaseck 2023). Collectively, these frameworks emphasize the reframing of women as knowledgeable, both practically and deviant, providing an example of a community-based, equitable resilience which challenges the rise of technocratic, dominant, climate discourses as well as proposing inclusive measures of adaptation to climate.

2.5 Bangladesh Coastal Studies

There is a lack of research on the Bangladesh coastline seeking solutions of an infrastructural nature, like the use of concrete embankments, deep tube wells, or desalination plants, rather than possible adjustments at household levels, especially the female-headed households. Armchair research of chars and Sundarbans emphasizes issues such as salinity, flooding, and cyclones; however, very little devotes time to gender-oriented behavior in particular upazilas such as Manpura, Hatiya, or Shyamnagar. An example of this is just when salinity-resistant type of crops is researched, females are not well established in selecting, saving, and even sharing of these crop seeds, mostly in tin boxes with the neem leaves. Equally, community-based water management by women, like cleaning the pond once a week in Manpura, women-only ponds in Shyamnagar are not discussed in most policy circles. This paper fills this gap by recording the coping mechanisms of women in these ecologically diverse upazilas, providing a middle ground between household and community-based assessment of resilience. The research concentrates on such activities as short-cycle crop growing in Hatiya, floating gardens in Shyamnagar, or early warning signs in Manpura, showing how women are making decisions to adapt to site-specific climatic issues, thus establishing grounds of gender-sensitive adaptation policies transferable to other coastal areas.

It focuses on the indigenous practice of women, thus enabling the academic knowledge of a gendered resilience approach to the coastal parts of Bangladesh, as opposed to neutral adaptation discourses that revolve around technological or male-centered adaptation methods. It brings to light the role women play in household farming, water management, and disaster preparedness, and traces out the roles played by women in various ecosystems of Manpura, Hatiya, and Shyamnagar in order to give a complete picture of resilience in different ecosystems. It is proposed in the study to incorporate the knowledge of women into national and local climate policy, as well as more equitable, effective, and sustainable adaptive strategies that would use women's expert knowledge to address the challenging issues in coastal environments.

3. Methodology

Following an interpretivist ethnography, this research is based on a qualitative study that aims to visualize the embodied, relational, and tacit knowledge of women in coastal Bangladesh through its focus on lived reality in negotiating climate change. To ensure the element of storytelling, focus group discussions (FGDs) were used as the main form of data collection, where situations were created so that the participants could narrate about their situation in their own words, a format that reinvented the collective culture of coastal life. Rich contextual accounts were inspired by open questions on farming, water management, and disaster preparedness and included relational information such as the smell of salinized soil, the feel of pots filled with water, or sounds of animals before a storm. This participatory approach was able to verify that the data was based on the perceptions of the participants, promoted the sense of authenticity and richness, and made the emotional and physical aspects of their practices visible. The focus on ensuring the voices of women are leading the study helped the researcher to find the subtle yet subtle tactics that keep households and communities alive at the center of one of the most vulnerable regions to climate change in the world.

3.1 Study Area

The research will cover three upazilas that are different in ecology and culture, possessing varying climate challenges that determine how women adapt to them:

- **Manpura (Bhola):** It is an erosion-prone, tidally susceptible, and salinized land with a mixed, fishing-based-cum-salt-tolerant agricultural livelihood. In the case of women here, they have these elevated seed beds to keep crops safe in case of a flood, straws and compost heaps on which they plant, keep their water tanks up so there is drinking water, and they go to these heavy 5-gallon containers in the hot sun sometimes. The remoteness of the island heightens the dependence on local knowledge since external resources usually become delayed when a storm occurs.
- **Hatiya (Noakhali):** Char lands developed by changes in the course of rivers, and this necessitates flexible agricultural activities to deal with erratic flooding. Women grow crops with a narrower cycle, such as radish and spinach, so that they will meet erratic monsoons, as their hands create seeds in muddy fields that are readjusted by rivers. They control communal cement tanks sponsored by NGOs whose surfaces are sparkling in the early morning when the women are scrubbing them with the assurance of water security in an active land.
- **Shyamnagar (Satkhira):** What once was surrounded by the Sundarbans (Sundarbans fringe), on the edge of salinity and also of waterlogging and frequent cyclones, and where stands the mangrove forest, a defense as well as a testimony of ecological vulnerability. Women invent floating gardens of bamboo and water hyacinth, intertwining fibrous plant materials into floating vegetable gardens that withstand floods and invent composted mangroves to add resilience to the soil using the salty breeze and the earthy aroma of compost. These environments offer a deep context for analyzing women-led adaptation, describing the variety of climate conditions and resilience capacity in coastal Bangladesh.

3.2 Participants

There were seven FGDs, each of which consisted of 8-10 women, and the number of participants was about 60 women. There was a variety of viewpoints and experiences through purposive sampling. It was ensured that the participants were stratified by age (20-35, 36-55, 56+) to consider the generational differences in knowledge and practice, as well as by livelihood (housewives, farmers, workers at NGOs and government, as well as others) to consider the different roles in resilience. Young women who tend to be less inhibited to experiment with crops such as okra brought such crops to the school gardens, and elders, bestowed with ancestral knowledge, shared ideas about seed preservation by using tin boxes with neem leaves or preserving water in clay pots. Women with diverse socio-economic backgrounds, including those

with less access to resources, were to be represented in the selection of the participants, a process guided by consultations with the communities based on the lived realities of the coastal.

3.3 Data Collection Tools

FGDs were guided by five theme topics with open-ended questions that tried to generate answers that are detailed, narrative, and supplemented with sensory and contextual data that may be set out to produce in-depth analyses:

- **Household Farming Decisions:** This was centered on seed choices, crop rotation, and control of pests based on salinity and flooding. Some of them are the use of BRRI Dhan 67 in salty soils; two-month crops in Manpura, or the use of neem paste to take care of the pests in Shyamnagar.
- **Water Management Strategies:** Water management schemes were discussed involving rainwater harvesting, filtering, and common maintenance pipes. Women narrated how they kept water in earthen pots covered with leaves of mango, and water passed through charcoal-sand filters like Manpura, or the cleaning women-only ponds in Shyamnagar.
- **Disaster Preparedness:** The participants were able to identify the environmental indicators, such as the appearance of ants on the rooftops in Shyamnagar or reddish sky in Hatiya, and safeguarding actions such as securing the roofs with nylon rope in Manpura or hanging utensils on the ceiling of a house in Shyamnagar.
- **Knowledge Transformation:** Intergenerational learning was also identified as an important theme: i.e., grandmothers educating the seed keeping in Shyamnagar and sharing common knowledge on women's groups in Manpura.
- **Adaptive Innovations:** Women described how they integrated old and new practices, such as floating seedbeds in Manpura, warning bell systems in Hatiya, or mangrove compost in Shyamnagar. The use of storytelling produced an image of a touching feel of saline soil under fingernails, the smell of neem paste, a splash of pond water during the halakhha cleaning process, or frogs screaming more strongly before the storms, adding the emotional touch and the cultural background to the information.

4. Findings

4.1 Household Farming Practices

In Manpura, Hatiya, and Shyamnagar, women use adaptive techniques on farms to address climate challenges such as salinity, flooding, and indifferent monsoons, a strategy that guarantees food security in low-resource environments where the traditional forms of farming are slowly becoming unsustainable. In Manpura, one of the participants said, "*We examine the state of the soil. When it is too salty, we take BRRI dhan 67 or BINA dhan 10*", describing how they rub it between the thumb and fingers and experience the gritty, moist soil, and then taste the salt on their lips to make planting choices. Women in Hatiya cultivate short-range products such as radish, spinach, and lentils to prevent late floods, and so they sow seeds at the right time in accordance with the avoidable monsoons, which change regularly, and their fingers were fast with the rearrangement of muddy fields whose countryside had been altered by river waters. Women in Shyamnagar raise ridge gourd and sponge gourd, which cling to trellises to avoid being washed away by floods; their green vine sprawls over ponds of silt, securing crops even when waters have taken everything.

Organic pest control forms a foundation of its practices and uses locally procured materials to guard the crops against destruction using scentless chemicals that are expensive. People in Manpura use ash and neem paste to keep insects at bay, and neem paste smells strongly; women cover touching shoots with the paste by spreading it on their bodies. In Hatiya, women revealed that they would spray garlic water over crops and mash the wild garlic cloves still and combine them with water in old tin cans that repulse insects. The ash made by burning coconut shells in Shyamnagar is provided by women; the sound of crushed

charred shells is drowned out by the smoke of burning. Another important tactic is crop rotation: in Shyamnagar, one of the participants said, "*We are rotating between shrimp and green leafy vegetables to minimize weaknesses in soil and restore the soil nutrients in salty conditions*". Local issues are captured by site-specific variation: In Manpura, they resort to salinity-tolerant rice varieties to overcome tidal surges, in Hatiya, their attention is to strike the optimum crop at the right time to avoid the riverine floods, and Shyamnagar resorts to shrimp cultivation as persistent salinization has made rice cultivation not worth pursuing.

There are additions of sensory details to such practices, which represent the embodied experience of women. The textures of salty earth beneath fingernails, the stench of neem paste with a field of ripples, the repetitive motions of planting seedlings in a muddy trench, and green vines that stretch upwards above the floodwater all depict that true sense of belonging to the land. These affordable, eco-friendly knowledges, which women have acquired through their own observations, testing, and experience, show how women were able to be strong and, most of all, survive such complicated environmental conditions. Engaging women with local ecosystems, such as salty soils in Manpura, shifting rivers in Hatiya, and cyclone-prone landscapes in Shyamnagar, makes the women the anchors to the food security of the households, which can be a model example of sustainable agriculture in the areas prone to climatic calamities.

4.2 Water Harvesting and Management

Women's innovation in water management is determined by the shortage of and high salinity of water, which makes it difficult to get potable water in high-salinity-prone localities where water sources like wells and ponds are mostly contaminated. At Manpura, rainfall is collected in clay pots lined with mango leaves. In order to cool the water, the women cover the pots with the leaves, then squeeze them closely to get out the stench associated with clay, and gently inhale the sweet scent of the mango leaves. Pond water is filtered with charcoal-sand (dashed on top of each other in old buckets, to capture sediment), and powdered alum is used when a water reserve is exhausted. They painstakingly mix muddy water until it clears, their hands shake-free even with the intensity of work. In Hatiya, women have shared cement tanks sponsored by NGOs that are smooth to the touch and shine like the sun when the women are scrubbing them in a communal cleaning process. In Shyamnagar, women bury clay pitchers outside kitchens to provide cool storage, dig small holes in order to keep water shaded, and, in order to keep mosquitoes away, dip banana stems that they use in the tanks so that with their rough texture, they break breeding.

Water management is characterized by community efforts which provide collective cores. The ponds in Shyamnagar are fenced, cleaned once a month, and the women scrub the algae off the sides and carry the trash away in woven baskets. In Manpura, women are in charge and have their pond cleaning days where each woman turns up and comes with an instrument such as a bamboo rake or a metal scoop to clean the pond, and their voices can be heard everywhere along the waterbody, and their toil and fun are heard. These shared activities are helpful not only to secure the water quality but also to develop the social communication among women who would share their stories and techniques during childbirth. Physicality of the tasks is emphasized by sensory details: the feel of the weight of water-filled pots on hips, and muddy banks of the pond spattered with water, the rhythm of scrubbing and hauling communal, and the feel of the cool clay against skin. A combination of personal innovativeness and cooperative effort has made these practices successful in water security in saline-prone areas, which represents the critical role of women in resource management and community resilience.

4.3 Disaster Readiness

Participants revealed that they depend on environmental clues and preparedness measures to reduce threats of cyclones, floods, and tidal surges and safeguard properties and neighborhoods in areas where formal warning systems are delayed or unavailable. A participant in Shyamnagar simply followed the running ants up the mud walls: "*When the ants climb to the roof toppers, it is sure that a flood is coming*". Before a thunderstorm, women sniff in Manpura a heavy, strange-smelling sea breeze, which is thick with salt and tension, and has the smell of an upcoming cyclone. In Hatiya, women define reddish, heavy sky as

a sign of a cyclone, and its eerie color shines on fields and houses. There are other clues like the barking dogs in Manpura, rowdy frogs in Shyamnagar, or quiet birds in Hatiya that marked the nature warning before the disaster.

Strategies of preparedness are useful and active responses that are most customized to the risks present in a particular upazila. Women in Manpura bind roofs using nylon ropes in order to resist the cyclonic winds, and their hands twist the ropes with ease as they knot the ropes, securing houses against tuning winds. In Hatiya, women stuff up the food and water in a polythene bag on the door to evacuate quickly since there is a need to get necessities in case of sudden floods. The solar lights and tools are being hung in the ceilings of Shyamnagar homes to fend off floods: the halo of up-lit houses is visible on turbulent nights, and the hardware hangs safely above inundating flood waters. It takes a community to be resilient: in Hatiya, women are chalking homes, so volunteers could check elderly or pregnant people inside, and the white streaks on mud walls are better seen in contrast. In Shyamnagar, the women open the cyclone shelters and make the bedding and first-aid boxes ready; their footsteps echo across the empty corridors as they wait to receive the evacuees.

Such plans are placed on local risks such as the tidal surges in Manpura, riverine flood in Hatiya, and the Cyclones in Shyamnagar, which is a wise combination of wisdom and action. The intensity of environmental awareness is emphasized with the senses: the silence of a watching storm in a black pond, the frenzied distress of barking of a dog in the silence of the night, the silence of an empty sky, the smell and the touch of knotting ropes, and the stuffing of bags. It is based on observation and experience practices, and they show that women play an essential role in disaster preparedness and, as a result, form a paradigm of community-based resilience that can supplement formal systems.

4.4 Knowledge Transmission Mechanisms

The learning at the intergenerational and community level helps the knowledge of women to persist, as they continue to face a rising climate crisis. An elderly participant in Shyamnagar said, "*My grandmother would teach me all about how to heal and safeguard plants, she would tell me about those times we used to sit under a neem tree with its leaves swaying in the breeze and she used to narrate such stories into seeds and pests in the open air*". In Manpura one of the women remarked: "*My mother taught me anything. I am now attempting to impart my knowledge to my granddaughter*", and her methods include such pearls as keeping the seeds in a pot of clay and river ash, and neem leaves so that the pots, with their cool surfaces, extend a visible connection to ancient knowledge. Community learning occurs with the help of informal methods: in Manpura, women talk about practices as they chat in the afternoons with the neighbours, and the sound of their voices can be mixed with the sound of cooking pots and the village activity. Ladies of Hatiya are non-formal learners who observe others to watch what other people do, they are very curious to know what others are doing and imitate what works: "When they attempt something, and it works well, then I do the same."

Education is also formal, and local practices are instilled into formal procedures. At Manpura, the health classes in schools train the purification of water as well as the modern aspects of hygiene, keeping the tradition and science together. Women exude friendliness in Shyamnagar and in their group knowledge-sharing circles every Friday afternoon. Women here are allowed to tell stories and talk together while drinking tea and share advice about floating gardens or pest control. learning is pegged on sensory memories: the aroma of buried seeds in clay pots, the feel of the earth between fingernails as we learn to plant, the laughter in group discussions, the shadow of a neem tree as we are told stories. Such systems are usually highly relational and informal, but serve to customize ancient traditions to new issues such as rising salinities or unpredictable rains, and guarantee stability through time. Transmission and storage of knowledge keep women in a living archive of adaptive strategies, which is crucial in the survival of coastal communities.

4.5 Hybrid Adaptive Innovations

Women implement a fusion of traditional and modern methods to deal with climate issues and demonstrate ingenuity in low-resource environments, as many solutions are not generally workable with traditional methods. At Manpura, there are floating seedbeds consisting of bamboo and water hyacinth (their buoyant frames floating on muddy waters as women cultivate vegetables such as chili or red amaranth), and they are used to shelter crops in times of floods. In Shyamnagar, women line up shrimp in high bamboo racks to avoid destruction in floods; the fish's briny smell scents the air as they shake them out under wire tents to flee flies. The old way of flood warning is renewed in Hatiya, where a warning bell system is marked by a clang, which recalls village walls all at once, with a mix of traditional sound and contemporary sensation.

Other inventions are the mangrove leaf compost by Shyamnagar to enhance the salt-resistant soil, and the salty taste of the leaves merges with the land and fertilizes the land. In Manpura, salt-testing strips enable women to test the pond water to consume it, a modern technology combined with old wisdom about the water resources. The crops in Hatiya are propagated in floating seedbeds made of coconut husk; the rough husk of the coconut keeps the plants fixed in place. Sari is also used by Shyamnagar women to filter the water when water filters are not available, the weaving of the material trapping sediment as they drip water through the sari. The practices which are usually forged in cooperation with women groups or even with the assistance of the civil society (NGOs) intersect the local knowledge with external means, providing expandable solutions. Smelling, tasting, seeing: the feel of water hyacinth between calloused hands, the squeal of a warning bell, and the smell of mangrove compost are all indications of the creativity of women. Such inventions indicate how women can integrate traditional knowledge into contemporary challenges of climate by providing state-sustainable and low-cost models of resilience, which may be reproduced across coastal territories.

5. Discussion

5.1 Integration with Theoretical Frameworks

Ecofeminists present the practices of women, like tending crops with neem paste, cleaning their water by using charcoal, or preserving the seeds in clay pots, as a response to environmental destruction, putting an emphasis on the affiliation between them and nature in taking care duties. These are practices of symbiosis with the environment where women produce life on saline soils, secure water, and safeguard families against calamities, all of which is an illustration of a holistic resilience. Political ecology has served to indicate high rates of marginalization risk to women in resource profile due to low access to land, exclusion on agro extension programs, or policy making under representation in the extent to which they become vulnerable to the aspects of utilizing low cost, indigenous responses of resource preservation, as in the case of seed storage, or community sustainable activities such as cleaning up of ponds. Women negotiate these systemic obstacles with resourcefulness, as women can only find solutions within the patriarchal systems and male-dominated systems. An alternative to the Western-centric model of adaptation is offered by decolonial environmentalism, which challenges the colonial history of resource extraction and environmental exploitation by locating locally sustainable, ecological alternatives to expensive desalination plants or imported hybrid seed in such practices as floating seedbeds or mats of mangrove roots turned into compost. Collectively, the frameworks highlight the knowledge of women as practical and combative and provide an example of resiliency that is both fair and based on the needs of the community, which challenges prevailing, technocratic notions of climate and supports the case of adaptation plans that embrace all residents.

5.2 Comparison with Regional Studies

The use of natural pest repellents such as neem paste, water, slippery garlic, or ash by women is similar to practices by women in coastal Indian communities, where they employ organic solutions so as to ward off pests in the resource-limited environment. However, the focus on community perspectives on water management, which Baidar later describes in Bangladesh, not in the top-down approach of water projects in Sri Lanka, although, according to (Baidar 2022), these latter projects far outnumber the community perspective-driven projects, has been unique, with pond cleaning by women in the town of Shyamnagar or weekly cleaning days in Manpura, Bangladesh. Intergenerational learning, manifested as in the case of the grandmother in Shyamnagar, or pass-on between mother and granddaughter, as in the case of Manpura, also makes this study distinctive. South Asian studies on how inter-generational learning is accomplished are usually absent because of immediate outcomes on adaptation. Such comparisons have shown how the role of Bangladeshi women and, in fact, their collective and relational perspective of resilience have helped combine individual ingenuity with community participation. Putting women's practices in the wider regional strategies, the study highlights the possibilities of women's practices in defining sustainable adaptation practices along the coasts of South Asia that are vulnerable to climate change.

5.3 Contributions to Feminist Political Ecology

The work contributes to feminist political ecology by representing women in the negotiation to create ways of adapting to climate change in a climate-neutral discourse that promotes the idea of a technological, or otherwise male-dominated, solution in the form of mechanized agriculture or massive infrastructure dedicated to such practices. It points out the ways in which women bring together the resilience of the household and the community in terms of being able to choose salt-tolerant seeds in Manpura and to organize water at the community level in Shyamnagar. The research promotes the active participation of women in policymaking by providing them with an example of gender-responsible adaptation, prioritizing tacit, embodied knowledge over technocratic ones. It also highlights the point where gender, environment, and power meet and shows how women overcome structural constraints (e.g., having no access to land or agricultural products) so as to come up with sustainable, community-based solutions, such as floating gardens or warning bell systems. The paper re-contextualizes the concept of resilience as a gendered process, where women played a central role in the development and construction of adaptive practices, which are, to an environmental and social extent, sustainable.

5.4 Policy Implications

Women's indigenous practices should be incorporated into national disaster risk reduction (DRR) and water management policies to make them more resilient and gender fair. As an example, to achieve water and food security in salty areas, it will be possible to facilitate activities aimed at cleaning ponds led by women or seed conservation activities with the invaluable local knowledge of women. The co-design of programs between NGOs and local councils and women should be increased where possible to scale up floating seedbed training in flood-prone Manpura or warning bells systems in Hatiya, among others, to give sustainable, low-cost solutions. The structural barriers also demand different policies that grant women access to resources, land title, or farm inputs to ensure that they are not dependent on informal ways of doing things, and they become stakeholders. Formal transmission of knowledge might be achieved through community-based training programs, by making sure that the younger generations know such practices as the use of neem to ward off pests, or rainwater harvesting using clay pots. These would enhance long-term resilience through institutionalizing women's knowledge, cooperation among communities, non-governmental organizations, and government agencies, resulting in all-inclusive and equity-based adaptation systems.

6. Conclusion

In Manpura, Hatiya, and Shyamnagar, women are utilizing local traditions to create climate resilience in one of the most vulnerable areas in the world: salinity-resistant farming, rainwater harvesting, preparation for disaster, passing of knowledge, and innovation of hybrid. Such preparations, adapting measures like using BRRI dhan 67 in saline soil, stash water in clay pots lined with mango leaves, watch ants atop rooftops to warn of flood, tell stories to preserve seeds, make floating seed beds using bamboo and water hyacinth, have become an important strategy of survival at the household and community levels. With long histories in the ecosystems they reside in, and generations of practice gleaned through trial and error, experiment and community, these practices provide sustainable and low-cost management of difficult climate pressures, including salinity, flooding, and cyclones. Their success can be seen in the fact that women are also flexible enough to integrate traditional knowledge and modern innovations, e.g. warning bell system or salt-testing strips to meet the growing challenges.

To increase their impact and make them sustainable, policymakers, NGOs, and local councils need to co-design resilience interventions (e.g., community-based water systems, seed banks, or training in floating garden methods) with women. These programmes would give women power as important stakeholders since they would be regarded as having the expertise that would lead to a successful adaptation. Further improvement of the contribution of women would eliminate structural barriers, including access to land or agricultural inputs, and decrease their dependence on informal practices, fostering gender equality. To assess the long-term effects and follow the development of practices in response to climate change, a longitudinal study could be carried out; a participatory action research could also be conducted to empower communities to solve their problems collectively; or to learn how to use technology to increase the knowledge of women, like mobile applications to get warning about the weather, or cheap sensors to measure the salinity of soils. With a focus on local practices of women, this paper lays the groundwork for fair and sustainable adaptation in coastal areas of Bangladesh. Although these teachings may be applicable in other climate-vulnerable areas across the globe, where local wisdom could help bridge the gap between environmental issues and a strong future.

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