



Policy Perspectives on Water Management for Resilient Agri-food Systems in Southwest Coastal Bangladesh

M. Mokhlesur Rahman and Mou Rani Sarker



Contents

Introduction	3
Context of study area	6
Analytical framework	8
Availability and water sources	8
Seasonality and water usability	9
Accessibility	10
Adaptability to changing food producing ecosystems	11
Coherency and system linkages	12
Status of national water-agri-food policies	13
Review of relevant national policies	14
Concluding Remarks	29
References	32

List of tables

1	Different fishing bans within the Sundarbans and adjoining waters	10
2	Status of policies in water and agri-food systems	13

List of figures

1	Water-related sectors and agrifood	4
2	Complex agri-food systems in Shyamnagar Upazila, Satkhira District	6
3	Policies around water-food systems under review	7
5	Universal systems linkages in water-agri-food functions	29

Disclaimer

This publication has been prepared as an output of the CGIAR Initiative on Asian Mega-Deltas and has been internally peer reviewed. Responsibility for the opinions expressed and any possible errors lies with the authors and not the institutions involved.

Introduction

Conventional food systems emphasize crops like cereals, vegetables, oilseeds, and spices, typically cultivated in cropland ecosystems. Beyond this, food is also sourced from wetlands, forests, hill slopes, and coastal-marine environments, both farmed and wild. In Bangladesh, each ecosystem has distinct ecological traits that determine the quantity, quality, and diversity of food it generates over time (Barois, et al., 2024). These ecosystems are inherently dynamic, undergoing seasonal biophysical changes that shape their food production capacity, diversity, and availability throughout the year.

Whether derived from farming or wild sources, food production is deeply influenced by seasonal water and climate variability (Backmore et al., 2021). For instance, saline-prone, freshwater-scarce coastal landscapes support saline-water shrimp farming during the dry season, while the wet monsoon transforms the same land into fertile ground for rice cultivation due to abundant rainfall and reduced salinity. Consequently, land user groups shift with the seasons, with shrimp farmers dominating in the dry months and crop farmers in the monsoon. This spatial and temporal variability in food production landscapes reflects seasonal changes in water quality, quantity, availability, and accessibility, which shape the types of food that can be produced. As the lifeline of food systems, water plays a pivotal role in enabling or limiting agri-food system functions, determining the types of food produced, and influencing overall yield performance across diverse bio-physical environments.

Access to reliable water is more than a matter of availability; it is essential for the effective functioning of agri-food systems (Ringler et al., 2022). However, climate change, growing sectoral demands for water, and upstream water withdrawals are creating significant uncertainty around the equitable distribution of water resources among user groups (Jamal, 2024). As a cornerstone of society, the agri-food system depends heavily on water resources and contributions from multiple sectors. The interconnected nature of water and agri-food systems, with their multi-sectoral dimensions (Figure 1), often poses coordination challenges (Irfanullah et al., 2023). While these systems have the potential to be mutually enabling, they are frequently hindered by competing interests and issues of territoriality (Saito-Jensen et al., 2010).

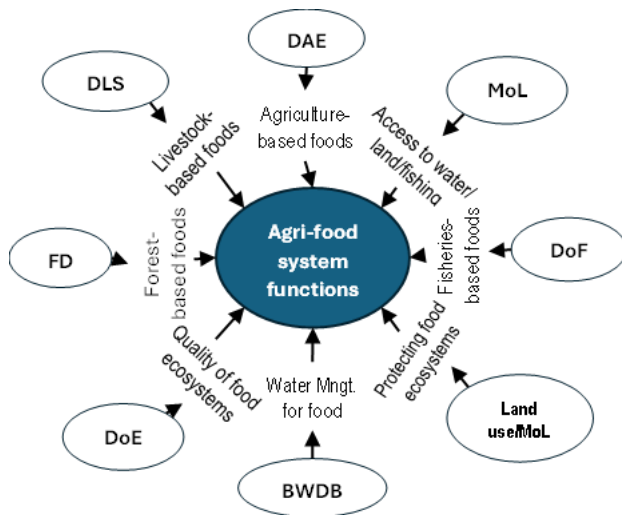


Figure 1: Water-related sectors and Agri-food

A key reason for the lack of coordination lies in sector-specific policies, as each sector operates within its own mandates, targets, and frameworks, fostering a siloed rather than integrated approach (Dewan et al., 2015). However, existing policies advocate for an Integrated Water Resources Management (IWRM) approach, designed to maximize collective outcomes through synergy. IWRM has the potential to bring diverse water-related agencies to the planning table, enabling rational and balanced allocation of scarce water resources across sectors. This approach prioritizes the needs of agri-food systems, which are highly water-dependent and vulnerable to changes in water availability and quality driven by both climatic and non-climatic factors.

Water management remains complex due to numerous social, policy, and institutional drivers (Cosgrove et al., 2015; Chan et al., 2016). A key challenge is the lack of understanding of the intricate social-ecological dynamics and weaknesses in policies that hinder collaboration among relevant sectors and stakeholders, including grassroots user communities. The protection, use, and management of canals as freshwater sources in saline-prone coastal areas exemplify such non-coordinated, maladaptive practices (Dewan 2021). These practices not only degrade canals but also exclude poor local communities from their customary water-use rights, effectively privatizing common-pool resources (CPRs), reducing fisheries biodiversity, and increasing food insecurity.

For instance, canals are often leased to a small group of wealthy individuals under the Ministry of Land's (MoL) wetland leasing policy, which negatively affects open water fisheries and aquatic biodiversity (contradicting fisheries and environmental policies).

Leaseholders frequently convert wetlands to alternative uses (violating land use, environmental, and Ecologically Critical Area [ECA] rules), obstruct water flow (contravening water policy), and disrupt agri-food systems (affecting agricultural policy). The unilateral decisions of the Upazila Jalmahal Committee on canal leasing often conflict with various other water-related policies. A coordinated, multi-sectoral approach to canal protection and restoration could align with multiple sectoral goals, supporting agri-food systems and enhancing ecosystem services.



Photo: "Fallow Land Following Aman Harvest in Munshigonj Union, Satkhira

Context of study area

In Southwest coastal areas in Bangladesh has a unique and dynamic ecosystem shaped by the confluence of freshwater rivers and saline tidal waters from the Bay of Bengal (Haq et al., 2024). This region encompasses a mosaic of ecosystems, including mangroves, estuaries, tidal wetlands, river channels, and coastal floodplains, with the Sundarbans, the largest contiguous mangrove forest in the world biodiversity (Iqbal, 2020; Guhathakurta, 2003). These ecosystems are biologically diverse and play a crucial role in supporting livelihoods, agriculture, fisheries, and coastal protection. The region is highly sensitive to environmental changes due to its low-lying topography, saline-prone soils, and susceptibility to cyclones, tidal surges, and sea level rise. The area supports diverse land use practices, including rice farming during monsoons and shrimp aquaculture in the dry season, highlighting its dependence on seasonal hydrological and climatic variability.

Figure 2 illustrates the complex, water-dependent agri-food systems of Munshigonj union in Shyamnagar Upazila, Satkhira District. These systems face ongoing challenges in securing adequate quality water for agriculture, fisheries, livestock, and forestry, all of which are critical to food production. Given the pivotal role of various state agencies and institutions in managing water resources, it is crucial to analyze sectoral policies to assess how they support or hinder the creation of a coherent and enabling policy environment. This environment must ensure the availability and accessibility of water, thereby contributing to the sustainability of food systems.

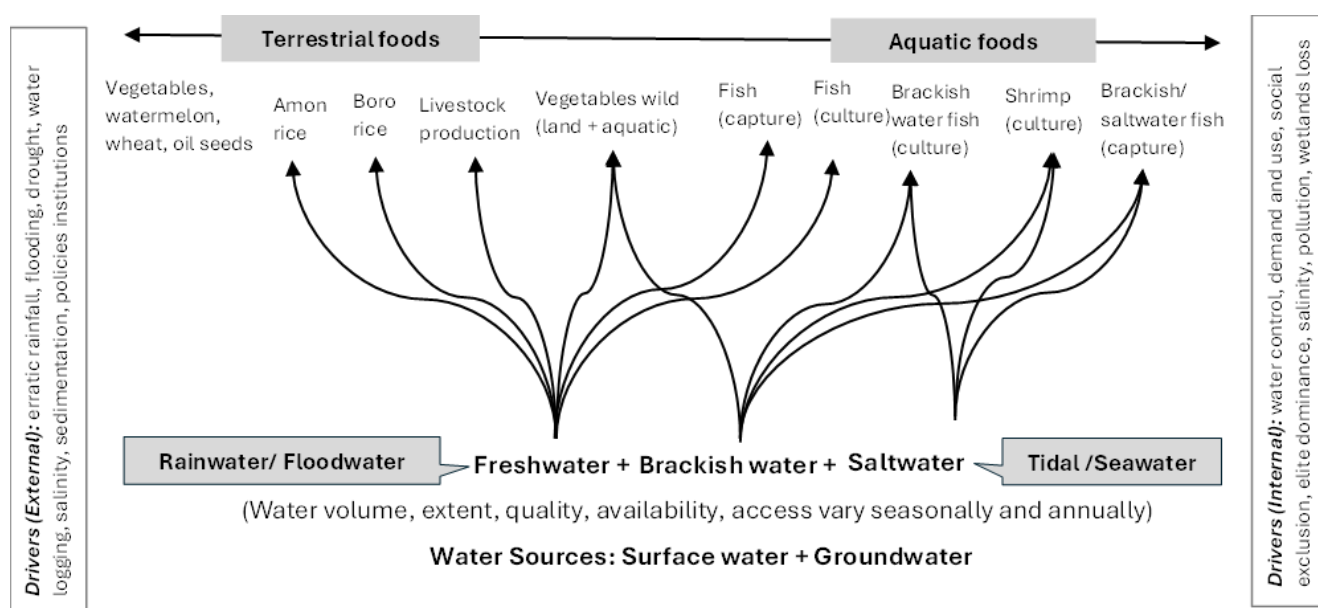


Figure 2: Complex agri-food systems in Shyamnagar Upazila, Satkhira District.

In this study, we reviewed 13 water-food sectoral policies (Figure 3). The major policies include National Water Policy 1999, Bangladesh Water Act 2013, National Fisheries Policy 2023, National Shrimp Policy 2014, National Livestock policy 2019, National Food & Nutrition Security Policy (2021-2030), National Agricultural Policy 2018. Apart from these policies, we also reviewed other supporting policies like National Adaptation Plan water (2023-2050), National Environment Policy 2018, Land Use Policy 2001, Jalmahal Policy 2009, Disaster Management Policy 2015, and Ecologically Critical Areas Management Rules 2016 which also influence water-food systems. All these policy instruments are analyzed to identify gaps and recommend actions for creating an enabling policy framework that supports the transformation of food systems in Bangladesh.

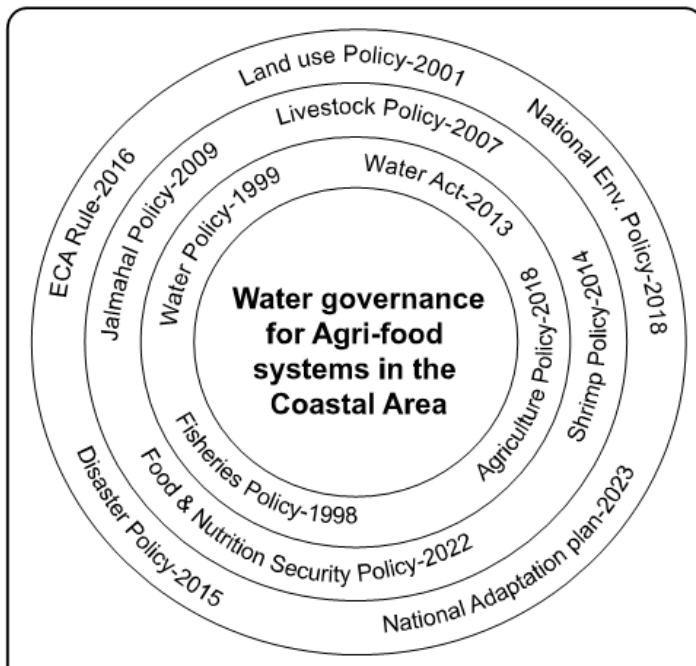


Figure 3: Policies around water-food systems under review.

Analytical framework

This review examines water and agrifood-related challenges in the Munshigonj union of Shyamnagar sub-district, Satkhira district, with a focus on the interconnectedness of water, agriculture, food systems, and governance. It examines how national policies govern water resources to address the needs of agri-food systems and local communities, including farmers, as well as inland and aquaculture farmers. The analysis emphasizes key issues such as: a) water availability and sources, b) seasonality of water systems, c) accessibility to water, d) adaptability of water systems, and e) policy coherence in supporting integrated water resource management.

a) Water availability and sources

Water availability is one dimension of water security, but equitable access to water by different users is a critical precondition for maximizing water-based productivity. Broadly, coastal Shyamnagar has two water sources: i) surface water and ii) groundwater. Surface waters include rivers, canals, mangrove forest waters, roadside ditches, seasonally flooded lands, and ponds. Most water systems are state-owned, controlled, and managed by different state agencies under sector-specific policy instruments.

An updated and accurate database of water bodies in various geographical settings is essential for effective planning and management of water-dependent resources. For example, water for winter, summer, and monsoon food production, fisheries, and livestock production. Water-related databases maintained by the Bangladesh Water Development Board (BWDB), Ministry of Land (MoL), and Department of Fisheries (DoF) are outdated and inaccurate, as water bodies have undergone changes over time due to various factors. Many wetlands, canals, roadside ditches, Charland, and tertiary rivers have been converted, silted, dried up. Therefore, developing resource management plans based on outdated and inaccurate datasets is not feasible. Notably, the agri-food system planning relies on the quality and quantity of freshwater available in any planning unit over the seasons of a year, more specifically, water availability in the winter and summer seasons.

Against this backdrop, we will review the related policies and determine i) whether they adequately focus on water body inventory by type and extent, ii) whether the policies are directed to updating water-body databases assorted by saline and freshwater, and iii)

management systems like leasing and open systems or under institutional management. However, water bodies change over seasons in their qualitative and quantitative features that influence agri-food systems.

b) Seasonality and water usability

The country has three cropping seasons: dry winter (Rabi season), hot summer with minimum rains (Kharil-1), and wet monsoon with high rains (Kharip-2). Seasonal water availability influences the food production functions (agriculture, aquaculture, fisheries, and livestock).

In the dry season, high water salinity dominates saltwater shrimp farming in ponds, facilitating crop land salinization. Low or no rainfall contributes to water scarcity in inland waterbodies (ponds, canals, creeks, shrimp ponds). It makes it challenging for farmers to grow crops as most of the canals retain rainwater (freshwater) and get dry in winter. However, ponds/canals act as freshwater storage to grow rabi crops (vegetables and boro rice) in limited areas; otherwise, vast cropland remains fallow in winter. The dry winter often triggers conflicts between shrimp and crop farmers on water use and salinity issues.

The summer comes with dry, warm weather with low rains following winter. This compels farmers to refrain from farming, except for a few that grow summer rice and vegetables with water sources (pond/ canal). This time, white fish aquaculture also suffers from water scarcity, and most farmers sell their socked fish and prepare for the next round of fish farming at the onset of the Monsoon. Shrimp farmers also harvest and prepare to start freshwater giant prawn (*gol da*) farming with white fish. Hence, summer is unsuitable for agriculture, and most cropland remains fallow. Then, the monsoon comes with rain, creating an enabling farming environment.

High monsoon rain dilutes soil and water salinity, creating a suitable environment for agri-food farming when farmers cultivate *amon* rice in nearly 100% of the cropland in Shyamnagar. Farmers also do pond aquaculture (white fish, crab, and gol da prawn), and fishermen catch fish in rivers, canals, and flooded lands. Some households store their ponds with rainwater for winter-season farming at the individual level, while people store rainwater in canals for winter-season farming at the community level.

With this backdrop, the review of whether the water and agri-food relevant policies i) have taken the seasonal dimensions of water availability that seriously affect agri-food systems

outcomes, ii) policies provide directives to create dry season freshwater provisions, ii) balanced use of scarce freshwater among the different users in the dry season, iii) winter crop diversification to reduce irrigation needs of crops, iv) conservation agriculture, v) unique farming systems for water scarce areas like coastal saline prone areas.

c) Accessibility

Although there are available water sources like rivers, canals, and creeks inside and adjacent to the Sundarbans in Shyamnagar upazila, people's access to water is restricted owing to different policies, power dynamics, elite dominance that intersect communities' rights of access to waters/ water resources. Farmers need freshwater during dry seasons but are constrained due to high salinity and scarce freshwater availability. Many state-owned closed or semi-closed canals could have been good sources of rainwater storage. Still, this option is slim due to canal leasing for aquaculture, conversions, encroachment, and elite dominance. Besides, access to fishing in rivers and open waters is constrained due to fishing bans imposed by the government (Table 1).

Table 1: Different fishing bans within the Sundarbans and adjoining waters.

Fishing bans within and adjacent to the Sundarbans	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3-month fishing ban in SRF												
2-month crab fishing bans within the entire SRF												
Year-round fishing ban in 6 dolphin sanctuary sites within SRF												
Year-round fishing ban in 3 World Heritage Sites within SRF												
Year-round fishing bans in 18 canals within SRF												
22-day fishing Mother Hilsa protection bans within SRF												
8-months Jatka protection bans within SRF												

Note: SRF= Sundarbans Reserved Forest

[Source: KII findings on water governance study, Dacope, Khulna by Rahman, M, July 2024]

Groundwater options are generally minimal for agri-food farming due to salinity. However, some areas of Shyamnagar have groundwater, either semi-saline or fresh water, suitable for food production. For example, the Harinagar area of Munshigonj union has a sweet water aquifer, but the land has been used for saltwater shrimp farming for a long time. They are unwilling to give off shrimp farming, even after having repeated violent conflicts between shrimp and rice farmers. The BWDB also controls some canals under some development projects. However, the upazila and district administrations often overrule the BWDB and provide lease water bodies through the Jalmahal Committees, which restrict access by the ordinary people.

Our review thus focuses on whether relevant policies have directives to ensure equitable access to water resources for agriculture and fishing by the farmers and fishermen, including land zoning that reduces conflicts among the different water users.

d) Adaptability to changing food producing ecosystems

Water availability, seasonality, accessibility, demands, etc., are dynamic and have changed over time due to climatic and anthropogenic drivers. Under the changing climatic systems, rainfall patterns are now different and unpredictable and vary each year (erratic rain). Prolonged pre-monsoon drought, rising temperatures, frequent cyclones, and tidal flooding are impacting water and food systems, making it difficult for nature-dependent occupational groups (farmers, fishers, and aquaculture). Besides, food-producing ecosystems have also undergone remarkable biophysical changes that have affected water systems. For example, many canals and lakes that used to be perennial a decade ago have now become seasonal or wholly lost; thus, their ecosystem services are either negligible or lost, with adverse impacts on agri-food systems. Social accessibility to water systems/ sources for agri-food production also becomes restricted due to leasing, elite capture, and conflicts. Thus, the policies may suggest exploring innovative and adaptive local management of water sources/ canals to support agri-food systems.

Considering the ground realities, we assess whether the relevant policies i) focus on adaptability to changing water-food-producing ecosystems, ii) provide directives to ensure equitable access to water by different users, iii) focus on improving and sustaining the agri-food systems in vulnerable coastal areas, iv) suggest exploring innovative and adaptive local management of water sources/ canals to support agri-food systems.

e) Coherency and system linkages

The food-producing ecosystems comprise multiple interlinked and interdependent resource systems (cropland, wetlands, forest etc.) that involve diverse users and agencies. A food production landscape is thus a complex multi-user system upon which different users and agencies have their stakes with defined roles and interests and influence the systems' functions. These interlinked food-producing ecosystems are mutually supportive in creating an environment that enables diverse food systems over the seasons. However, different agencies manage and operate these interlinked ecosystems under agency or sector-specific policies. Policies on land, water, agriculture, fisheries, shrimp farming, Jalmahal/wetlands, livestock, environment, climate change /NAP, and land use are relevant to water and influence agri-food systems governance. Since the food-producing ecosystems are inclusive of multi-resource systems, a coherent and aligned policy framework is needed to make synergistic planning to maximize overall food outcomes from each bio-physical setting, like coastal saline-prone areas.

With this backdrop, we will assess i) whether the policies recognize that agri-food systems are multiple resource systems, and that water needs and demands vary seasonally among different users, and ii) whether relevant policies are coherent and mutually inclusive to foster resilient agri-food production outcomes, iii) whether policies are Favor equitable access to water for food-system outcomes.

Status of national water-agri-food policies

Table 2 and Figure 3 present 13 national policies related to water and agri-food under review. Three of these are over 20 years old and require immediate updating, two are more than 15 years old, and three are moderately outdated and also need revision. Only five policies are recent and up to date.

Table 2: Status of policies in water and agri-food systems.

Sl	Policies	Year enacted	Age as of 2024	Remarks
1	National Water Policy	1999	25 years	Very old - needs urgent updating
2	Bangladesh Water Act	2013	11 years	Moderately old- needs updating
3	National Agriculture Policy	2018	06 years	New
4	National Fisheries Policy	1998	26 years	Very old - needs urgent updating
5	National Shrimp Policy	2014	10 years	Moderately old - needs updating
6	Bangladesh Jolmohal Policy	2009	15 years	Old -needs urgent updating
7	National Livestock policy	2007	17 years	Old - needs urgent updating
8	National Food & Nutrition Security Policy	2021	03 years	New
9	Ecologically Critical Area Management Rules	2016	08 years	Recent
10	National Environment Policy	2018	06 years	Recent
11	National disaster Policy	2015	09 years	Relatively new - needs updating
12	National Adaptation Plan	2023	01 year	New
13	National Land Use Policy	2001	23 years	Very old - needs urgent updating

Review of relevant national policies

National Water Policy 1999

The National Water Policy (NWP) 1999 in Bangladesh was developed as a comprehensive framework to address the challenges and optimize the management and development of the country's water resources. The NWP recognized that the ongoing water crisis is primarily due to i) weak institutional management, ii) inadequate regulatory tools, and iii) unsustainable practices.

The policy outlines six broad objectives to counter these issues and enhance water resource management through improved governance and sustainable practices. The policy emphasizes the need to safely develop and utilize groundwater and surface water resources to meet the country's domestic, agricultural, and industrial water demands, ensuring water security across different socio-economic levels. The NWP 1999 advocates for significant institutional changes to support decentralized water management. This includes enhancing the role and efficiency of the Water Resources Planning Organization (WARPO), though it notes WARPO's struggles with internal inefficiencies. WARPO is envisioned as a technical advisor to the Bangladesh Water Development Board (BWDB) and the Planning Commission.

Recognizing the critical role of gender inclusion in water resource management, the policy includes provisions to ensure women's participation in decision-making processes related to water management. The policy also suggests protecting the interests of low-income water users and women in water resource management. To this end, the policy encourages relevant public and private institutions to provide information and training to the local community organizations for managing water resources efficiently.

Despite its comprehensive approach, the NWP 1999 does not explicitly address climate change as a factor in water resource development. However, it acknowledges environmental vulnerabilities within various sections:

(a) Water and agriculture: Policies focus on improving water efficiency, particularly in irrigation, through drainage-water recycling, rotational irrigation, crop diversification, and adopting water-conserving crop technologies. These measures indirectly support climate resilience, though the policy does not address direct climatic anomalies.

(b) Water supply and sanitation: Recognizes the scarcity of available drinking water and proposes solutions like rainwater harvesting and conservation to improve water availability.

(c) Water for the environment: Policies aim to restore, conserve, protect, and preserve water resources through regulatory, planning, and management approaches. However, explicit integration of climate change into these themes is missing.

(d) Coastal areas- the policy focuses on upland river flows to preserve the coastal ecosystem threatened by salinity intrusion; it discourages filling state-owned water bodies to preserve natural aquifers and the environment, including protecting against degradation and resuscitate natural water bodies (rivers, lakes, ponds, canals, etc.), affected by man-made interventions or other causes; taking steps to remove encroachments on watercourses that cause obstructions to water flows and create ecological hazards.

Under the planning and management of water resources section, policy a) directs the development of water resources of the major rivers for multipurpose use viz. irrigation, fisheries, navigation, forestry, and aquatic wildlife, b) delineates water-stress areas based on land characteristics and water availability for managing dry season demand; c) suggests WARPO prepare and periodically update a National Water Management Plan (NWMP) addressing the overall resource management issues in each region and the whole of the country, providing directions for the short, intermediate, and long runs; d) the plan will be executed by different agencies as determined by the Government from time to time.

While robust in many respects, the NWP 1999 lacks explicit directives on how the suggested activities under planning and management of water resources will be executed. These demand a multi-agency coordinated approach, including the vital role of WARPO in getting relevant institutions onboard to execute the tasks. The policy also lacks clear directives to tackle emerging and future challenges, such as climate change impacts, which are critical for the sustainable management of water resources. There is also no dedicated section on the transformation of agri-food systems in water-stressed conditions, which is essential considering the integral role of water in agriculture and food production.

While the NWP 1999 laid a solid foundation for water resource management in Bangladesh, there is a pressing need to update its provisions to include climate change mitigation and adaptation strategies and more explicit measures for food security to ensure that water management strategies remain relevant and robust in the face of evolving environmental and socio-economic challenges.

Bangladesh Water Act 2013

This act is the most recent water-related legal instrument in Bangladesh. It incorporates the National Water Policy (NWP) 1999 and supersedes all previous water-related legislation. The government promulgated this Act, envisaging integrated surface-groundwater development and more robust water distribution and protection systems. The Act comprises seven chapters that address various aspects of water management, including rights to water for drinking, sanitation, sewage disposal, water control, and the conservation of water resources. It also details regulations concerning land ownership and the use of surface water and establishes that certain rights related to water use are non-transferable without permission from competent authorities. A significant feature of the Act is the establishment of the National Water Resources Council and the Water Executive Committee. These bodies are tasked with several responsibilities, such as promoting the NWP and National Water Resources planning, monitoring and evaluation, and ensuring water resource integration. They also focus on data exchange, joint international research, and training programs concerning water resource management, including developing guidelines for using international rivers.

Despite its broad scope, the Water Act 2013 has significant omissions. It fails to address non-point water pollution sources, such as fertilizers and pesticides, which were only briefly mentioned in the previous National Water Policy 1999. Furthermore, the Act does not capture elements of the National Policy for Safe Water Supply and Sanitation 1998, such as the commitment to ensuring drinking water for all, which aligns with international agreements. Additionally, women's participation in water resource management, emphasized in prior policies, is overlooked in this Act.

The Act also fails to specify the institution responsible for ensuring Environmental Quality Standards (EQS), creating ambiguity between the roles of the Water Resources Planning Organization (WARPO) and the Department of Environment (DoE). The financial

mechanisms for implementing the Act and the specific tasks and responsibilities of WARPO officers are not clearly defined.

Enforcement mechanisms such as compliance orders, protection orders, removal orders, imprisonment, and fines are mentioned; however, the Act lacks clear guidance on their implementation. There are also inconsistencies with judicial definitions, as seen in the differing interpretations of 'foreshore' by the Water Act 2013 and a 2009 High Court ruling. Additionally, the Act does not address crucial issues like land grabbing, river encroachment, or the establishment of treatment plants for industrial effluent. Moreover, it restricts legal actions against violators of the Act to those filed by the Director General of WARPO or their appointee, significantly limiting the ability of citizens and NGOs to initiate lawsuits. This centralizes enforcement power within the Executive Committee under the Ministry of Water Resources, potentially limiting public and non-governmental oversight.

While the Bangladesh Water Act 2013 establishes a framework for water resource management and policy implementation, it exhibits gaps in pollution control, public health, institutional clarity, enforcement mechanisms, and public participation, necessitating further revisions to address the complexities of water management in Bangladesh.

National Agriculture Policy 2018

National Agriculture Policy (NAP), first introduced in 1999 and later amended in 2013 and 2018, is designed to ensure food security and promote sustainable agricultural practices. Key objectives of the policy include increasing crop production and diversification, boosting farmer incomes, ensuring the provision of nutritious and safe food, and enhancing overall agricultural productivity. The NAP aims to modernize agriculture by integrating technology and research, improving resource management, and supporting farm mechanization. It also aims to enhance resilience against natural disasters through improved water management and agroforestry initiatives.

For coastal saline-prone areas, the NAP focused on using saline-tolerant crop varieties where traditional crop varieties cannot grow due to high soil and water salinity. It also aimed to bring fallow land under farming systems using appropriate technologies like

crop diversification and new varieties to increase food protection and income for farmers. It also focused on creating freshwater provisions and protecting crops jointly with communities by restoring canals and ditches, including planting trees to conserve rainwater water for farming. To address climate-induced increased droughts and salinity, excavating canals, ponds, and ditches to preserve rainwater and use drought-resistant crop varieties, including practicing sorjan methods of agriculture in water logging areas, is suggested. The policy recognizes the value of environment and sustainability suggests research on crop-water-fish-agro-forestry interlinkages to enhance farm productivity and, at the same time, environmental sustainability. It suggests increasing irrigation efficiency in areas where water shortage affects farming systems, including using piped irrigation systems to save water.

Despite these comprehensive goals, the NAP 2013 has faced criticisms for failing to address inevitable sector-specific tensions, notably the conflicts between landowners and shrimp farmers, including shrimp farmers versus rice farmers, regarding water use and salinity-related conflicts. This issue arises partly because while the policy allows farmers to install tube wells for small-scale groundwater withdrawal for irrigation, it lacks provisions for regulating larger-scale water usage, such as that required for shrimp cultivation. The policy delegates the responsibility of assessing requests and issuing licenses for installing tube wells to the Upazila Irrigation Committee (UIC) under the Ground Water Management Ordinance (GWMO) 1985. However, enforcing this procedure is often lax at the farm level, leading to unresolved disputes and management issues in water usage for agriculture versus aquaculture.

Thus, while the NAP has made significant strides in promoting sustainable agricultural practices and enhancing food security, more explicit guidelines and better enforcement mechanisms remain needed to address and resolve sector-specific challenges, particularly in regulating water use for diverse agricultural needs. It would help mitigate conflicts between crop farmers and shrimp cultivators, ensuring equitable and sustainable use of resources. The policy suggests having a separate strategy extension strategy for women. However, it did not elaborate on how this can be materialized.

National Fisheries Policy 1998

The Bangladesh National Fisheries Policy 1998 addresses significant gaps in managing and developing the nation's fisheries resources, which had yet to meet development projections due to various challenges. This policy articulates detailed management strategies across different sub-sectors of the fisheries industry, focusing significantly on sustainable practices and regulatory measures to ensure sustainable management of aquatic environments and fisheries biodiversity.

Section 6 of the policy (*Inland Open Water*) focuses on water governance. It bans the discharge of harmful wastes, toxic chemicals, and insecticides into water bodies and the use of harmful gear, which is detrimental to the sustainability of fisheries. The policy encourages active engagement between local fishermen and government bodies in policy implementation. It explicitly prohibits the catch of small-size *Hilsa* -Bangladesh's most commercially important and national fish.

Section 7 (*Inland Aquaculture*) directs the conversion of barren ponds to aquaculture practices and mandates the development of soil maps to guide the application of lime and manure, optimizing soil health for aquaculture. The Department of Fisheries and various NGOs share training and educational responsibilities, focusing on improving techniques and sustainability in inland aquaculture.

Section 8 (*Coastal Shrimp and Aquaculture*) underscores the importance of protecting sensitive habitats. Shrimp farming near mangrove forests and during breeding seasons is prohibited to prevent ecological disruptions. The section also calls for maintaining an environmental balance in shrimp production to balance economic benefits with ecological sustainability.

Section 9 (*Marine Fisheries*) introduces stringent controls on marine fishing practices. To protect aquatic ecosystems, it bans trawling in coastal waters and the harvesting of shrimp in breeding grounds and along migratory routes. Additionally, it limits the expansion of the trawler fleet, a measure aimed at preventing overfishing and promoting sustainable fishing practices across the nation's marine environments.

The policy intended to enhance fisheries production while emphasizing ecological sustainability, faces multiple implementation challenges that undermine its effectiveness. The policy struggles with indiscriminate fishing practices and overexploitation, exacerbated by local political and economic influences prioritizing short-term profits over

sustainable resource use. It has led to declining yields, biodiversity, and habitat destruction, particularly in the *Jalmahal* areas.

A lack of coordination among government departments, including those managing state-owned wetlands and the Sundarbans wetlands, results in ineffective management and conservation efforts. The empowered authorities often have conflicting interests, leading to inefficiencies and neglect of responsibilities. The policy needs a clear strategy for implementing community-based fisheries management. It needs to sufficiently involve local fisherfolk in management decisions, missing opportunities for more sustainable and inclusive resource management.

Short-term leasing arrangements discourage conservation efforts by leaseholders, and the policy needs to adequately protect essential habitats such as spawning grounds or effectively manage marine protected areas. The policy and associated strategies need updating and often fail to incorporate modern conservation needs such as climate change and biodiversity protection. The policy disproportionately focuses on a few economically significant species like *Hilsa* and black tiger shrimp, which can skew broader management focus and neglect other species as contributors to maintaining aquatic ecosystems. More stringent penalties for water pollution and adequate enforcement of existing regulations must be enacted. Additionally, many officials need more technical expertise to manage fisheries sustainably, further hampered by a leasing policy recognizing fisheries as living renewable resources.

National Shrimp Policy 2014

The National Shrimp Policy 2014 represents a significant step towards more sustainable and responsible shrimp farming practices. The policy focuses on promoting economic growth and protecting ecological health by recognizing the potential environmental impacts of shrimp farming in coastal regions. By involving private investment, the policy aims to modernize and enhance the efficiency of the shrimp farming industry to boost productivity by adopting advanced technologies that are economically viable and environmentally sound. A critical element of the policy is the outright prohibition of mangrove destruction, which is vital for coastal green protection of coastal-marine biodiversity and natural water filtration systems, including supporting the livelihoods of poor households.

The policy includes strict measures to prohibit the illegal introduction of saline water into freshwater systems, which can lead to significant ecological damage and negatively affect freshwater habitats and agriculture, white fish farming, and livestock. It encourages integrated shrimp farming with agriculture, helps protect biodiversity, promotes better use of land and water resources, and reduces the risk of environmental degradation. This practice not only helps enhance farm yield but also creates jobs and reduces poverty, offering hope for the social benefits of the policy.

By establishing limits on shrimp farming ponds, the policy aims to prevent excessive concentration of shrimp farms, which can lead to severe environmental impacts, including water pollution and alteration of ecosystems. The policy underlines the importance of the shrimp industry to the national economy through exports and its role in nutrition fulfillment for national and global markets. By promoting sustainable practices, the policy not only supports the long-term viability of the shrimp sector but also reassures the audience about the industry's future as a valuable economic resource.

While the policy introduces significant measures toward sustainable shrimp farming, it faces several criticisms, including enforcement challenges due to weak monitoring and regulatory frameworks that could allow continued illegal practices such as mangrove destruction, salinization of cropland, and safe farm effluent management. The policy emphasizes semi-intensive methods, and private investment might marginalize small-scale farmers who need more resources to upgrade their practices, potentially leading to economic viability issues for these stakeholders. It suggests making land zoning for shrimp and rice farming to improve the local environment, balance water management, co-production of shrimps and agriculture, and reduce social conflicts. The land zoning policy, however, has yet to be implemented at the field level for various socio-political reasons. The policy also has overlooked thorough ecological assessments - pollution from antibiotics and farm effluents still needs to be addressed. The policy needs to adequately address the adaptability of shrimp farming practices to the impacts of climate change, which is critical for ensuring the industry's long-term sustainability to environmental changes.

Government Jalmahal Management Policy 2009

The Jalmahal Management Policy 2009 aims to promote the socio-economic development of poor fishing communities by allocating state-owned wetlands (Jalmahals) to fishers' cooperatives. It focuses on benefiting the 'real fishers' by transferring the fishing rights to them.

Despite these provisions, the policy has several critical shortcomings that undermine its effectiveness:

a) Politicization and conflicts: Including local lawmakers and Upazila Chairmen as advisers in the management committees has introduced a potential for politicization and conflict. This arrangement could divert the focus of the policy away from its primary beneficiaries—the fishermen—and instead serve political interests.

b) Inadequate protection for fishermen: There is a significant gap in protecting genuine fishermen from exploitation by intermediaries during leasing processes—administrators dominate the management committees. Deputy Commissioner (DC) at the district level and UNO at the upazila level may not necessarily represent the best interests of the fishermen, which continues to leave them vulnerable to exploitation.

c) Ambiguous definitions and exclusivity: The policy fails to adequately define what constitutes a 'fisher,' which is crucial in a rural context where most families own fishing gear and do fishing, especially during the monsoon months. This broad definition can dilute the effectiveness of the policy by potentially including non-fishers, thus not accurately targeting the intended beneficiaries.

d) Financial Barriers: The financial requirements for leasing *Jalmahals* are prohibitively high for poor fishermen, and there are provisions for annual increases in lease values, which in most cases are unaffordable for poor fishers, thereby excluding them, which the policy aims to support.

e) Environmental considerations: The policy does not provide clear directives on environmental protection and sustainable management of the *Jalmahals*. Thus, the leaseholder practices unsustainable and ecologically damaging means of fishing. Without directives that guide sustainable fisheries management, the policy misses an opportunity to promote the sustainability of wetland ecosystems and biodiversity.

To address these issues, revisions to the Jalmahal Management Policy should consider more explicit definitions of eligibility to ensure that only genuine fishers' benefit, reduction of financial barriers to allow poorer fishermen to participate, and inclusion of stringent measures for environmental conservation. Additionally, reducing political influence in management decisions and focusing more on community-led fisheries governance could enhance the policy's effectiveness and fairness, ultimately contributing to achieving its intended goals of uplifting the socio-economic conditions of fishermen communities.

National Livestock Development Policy 2007

The National Livestock Development Policy (NLDP) 2007 outlines ten critical policy areas to advance Bangladesh's livestock sector. These areas include dairy development and meat production, poultry development, veterinary services and animal health, feeds and fodder management, breeds development, hides and skins, marketing of livestock products, international trade management, access to credit and insurance, and institutional development for research and extension. Each of these areas is essential for the sustainable growth and development of the livestock industry, addressing various aspects from production and health to marketing and trade facilitation.

The NLDP 2007 does not explicitly include provisions or directives related to water management within the livestock sector, especially in areas exposed to high soil and water salinity, freshwater scarcity, and scarcity of grazing land, such as in the coastal region. Similarly, the NLDP 2007 does not explicitly outline provisions related to the broader agri-food system where livestock is part. However, under the section Dairy Development and Meat Production, the policy acknowledges the significant role of dairy animals in enhancing household food security, particularly for low-income groups. By improving income and nutrition levels, dairy animals strengthen food security at the household level. This recognition highlights the importance of dairy development initiatives for economic growth, addressing nutritional needs, and promoting food security among vulnerable populations. The policy, however, did not adequately focus on climate change threats to livestock, particularly in saline-prone coastal areas.

National Food and Nutrition Security Policy 2021

Bangladesh has launched a decade-long National Food and Nutrition Security Policy (NFNSP) aligned with the Sustainable Development Goals (SDGs) on food and nutritional security. The NFNSP is to meet both domestic and international commitments. This commitment underscores Bangladesh's comprehensive approach to addressing food and nutrition challenges. The recently unveiled Plan of Action outlines specific targets from 2021 to 2030, marking a crucial milestone in the nation's journey to bolster food security and enhance nutritional outcomes for its population.

The NFNSP 2021-2030 emphasizes the need for improved water management practices, recognizing the importance of water efficiency and conservation. Under Area of Intervention (Aoi) 1.1.3, the action agenda focuses on expanding and promoting water-efficient and environmentally friendly irrigation technologies, including surface irrigation. It involves increasing surface water usage, enhancing water conservation, and facilitating access to sustainable irrigation technology. Additionally, under Aoi 1.1.5, efforts are directed towards improving access to land and waterbodies while ensuring their efficient use to enhance input efficiency for productivity gains and environmental protection.

Moreover, Aoi 4.2.1 aims to increase the resilience of agricultural systems through climate-smart technologies and stress-tolerant crop varieties, with a specific action agenda focusing on adopting measures and infrastructure to enhance water management. Finally, under Aoi 5.4.3, which seeks to develop climate-resilient food systems, an action agenda is dedicated to developing water modeling to understand better and address water-related challenges within food systems.

National Land Use Policy 2001

The National Land Use Policy (NLUP) 2001 is an important policy document concerning land use in Bangladesh. The main objectives of NLUP 2001 are to ensure criteria-based uses of land and to provide guidelines for the usage of land for agriculture (crop production, fish cultivation, and rearing of ducks and chickens), housing, afforestation, commercial and industrial establishments, rail and highway and tea and rubber gardens. This policy mainly identifies land use limitations and management of the country's limited land resources. The policy sets guidelines for improved land use and zoning regulations.

The policy also recognizes the importance of wetlands and suggests not creating any obstacles to fish movements and blocking water flows to wetlands that are important to fisheries.

The policy, however, does not suggest any special measures to establish wetland sanctuaries and ECAs of wetlands and protected areas of ecologically rich and sensitive areas or biodiversity hotspots, including protecting canals and riverside mangroves on the coast. Although it says land zoning for setting up industries, the potential risk of industrialization all over the country, and more so in the coastal area to sensitive natural ecosystems (World Heritage site, Ramsar site, ECAs, forest PAs), is found missing in the policy. The policy suggested initiating fish culture in open waters, which is detrimental to the sustainability of natural capture fisheries production and biodiversity and must be discouraged (9.1). The policy also ignores the need to preserve or allocate water for nature or wildlife. Although the policy suggested special measures for saline-prone freshwater-scarce coastal areas, it needs more focus on protecting and restoring canals to preserve freshwater for agri-food production and inland fisheries biodiversity. The policy also ignores the importance of delineating mangroves that naturally grow in Charland, which are exposed to conversions, grabbing, and degradation and need urgent protection and sustainable management measures.

The Ministry of Land issued the policy, but the government needs help with implementation, partly ascribed to the dispersion of land administration authority among many different ministries. Moreover, other cross-sectoral policies have not been harmonized in the NLUP 2001, which also creates problems for the successful implementation of the policy. There is hardly any reflection of the execution of the policy on the ground.

Disaster Management Policy 2015

The National Disaster Management Policy 2015 defines the national perspective on disaster risk reduction and emergency management and describes Bangladesh's strategic framework and national principles of disaster management. However, this Policy also suggests conserving, protecting, and managing water resources to attain food security for the country's vulnerable people. These include a) restoring rivers and canals from encroachers/ grabbers to protect crops and settlements from heavy rains and

flooding. This will increase waterbodies' capacity to store flood or rainwater, which farmers can use to produce food in the dry season; b) Rehabilitate water bodies, encourage local people to store water to protect crops from drought, and irrigate crops in the dry season (canals, rivers, ponds, and canals along flood control dikes); c) it also encourages people to create rainwater reserves and manage drought based on indigenous knowledge and practices. In coastal saline-prone areas, storing rainwater in restored waterbodies will help diversify crops in winter to ensure food and income security and dietary diversity; d) suggesting enforcing legal actions against converting cropland to shrimp farms – which will help protect cropland under severe reduction threats; e) developing saline-tolerant rice and other crops and disseminate the technology widely in saline-prone areas to ensure food security and crop diversity in highly saline-prone coastal regions. The policy suggests developing tidal water and salinity forecast systems to benefit farmers who can make effective farming plans. Finally, it focused on building farmers' adaptive capacity to adapt to climate-induced risks and stressors through adaptive management of water resources and practices of less water-demanding crops.

One crucial aspect that the Policy did not highlight is the pivotal role of local communities in managing waterbodies. Under a community-based management system, with the inclusion of women and social diversity, these water bodies can be effectively preserved and utilized.

National Adaptation Plan of Bangladesh 2023

Bangladesh's National Adaptation Plan (NAP) (2023-2050) aims to adopt and implement long-term integrated adaptation activities to combat climate change and build resilience. The Plan targets eight sectors and thematic issues, with water resources as the top priority.

The NAP (2023-2050) prioritizes water, land, and sediment management as critical areas for adaptation. Measures include rehabilitating polders, managing internal drainage, and ensuring quality polder construction. The NAP emphasizes green belt development, co-management committees, and rainwater harvesting. Other measures involve ecosystem-based adaptation, early warning systems, and river dredging. Suggestions include groundwater management, eco-engineered flood control, and sustainable erosion

protection. Coordination with the Bangladesh Delta Plan 2100 and climate adaptation projects is stressed and recommended initiatives like poverty reduction funds, gender-sensitive livelihood programs, and youth-led disaster management. It also highlights transboundary cooperation, participatory water management, and climate-sensitive land zoning. Scaling up these measures, alongside resilient infrastructure development, is essential for climate-resilient water management.

The NAP allocates significant resources to 21 water resource management interventions (WRM), totaling BDT 10,383 billion. These interventions include coastal protection, freshwater management, early warning systems, rainwater harvesting, dredging of rivers, and drought management. The aim is to enhance resilience against climate change-induced hazards like cyclones, flooding, erosion, and drought, ensuring sustainable water resource management and safeguarding communities and infrastructure. The WRM plan encompasses various activities to enhance resilience against climate-induced water-induced hazards in Bangladesh. Relevant WRM activities include:

- Repairing and constructing coastal polders and sea dikes.
- Monitoring and managing freshwater resources to reduce vulnerabilities in salinity-prone areas.
- Protecting vulnerable regions from tropical cyclones and flooding.
- Strengthening early warning and dissemination services.
- Implementing community-based rainwater harvesting.
- Dredging major rivers for smooth drainage during extreme events.
- Constructing and rehabilitating flood and drainage measures with eco-engineering solutions.

Other activities include internal drainage management in char and island areas, protection against flash floods and erosion, sustainable shoreline erosion management, reclamation and development of lands for afforestation and settlements, river management through bank stabilization, ecosystem-based sediment management, drought management measures, participatory land and water resources management, transboundary river basin management, and remodeling of water-regulating structures considering climate change scenarios.

National Environment Policy 2018

The national environment policy envisages environmental conservation, pollution control, biodiversity conservation, and mitigation of the adverse effects of climate change to ensure sustainable development. The policy paid adequate attention to different sectoral policies. It highlighted the application of this policy coherently with other sectoral policies to make the intended transformation in the country's overall environmental resources. Regarding the agri-food systems environment, it recognized the importance of conserving and protecting common pool resources (CPRs) like forests, rivers, canals, wetlands, haors, oxbow lakes, and ponds to benefit ecosystems and local communities. It thus suggested that the CPRs not be changed to other land uses.

Regarding water issues, it emphasized the rehabilitation of degraded wetlands (rivers, canals, beels) to increase water retention capacity. It restricted other uses of degraded wetlands rather than emphasizing rehabilitation to serve as wetland ecosystems. It also restricts the alternation of water flows of watercourses while implementing other development programs such as irrigation, road, and embankment construction. The policy directs measures to control flooding, preserve rain/flood water, and adopt sustainable development and management of water resources, including efforts to increase the capacity of water bodies to reserve water for dry season use through rehabilitation and maintain certain water levels in the dry season. It recommends re-establishing connectivity between wetlands where disconnected due to various natural and anthropogenic causes to increase aquatic biodiversity and services. The policy also emphasized developing a database by conducting surveys of rivers and water bodies and GIS mapping of rivers and water bodies indicating their locations and areas.

The policy also recognized fisheries as vital and suggested state-owned wetlands within and near protected areas. The rule discourages leasing of wetlands within ECAs, instead adopting community-based or co-management systems. It reiterates prioritizing fishing rights for poor local people in open water systems (rivers, canals, beels, flooded land), restoring degraded wetlands, and declaring them protected areas. It discourages the reduction of wetlands or dried out every year to catch fish. It also recognized the importance of land zoning for coastal shrimp farming areas to avoid environmental degradation and recurrent conflicts with crop farmers. It highlights protecting wildlife and biodiversity through proper research, protection, and management of their habitats.

This comprehensive policy incorporates climate change issues and focuses on allied agencies collaborating in the environmental sector. Still, appropriate mechanisms are needed to develop a synergistic approach to addressing multisectoral ecological issues and concerns, including the transformation of agri-food systems.

Ecologically Critical Areas Management Rules 2016

The Ministry of Environment, Forest and Climate Change (MoEFCC) intended to restore and better manage some ecosystems exposed to and affected by anthropogenic and natural disturbances. These ecosystems are likely to be severely degraded and about to lose their ability to provide ecosystem services. The MoEFCC has declared 13 biodiversity-rich areas as Ecologically Critical Areas (ECAs) under the Environment Conservation Act in 1999. The Sundarbans catchment area is one such ECA located outside the Sundarbans Reserved Forest, 10 km extended landward, threatened mainly due to human activities. The government of Bangladesh approved the ECA Management Rule in 2016, which aimed to facilitate improved management of ECAs in the country. For the enhanced management of ECAs, the Ministry proposes to form several management committees at different levels, starting from the ECA site and moving to a union, upazila, district, and central ECA management committee.

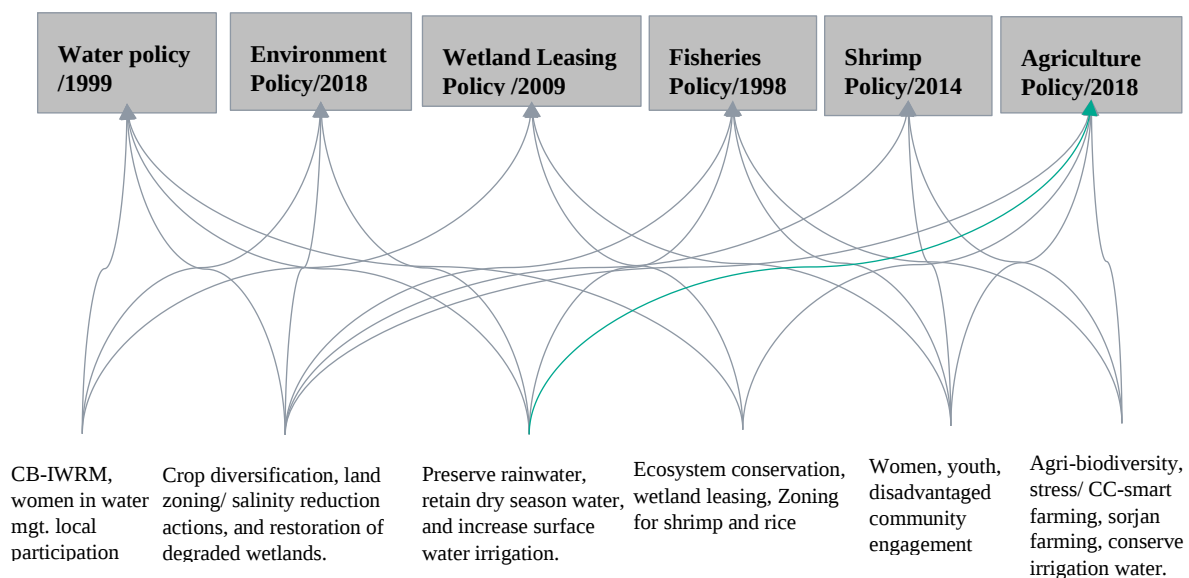


Figure 4: Universal systems linkages in water-agri-food functions.

The Rule recognizes the importance of local communities' dependence on natural resources and suggests provisioning alternative livelihood options for people affected by decisions that affect community livelihoods, like fishing bans in the area. The Rule also suggests legal action against the person (s) conducting illegal activities within the ECA, viz., conversion of wetlands/ canals, etc. The Rule suggests taking measures to resolve conflicts between social-occupational groups regarding using any resources, viz. To protect natural ecosystems, the Rule restricts activities that have negative impacts on ecosystems and biodiversity, viz. forest, mangroves, fisheries, wetlands, canals, aquatic sanctuaries, coastal habitats, and other activities that pose threats to coastal ecosystems, viz. clearing of mangroves in char lands, obstructing water flows, etc.

Despite mentioning all conservation-enabling activities for the benefit of ecosystems and local communities, the Rule ignores the impacts of climate change on ECAs and lacks coordination mechanisms among the relevant agencies mandated for providing services to agriculture, fisheries, water, and forests, which may challenge achieving the ECA management outcomes.

Concluding Remarks

Water-food systems are multiple resource systems managed and operated by different state agencies under their sectoral policies. Hence, the relevant agencies must consider the integrated nature of water and food systems and the interdependencies of natural food-producing ecosystems. It is essential and urgent to harmonize water-food-related policies and create an enabling working environment to achieve positive outcomes while maintaining ecological integrity by adopting nature-based solution (NbS) approaches. Figure 4 shows how the water-food systems are dependent on and relevant to six sectors, and there is a need to align the policies toward supporting the food system transformations.

Key policy influencing actions:

- Co-create advocacy issues through inclusive “situational analysis” and audience mapping and engagement of local user groups, including women and social diversities.
- Strong advocacy for sub-district, district, and national policy stakeholders. Facilitate regular dialogues at local and national levels to advocate for necessary changes.
- Making allies and creating waves (capacity bridging and movement building) to influence local actors.
- Crop zoning and land use planning. Considering the increasing demand for food production, promoting optimum land use and its conservation for higher productivity and output is essential.
- Cancellation of leased canals, rehabilitate them to create freshwater provisions, and provide management rights to local communities for use.
- Instead of privatizing common pool resources (CPRs), integrate them into community-based co-management systems to benefit both society and the environment.
- Older policies overlook climate change concerns, which must be incorporated, and each policy should also address pandemic management issues.
- Need to work at both ends - with the communities/constituents at the local level and with national policy stakeholders to bring intended change in policy landscapes.

Reference

- Barois, Z.O., Hasan, M.M., Ahmed, F., Rozario, S.R., Islam, M.A., Kazal, M.M.H., Shaheen, N., & Dengerink, J. (2024). An Overview of the Bangladesh Food System: Outcomes, Drivers & Activities. Foresight4Food. Oxford.
- Blackmore, I., Rivera, C., Waters, W. F., Iannotti, L., & Lesorogol, C. (2021). The impact of seasonality and climate variability on livelihood security in the Ecuadorian Andes. *Climate Risk Management*, 32, 100279.
- Chan, N. W., Roy, R., & Chaffin, B. C. (2016). Water governance in Bangladesh: An evaluation of institutional and political context. *Water*, 8(9), 403.
- Cosgrove, W. J., & Loucks, D. P. (2015). Water management: Current and future challenges and research directions. *Water Resources Research*, 51(6), 4823-4839.
- Dewan, C. (2021). *Misreading the Bengal delta: Climate change, development, and livelihoods in coastal Bangladesh* (p. 240). University of Washington Press.
- Dewan, C., Mukherji, A., & Buisson, M. C. (2015). Evolution of water management in coastal Bangladesh: from temporary earthen embankments to depoliticized community-managed polders. *Water International*, 40(3), 401-416.
- Guhathakurta, M. (2003). Globalization, Class and Gender Relations: The Shrimp Industry in Southwestern Bangladesh. *Globalization, Environmental Crisis, and Social Change in Bangladesh*, 295-308.
- Haq, M. I., Shamsudduha, M., Zahid, A., Ahmed, K. M., Kamal, A. M., & Taylor, R. G. (2024). What drives changes in surface water salinity in coastal Bangladesh?. *Frontiers in Water*, 6, 1220540.
- Iqbal, M. M., Abid, I., Hussain, S., Shahzad, N., Waqas, M. S., & Iqbal, M. J. (2020). The effects of regional climatic conditions on the spread of COVID-19 at a global scale. *Science of the Total Environment*, 739, 140101.
- Irfanullah, H., Asaduzzaman, M., Joshi, D., Garrett, J., Aheeyar, M., Dikkumbura, S., Rahman, M. M., Islam, M. A. (2023). Towards inclusive governance for resilient agri-food systems in Bangladesh. Policy Brief. Colombo, Sri Lanka: International Water Management Institute.
- Jamal, M. R. (2024). Blue grabbing of the green crop fields: A development conundrum in southwest coastal Bangladesh. *Land Use Policy*, 141, 107161.
- Ringler, C., Agbonlahor, M., Barron, J., Baye, K., Meenakshi, J. V., Mekonnen, D. K., & Uhlenbrook, S. (2022). The role of water in transforming food systems. *Global Food Security*, 33, 100639.
- Saito-Jensen, M., Nathan, I., & Treue, T. (2010). Beyond elite capture? Community-based natural resource management and power in Mohammed Nagar village, Andhra Pradesh, India. *Environmental Conservation*, 37(3), 327-335.

Authors

M. Mokhlesur Rahman, Center for Natural Resource Studies (CNRS), Dhaka, Bangladesh (mokhles@cnrs.org.bd); Mou Rani Sarker, International Rice Research Institute (IRRI), Dhaka, Bangladesh (mr.sarker@irri.org)

Citation

Rahman, M. M. and Sarker, M. R. 2024. Policy Perspectives on Water Management for Resilient Agri-food Systems in Southwest Coastal Bangladesh. CGIAR Initiative on Asian Mega-Deltas. International Rice Research Institute, Dhaka, Bangladesh. 32p.

Acknowledgments

This work was undertaken as part of the CGIAR Research Initiative on Securing the food systems of Asian Mega-Deltas for climate and livelihood resilience Asian Mega Deltas. Funding support for this study was provided through CGIAR Initiative on Asian Mega-Deltas.

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

To learn more about this Initiative, please visit [this webpage](#).

To learn more about this and other Initiatives in the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar-portfolio

© 2024 CGIAR System Organization. Some rights reserved.

This work is licensed under a Creative Commons Attribution-Noncommercial 4.0 International Licence ([CC by 4.0](https://creativecommons.org/licenses/by-nc/4.0/)).

