Research Article
Special Issue: Water for Food in Deltas

DOI: 10.59490/ijwg.12.2025.7772
ISSN: 2211-4505

TU Delft OPEN Publishing

Agri-Food System Governance in Bangladesh's Coastal Regions: Why the Socio-Ecological Systems Approach Needs to Be Politicized

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Submitted: 09 August 2024; **Revised**: 28 October 2024; **Accepted**: 11 December 2024;
Published: 16 January 2025

How to cite (APA): Joshi, D., Schulze, P., Amin, M. N., Gallant, B., Aheeyar, M., Rahman, M., Garrett, J., Sarker, M. R. (2025). Agri-Food System Governance in Bangladesh's Coastal Regions: Why the Socio-Ecological Systems Approach Needs to be Politicized. *International Journal of Water Governance, 12*. https://doi.org/10.59490/ijwg.12.2025.7772

Abstract

While Bangladesh is reported as doing well in food production, there is increasing concern that this essentially deltaic and highly climate-vulnerable country will face steep challenges in food governance and productivity. Anthropogenic drivers shaped by narrow economic goals and sectoral policies have deeply altered Bangladesh's food systems since the early 1960s and partly led to adverse outcomes. By combining policy and institutional analysis and primary research in Shyamnagar Upazila in Satkhira District in the southern coastal deltas, we revisit two key transitions – poldering and commercial shrimp farming – to reveal how diverse economic, social and political factors have shaped the efficiency, inclusivity and sustainability of agri-food systems. These complex interactions between agri-food systems, the broader ecology and heterogeneity in poverty, gender and other social identities are poorly understood and accounted for in policies and programme interventions. This has resulted in unequal conflicts and contestations around critical resources, which impact most marginalized groups, also because policy incoherence encourages collusion

between local elites and local decision-makers for resource appropriation and control. Conceptually, a social-ecological systems (SES) framework would identify these complexities. However, SES approaches tend to be technocratic and overlook the overtly economic framing of natural resources governance, diversity among local communities, and the politics of resource appropriation. This gap can be remedied by merging SES thinking with a critical political ecology lens to trace the historical, scalar and deeply intersectional nature of socio-ecological relations.

Keywords: social-ecological systems, resource governance, deltaic, agri-food system, politicizing

1. Introduction

Bangladesh is characterised by three major rivers - the Padma (Ganges), Brahmaputra, and Meghna - which criss-cross the country and create a unique 'land-water-scape' in which water and land are intricately interwoven. The convergence of these sediment-laden rivers has formed the world's largest river delta, a brackish water ecosystem interspersed with canals, mangrove forests, ponds, and wetlands that provides a multitude of vital ecosystem services (Ahammad et al., 2021; Islam et al., 2020). The Ganges delta is home to about 110 million people, or two-thirds of the country's population, who are engaged in irrigated and rain-fed agriculture, brackish and freshwater aquaculture, and inland and offshore fisheries, and depend on the region's freshwater canals, char land (eroding islands) and mangrove forests (Dewan, 2021; Hossain et al., 2020).

Over the last couple of decades, Bangladesh has done well in food production. Globally, the country ranges third in terms of rice production, and, in 2020, it produced 1.25 million tonnes of fish (inland water capture) and 2.58 million tonnes of aquaculture (prawn) (FAO, 2022). However, as the seventh most disaster-prone and climate-vulnerable country globally (Global Climate Risk Index, 2021), Bangladesh faces multiple and increasingly cross-scalar natural and human-induced hazards, such as flooding, cyclones and increasing salinity, which intersect with high social vulnerabilities to create complex webs of risks (Hagenlocher et al., 2018; IPCC, 2014). Bangladesh reported $3.72 billion in direct economic losses from 185 extreme weather events between 2000 and 2019 (Eckstein et al., 2021). This type of loss is expected to increase (Morales-Munoz et al., 2020; Whitehead et al., 2015) and is of particular concern for agri-food systems that function within complex deltaic socio-ecological systems (Adams et al., 2016; Ringler et al., 2022; Van Haren et al., 2023). For instance, salinity affects multiple spheres of household food production, including rice cultivation, homestead gardens, livestock and aquaculture (Lam et al., 2022).

While poverty and food insecurity have significantly decreased in Bangladesh, recent reports suggest that about a third of the country's population still faces moderate-to-severe food insecurity (FAO, 2024; IPC, 2023). In Bangladesh's low-lying coastal regions, local communities particularly at risk due to high poverty rates, landlessness and reliance on common natural resource pools are primarily minorities by religion and ethnicity and those disadvantaged by gender, class, caste and disability (Amoako Johnson et al., 2016; Karim & Mimura, 2008; Nowreen et al., 2014).

Social mechanisms and institutional arrangements, including formal and informal rules, norms and practices that govern resource use and management, play a critical role in shaping the governance of coastal agri-food systems (Gain et al., 2020). National agrifood policies, such as the National Adaptation Plan (2023–2050), Bangladesh Delta Plan 2100 and the Mujib Climate Prosperity Plan, increasingly acknowledge complex intersections of environmental issues and the challenges of climate change on food security (Government of Bangladesh, 2021; Irfanullah et al., 2023). However, translating national plans and policies to effective and equitable action on the ground has been a challenge, especially as there are few synergies and dialogues between national and subnational institutions and actors (Irfanullah et al., 2023; Ishtiaque et al., 2021; Stock et al., 2021). Policy appropriateness and viability – that is, the applicability of policies and policy implementation to address and anticipate complex, heterogeneous realities on the ground – remain key challenges, and there is an urgent need for more localized, context-specific interventions (Roy, 2021).

Another critical gap is that sectoral policies, including agricultural, environmental, water and land, are uneven in the extent to which they adopt a nexus approach. There is significant inconsistency in understanding the trade-offs and synergies required between sectoral interventions and the sustainability of diverse ecosystems (Gain et al., 2018; Hicks et al., 2022). Additionally, plans and policies often lack sufficient resources for implementation and monitoring (Irfanullah et al., 2023). Investigating water resource policies, Kumar et al. (2016) found fragmented and sectoral plans and institutional setups characterized by little cooperation across scales, resulting in poor planning and low level of cooperation in water resource utilization. Similarly, in a study focusing on community-based approaches to transboundary water governance, Saha et al. (2021) identified the neglect of top-down policies to include local actors and institutions, which, in turn, poses significant hurdles to a transition towards more inclusive and integrated resource management.

Moreover, power and gender asymmetries are explicit in local governance structures in Bangladesh (Cons, 2021; Sultana, 2009), leading to the prioritization of the interests of some over others and to distributional inequities, which results in what is known as 'elite capture' (Hoque et al., 2017). Because policy interventions occur amid considerable ambiguity of common pool resource rights, rules and resource governance (Hossain et al., 2020), they reinforce power imbalances in decision-making, resource use and dependency among local communities (Cotte & Nightingale, 2012). While the provisioning functions of ecosystem services are critical for the subsistence of poor deltaic populations, Adams et al. (2016) note that marginalized local communities often cannot access or influence the use of these resources. Around 30 million people in Bangladesh are identified as marginalized based on race, religious identity, caste, ethnicity, occupation, social identity (gender), as well as location of stay – particularly the chars and hoars (Bhattacharya et al., 2021).

In this article, we suggest that the complex, highly intertwined biophysical and socio-political contexts in the southern coastal deltas make a strong case for adopting a socio-ecological systems (SES) approach to understanding and addressing current and future challenges. However, we argue that this will require a shift in contemporary SES narratives, framings and methodologies, which tend to be overtly 'apolitical' and narrowly focused on the technical aspects of 'ecosystem services', 'resources', 'efficiency' and generic framings of common pool resources and local communities, even though what happens in terms of policy and practice is shaped by an entanglement of politics, narrow economic agendas and blatant and latent power dynamics (Aisher & Damodaran, 2016). Similarly, there is a tendency to see climate change impacts of ecosystem degradation and decreasing biophysical integrity as essentially technical and not as a problem 'fraught with entanglements, between the social and the microbial, bioscience and geopolitics, democracy and despotism, past and present' (Engelhard et al., 2021, p. 432). Our findings show that diverse climate challenges and risks to heterogeneous local communities in the southern coastal deltas are essentially an entanglement of complex anthropogenic drivers shaped by political, economic and ecological changes. What is required is 'examining what things are woven together … in this web of relations and how these processes take place' and shape everyday realities of diverse groups of people (ibid).

Building on this proposed framing of SES, and against the backdrop of evolving national plans and policies, this article examines two strategic land and water management transitions in coastal Bangladesh, namely, the introduction of the polder system in the 1960s and the shrimp boom in the 1980s to assess how food systems transitioned in the southern coastal deltas of Bangladesh. We also conducted a scoping study in the same region to demonstrate why power dynamics in natural resources use governance must be considered in the framings of a socio-ecological approach.

2. Understanding Socio-Ecological Systems (SES) in Deltaic Resource Governance

Agri-food systems[1] are complex webs of various sectors, activities and actors in which socio-ecological interactions influence access, allocation, distribution and management of required resources and outputs. By

[1] According to FAO, food systems (FS) 'encompass the entire range of actors and their interlinked value- adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal of food products that originate from agriculture,

forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded' (FAO, 2018).

understanding the influence of the variables acting within and between diverse ecological and social components of an SES, there is potential to manage food security with consideration of the most relevant variables (Amin et al., 2020).

As an analytical framework, the SES emphasizes sustainable livelihoods as an interdependent relationship between human and ecological systems (Ostrom, 2009), viewing this interdependence as complex systems of interactions of physical, ecological and social factors (Adams et al., 2016; Cotte & Nightingale, 2012; Preiser et al., 2018). Adopting an SES approach can contribute to more effective governance of ecosystem services and reveal the relationships between diverse social and ecological variables operating at different spatial and temporal scales. The SES also allows for an understanding of how social institutions shape and are shaped by the underlying characteristics of the natural resource (common pool resources), resource fluctuations, variability and divisibility, as well as common property rights and collective local action in ecosystem governance (Cotte & Nightingale, 2012). Also, scholars note that the SES approach is crucial for considering climate change impacts as continuously changing dynamics (Hossain et al., 2024).

The point we make in this article is that the application of SES often makes several implicit assumptions, for example, assuming homogeneity in communities and social cohesion in managing supposedly 'common' pool resources (Clement et al., 2019) and also assuming normative human–environment relations across spatial and temporal boundaries and overlooking the diversity of values and power relationships (Fabinyi et al., 2014). Chambers (2021) terms such a framing a 'socio-ecological fix' and, in the case of our research, a limited apolitical view of complex 'intertwined economic-environment crises' and one which 'downplays class' and gender struggles in the context of the climate crisis. Sovacool (2018) identifies four key challenges that shape common pool resource governance in Bangladesh: (1) enclosure or elite capture of resources or authority;

(2) exclusion of the most marginalized and vulnerable stakeholders from key interventions and benefits; (3) encroachment, meaning the lack of a transformative approach in agriculture and economic growth interventions; and (4) entrenchment, or the persistence of inequality due to power hierarchies and social norms and biases. However, these challenges are not only specific to Bangladesh. Local communities are not homogeneous in any given context, and elite capture of supposedly common pool resources tends to be the norm globally, as formal and informal social rules and norms and economic and political hierarchies shape the use, access and governance of socio-ecological services (Islam et al., 2020).

In this article, our findings show that the concept of SES remains relevant due to its strength in revealing dynamic couplings between humans and the environment. However, its salient drawback is that such system approaches run the risk of '[depoliticizing] the situation being represented' (Stojanovic et al., 2016, p. 15), emphasizing a seemingly technical and neutral analysis of problems and solutions that ought to be easily addressed by intervening at the local level.

3. Agri-Food-Water Governance and Policymaking in Bangladesh's Coastal Regions

3.1 Water and Land Transitions

Given the tidal dynamics and seasonal flooding, communities in Bangladesh's delta regions have long adopted traditional arrangements – temporary earthen embankments to contain freshwater and mitigate saline intrusion (Nowreen et al., 2014). This popular practice, known as Tidal River Management, is a transdisciplinary intervention bringing local knowledge and expertise together with grassroots movements in the collective management of natural resources (Gain et al., 2017).

Against this backdrop, the occurrence of severe floods in the 1960s and later in the 1990s resulted in a policy decision to adopt a Dutch model of flood protection, which introduced systems of more permanent embankments (dykes) that enclosed large low- lying areas (polders). Vast areas of land, or polders, were protected from their surrounding hydrological dynamics through a vast system of embankments, which

allowed controlled seasonal water inflow and excess water discharge via sluice gates (Nath et al., 2019; Rahman et al., 2022). These processes, driven by an emerging centralized state water bureaucracy and international actor support (Gain et al., 2017; Nowreen et al., 2014), were also aligned with South Asia's 'Green Revolution' plans for intensive agricultural productivity (Rahman et al., 2022). In principle, this was a win-win solution or a 'socio- ecological fix' (Chambers, 2021): mitigating flood and saline intrusion and improving food productivity and security and mitigation of poverty (Gain et al., 2017).

While the polder system did increase food productivity, it significantly altered the hydro-geo-morphological landscape and the integrity of its socio-ecological systems. Sediment accumulation and improper management led to the siltation and clogging of drainage canals, rendering ever-increasing tracts of land permanently waterlogged. Sediment starvation also contributed to land subsidence, thereby increasing the impacts of sea-level rise (Steckler et al., 2022) and increasing vulnerability to embankment failures, such as in the aftermath of Cyclone Aila in 2009 (Auerbach et al., 2015). These plans were thus costly and required continuous and high-cost maintenance and rehabilitation. In practice, these interventions have had highly mixed outcomes and are the focus of much scholarly and practitioner critiques (Barbour et al., 2022; Nowreen et al., 2014; Warner, 2010).

Public protests sparked in many locations across the polder region. Local communities, used to more flexible and adaptive flood protection practices, went as far as intentionally breaching the embankments to release stagnate floodwater and allow for tidal inflow (Hanlon, 2020; Nath et al., 2019). These attempts to return to longstanding communal water management practices are now institutionalized as an approach, known as Tidal River Management (TRM). TRM refers to the controlled periodic inflow and outflow of water into and out of the polders allowing for controlled periodic inflow and outflow of water in and out of the polders to accelerate land accretion (or reclamation) while preventing channel and river siltation (Gain et al., 2017; Hanlon, 2020; Masud et al., 2023). However, although TRM is formally adopted in policy, including in the current Bangladesh Delta Plan 2100, in practice, large-scale hydraulic engineering tends to take precedence over traditional, localized knowledge and experiences. This is primarily a policy/science challenge. As Gain et al. (2017) note, TRM can be seen as a departure from established practice solely focusing on the maximization of agro-economic development (via engineered water control and land-use expansion) to a more comprehensive and transdisciplinary approach that 'recognizes the complex interplay of natural and anthropogenic forces and the importance of local knowledge and engagement' (p. 4). Aligning experiential local know-how and disciplinary scientific practices is easier said than done. There are also hearsay concerns that TRM – a low-cost, low-investment intervention – is downplayed because of the powerful contractor–politician nexus in water management investments and infrastructure.

3.2 Shrimp Farming

The 1980s saw a new hydrological regime of increasing saline land within the polders – the rapid growth of commercial, export-oriented aquaculture – which was driven by several factors, mainly policy regulations, market forces, power and politics. Following a World Bank loan for the Shrimp Culture Project in 1985, numerous other financial incentives and international support were provided as part of adjustment reforms to help the expansion of aquaculture (UNEP, 1999). Growing international demand for shrimp promised significantly higher returns: shrimp production is far more profitable than traditional rice cultivation (Pokrant, 2014). Governmental policies such as the 2014 National Shrimp Policy (NSP) firmly ensured the transition to shrimp culture on the ground. Shrimp farming is now a significant part of the national economy, with exports of $407 million between 2021 and 2022 (Zami, 2022).

While shrimp farming contributed to economic development, it had diverse adverse socio-ecological effects. Firstly, high input investments meant that those who most benefited from this transition were the resource-rich (Amoako Johnson et al., 2016; Barbour et al., 2022; Hanlon, 2020). Shrimp farming needs saline water input, and, to increase profitability, many polders saw a marked increase in the inflow of saline water made possible by breaching or drilling of the embankments (Barbour et al., 2022; Nath et al., 2019). Individuals investing in shrimp production were not just better off, they were also more politically connected and thus able to manipulate the polder operational system by gaining control over sluice gate operations. These

developments altered the polder system, rendering the few TRM schemes in practice ineffective. Increasing inflow of saline water, overspill and pollution of aquacultures to adjacent farmland meant decreasing soil fertility and farmers' yields, loss of traditional fish species and other domestic food crops, and loss of grazing lands. Additionally, as shrimp farming is less labour-intensive than rice cultivation, there was, in time, a mass transition of agricultural land (Islam et al., 2015), resulting in less agriculture-related labour and income and, consequently, food and nutrition insecurity (Pokrant, 2014; Sarker, 2021).

Many smallholder farmers and fisherfolk initially resisted the transition to aquaculture. However, they could not alter the trajectory defined in policy, which is supported by external development agents and practiced by local elites with capital, political agency and economic power (Hanlon, 2020; Nath et al., 2019). In time, with increasingly saline or submerged land, more and more farmers turned to shrimp cultivation (Afroz et al., 2017) or, more commonly, leased or sold their land to emerging groups of better-resourced aqua- culturists (Shameem et al., 2014). While there were some compensation schemes for the loss of farmland, the most affected, primarily landless (labourers) or marginal landowners, failed to obtain these (Hanlon, 2020). This violation of the rights of local smallholder farmers and fisherfolk has increased social conflicts around land, water and other resource use and governance (Alam et al., 2017; Nowreen et al., 2014) and contributed to increasing poverty, resource use inequity and out-migration (Amoako Johnson et al., 2016; Nath et al., 2019, Shameem et al., 2014). In sum, commercial shrimp cultivation – 'developed without any sensitivity to local knowledge, practices, preferences, and resource use' – resulted in 'blue death' and 'shifted control over local resources from communities to external entities' (UNEP, 1999, p. 15).

It can be argued that the transition to shrimp culture in an export-oriented production system can result in higher demand for labour, particularly for women, allowing for 'work in the ponds, in net barricades and [especially for women] in "depots" where shrimps are sorted and beheaded' (Das, 2014, p. 18). However, as Das (ibid.) and many others argue, this work is exemplary of 'low-wage capitalism' and a 'reproduction of a working class that works for abysmally low wages and under very poor conditions' (p. 17). Halim (2004) writes that for the large numbers of women (and children) engaged in all aspects of the shrimp industry in Bangladesh, 'work is seasonal, menial and poorly paid … [and particularly in shrimp industry] women and children … are preferred workers [as they can be] paid less than the male workers and usually women never resist … exploitation' (p. 99). Das (2014) notes that the final task of beheading the shrimps and removing legs and shells from shrimps before packaging is also done by women. Male supervisors believe that 'women do the work right, and fast,' and many women agree, believing that 'men cannot sit for hours at a stretch to do this work' (ibid., p. 25). The gender bias around women being better suited to doing fine work holds true for all. In the shrimp industry, as elsewhere, 'nimble fingers make cheap labor' (Elson & Pearson, 1981, p. 1). The transition to the shrimp industry has had far-reaching socio-ecological and economic consequences and is exemplary of how 'capitalist relations are mediated by place-specific relations of difference and the specificities of nature-dependent production' (Das, 2014, p. 17).

3.3 Elite Capture of Productive Resources

The increasing salinity of water resources, primarily due to the poldering and then due to intensive shrimp production, has intensified conflict and contestation over utilization of freshwater resources in in the drainage peripheries of large rivers which run across the region as natural canals opening into the coasts. These common pool resources are the lifeline to water access and availability for domestic use and subsistence livelihood for large numbers of smallholder farmers in southwestern Bangladesh. However, our research shows that these water resources are mostly all under the control of local and external elites who hold long-term leases to exclusive rights and use, even though legislation, in principle, disallows the leasing of flowing streams of water.

Elite capture – the capturing, controlling or appropriating vital freshwater resources of a powerful few by virtue of their socioeconomic standing in the community – is rampant in the region through officially provided long-term lease licences (Nath et al., 2019). While the Water Act of 2013 (FAOLEX Database, 2013) prohibits leasing flowing water bodies, the term 'flowing' is restricted to rivers; natural and constructed canals are regularly leased to fishers registered under the Cooperative Department. Although these leases should, in

theory, benefit the wider community and the poor, there is a widespread concern that most lease arrangements benefit elite 'waterbody-grabbers', who turn out to be often absentee landlords and industrialists (Barkat et al., 2007; Nowreen et al., 2014; Rahman et al., 2022).

While some degree of elite capture might be inevitable, especially in highly heterogeneous communities marked by deep inequalities and elites with significant political authority (Bardhan & Mookherjee, 2000), the widespread capture of natural resources by elites in Bangladesh's coastal area has led to adverse socio-ecological conditions. Marginalized groups, including poor fishers and marginal smallholders, who could greatly benefit from this leasing mechanism, cannot compete with powerful individuals with the resources and political connections required. These characteristics of social and ecological systems undermine and steer value (gains) away from the marginalized, rendering the interests and individual gains of local elites as obstacles to the progress and development of the poor (Dewan et al., 2014).

A multitude of factors drive the unequal access and unsustainable use of common pool resources: the political economy of land and water use, policy gaps, elite capture and the lack of agency and voice among marginalized groups. Together, these activities have led to significant changes to coastal ecologies in Bangladesh. Past work has tied these challenges to divergent policies, a multiplicity of official and nongovernmental implementing actors, and local power hierarchies (Brugere et al., 2023; Ishtiaque et al., 2021; Khan & Giessen, 2021). Policies often fail to consider social and environmental complexities, feature inadequate implementation guidelines and lack monitoring and evaluation, especially in relation to socially inclusive governance (Irfanullah et al., 2023; Sovacool et al., 2019). All of these challenges run the risk of further driving environmental degradation (Eisenstadt et al., 2022; Nowreen et al., 2014). Economic drivers shaping the shrimp boom resulted in the elite capture of critical resources, which altered production systems and had severe environmental implications: the destruction of mangrove resources, increased salinity, declining land productivity, increased deforestation, growing landlessness and a rise in shrimp-industry-related appropriations, conflicts and violence and labour rights violations. Such negative impacts have far outweighed the anticipated economic gains (UNEP, 1999). In the current institutional setup, a lack of coordination signifies significant hurdles to understanding cross-sectoral synergies, risks and opportunities. For example, the Fisheries Department under the Ministry for Fisheries and Livestock is mandated to utilize inland water bodies to boost yields and create livelihood opportunities for fishing communities. At the same time, the Ministry of Land is the legal owner of these water bodies. Moreover, non-state actors such as NGOs often take on responsibilities for policy implementation with little cross-learning (Dewan et al., 2014). These entanglements in roles, responsibilities and authorities make for significant policy incoherence, which runs the risk of fuelling resource conflicts, competition and inefficiencies. Key interventions that could ensure critical checks and balances, such as the 2023 Environmental Conservation Rules of the Department of Environment and Ecologically Critical Area Management (Ahammad et al., 2021; FAOLEX Database, 2023; Islam et al., 2021), lack clear guidelines for implementation. This weak regulatory effectiveness hinders effective implementation and thorough policy evaluation, especially regarding socially inclusive governance.

On the ground, people are mostly unaware of public policies, signalling exclusionary policy development processes, especially for the disempowered and marginalized (Rahman, 2022). Beard and Phakphian (2009) note that even on projects that enable more participatory approaches, there is often a rush to implement projects without building understanding and individual and institutional capacities to adequately empower those generally excluded. This, along with unclear definitions of common pool water resources, has enabled the leasing of water bodies to a select few, depriving many marginalized groups of their livelihoods, food and nutrition. In the seminal text, Seeing Like a State, Scott (1998, p. 3) argues that such fuzziness is exemplary of 'statecraft' including 'muscle- bound' rules, laws and legislations that reduce complex realities to 'uncritical' forms of planning and technical infrastructure that eventually enable the state to '[re]order nature and society'.

What we discussed above explains that there is an increasing commitment to climate-resilient and sustainable livelihoods and increasing acknowledgement of the complex intersections between environmental issues and the challenges of food security (Irfanullah et al., 2023; Nowreen et al., 2014), as well as a continued focus on economic growth and in simplistic sociotechnical fixes. As shrimp farming is no

longer profitable in the southern coastal deltas, the current National Climate Adaptation Plan emphasizes exploring new suitable zones where shrimp farming businesses can be run in more climate-resilient ways. The logic offered here is that the significant economic relevance of export earnings from shrimp farming cannot be expected from paddy cultivation (Zami, 2022).

Similarly, the Bangladesh Delta Plan (BDP) 2100 is supposed to be a long-term holistic and integrated plan for the Bangladesh Delta to alleviate poverty and ensure 'long- term sustainable management of water, ecology, environment, and land resources in the context of their interaction with natural disasters and climate change' (GED, 2018, p. 4). However, the BDP has a somewhat homogeneous approach towards highly varying deltaic regions, and the underlying economic interest in Dutch aid is tied to trade policies and economic interests (Hanlon, 2020; Hasan et al., 2023). Therefore, it is unclear whether these policies will fully reflect the reality and needs of marginalized groups and will change the status quo or continue to reshape the environment to reinforce unviable agrarian livelihoods, possibly resulting in the disappearance and foreclosure of certain livelihoods in coastal Bangladesh (Paprocki, 2022).

We argue that if an SES analytical approach is to unpack these complex entanglements and uncertainties, it must adopt a much more robust political focus on knowledge hierarchies and power dynamics at scale. We exemplify this with an empirical case study in the southern coastal deltas.

4. Case Study: Agri-food System Governance in Coastal Bangladesh

To gain a more profound understanding of how policies shape local socio-ecological systems in coastal Bangladesh, we conducted a preliminary case study in the coastal area of Munshiganj Union,[2] located in Shyamnagar Upazila of Satkhira District, southwestern Bangladesh (see Figure 1). This study area is situated near the Sundarbans, the world's largest mangrove forest. It has a rich ecosystem, including mangroves, wetlands and forests, providing multiple services to heterogeneous groups of farmers, fishermen and non-timber forest-produce collectors.

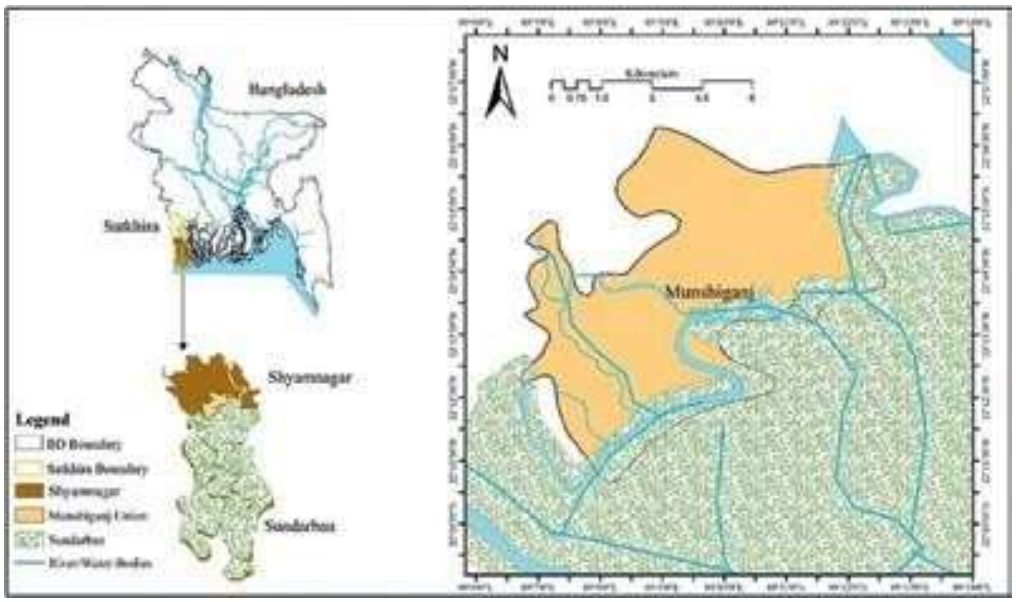

Figure 1. Study Area Map of Munshiganj, Satkhira.

The population in the region is extremely poor, with an average per-capita income of $0.90/day (Nishat & Rahman, 2019). Agriculture is the dominant occupation of house- holds, but it is no longer sufficient to sustain households, even in cultivating salinity- tolerant rice varieties (Lam et al., 2022; Shamsuzzaman et al., 2017). About 49 per cent of the farmers in the area are landless (Islam & Chuenpagdee, 2013) and rely on the natural resources of the Sundarbans, such as timber, honey, firewood and livestock fodder (Rahman et al., 2018). Users access resources in various ways, and these interactions have often resulted in conflicts between

different uses and users.

[2]A union is the smallest administrative unit in Bangladesh.

4.1 Shrimp Farming

The above-discussed shift from traditional agriculture and subsidence shrimp farming to a commercial, export-oriented aquaculture system is the norm in the study area. While rice was the predominant crop in the 1970s, shrimp-based aquaculture replaced traditional rice systems in the 1980s (Abdullah et al., 2021). This transition, fostered by wealthy farmers with more agency, dictated the land-use choices of other farmers; as a key informant from a regional committee summarized,

> *Influential people began shrimp cultivation, and as it grew, more smallholder farmers who had earlier resisted shrimp cultivation were forced (or incentivized) to change their livelihood practices. Due to surrounding shrimp farms, others were bound to shift as their land had become salinized.*

While policies emphasize the proper drainage of saline water from shrimp farms to prevent adverse effects on neighbouring fields, our case study revealed that shrimp farmers' control over embankment operations leads to frequent instances of adverse salt- water intrusion. As a female farmer noted,

> *Our and other lands [were] dramatically altered because of shrimp farming. The saline water required by shrimp was let into the farms, sometimes even by damaging the embankments we use and need [to use] to protect our paddies and our freshwater ponds.*

Today, 20 years after the widespread adoption of shrimp farming, on-going conflicts show how smallholders have been muscled out by politically powerful farmers who have appropriated smallholder plots of land without compensation. The smallholder farmers were unable to turn to governmental agencies, since anyone attempting to regulate saltwater shrimp farming was reportedly penalized. One local male farmer recounted:

> *Shrimp cultivation requires investment but brings large profits. So, the owners are more powerful. They buy muscle power and bribe local officials. Everything is in their control. The marginalized farmers are helpless in front of them and cannot protest. There was a good Madam (female sub-district officer) a few years ago who fought for the small farmers and made the shrimp farmers use proper drainage to drain out saline water. The shrimp* syndicate *got after her, filed false cases, and got her arrested. She was later transferred.*

However, increasing production costs, decreasing market prices and a rising incidence of disease outbreaks drove risks of investment loss for shrimp farmers, thus resulting in a re-emergence of paddy cultivation (Hossain & Hasan, 2017). In one instance, the conversion of 2.64 acres of aquaculture by a 49-year-old shrimp farmer in Singhortoli village in Munshiganj Union in 2019 motivated 40 other farmers to pursue aqua-to-agriculture conversion, amounting to 57 acres of shrimp farms turned into paddy fields in subsequent years (see Box 1). Reclamation of salt-affected soil to enable rice cultivation was challenging, but it was made possible by reverting to traditional knowledge practices for such conversions. This shift was reported to have created labour opportunities and increased food security. However, seasonal paddy cultivation constraints associated with rainfall events (or the lack thereof) were described as significant barriers. In the dry season, lack of canal water, seepage and discharge of saline water from the shrimp fields make growing rice impossible.

4.2 Appropriation of Water and Land

Our interviews in Munshiganj with the local community and staff from relevant local institutions revealed many on-going agriculture–aquaculture conflicts associated with these lease systems and elite appropriation of freshwater canals. These conflicts are aggravated by the messiness of the land: as Bhattacharjee et al. (2019) point out, the delta is a fluid landscape where there has been a perennial struggle between earth and ocean, and key problems arise due to endeavours – colonially, economically, scientifically – towards

controlling such 'transient environments' (Day et al., 2016, p. 276). Colonial governance systems of water governance that often focus on control over access tend to be in misalignment with local community views that water is a public resource. The 'messiness' comes into play where ownership over water resources occurs: specific access and control may be granted while the rest of a resource is deemed 'forbidden' to those without the resources and social capital to have ownership (ibid.). This process of management by laws and acts and the making and breaking of these – that is, through the deliberate absence of regulation – allows for the elite capture of resources. Even when local communities are willing to challenge elite control over resources, local officials are unwilling or unable to call out policy violations.

As one key informant in a regional committee stated,

> *Several times, villagers urged the responsible authorities to withdraw the canal lease, allow local people to use the water, and impose a ban on taking saline water into the canals, but all their demands were ignored.*

Along with canals, government-owned fallow/wastelands called Khas are also leased out, often to influential local people. There is a close overlap between those who control the functioning of these canals and those who control *Khas* lands. The legislation around managing 'flowing water' in canals is as unclear as leasing out *Khas* lands. As one female farmer remarked,

> *Local farmers are not allowed to use the canal waters. Khas leaseholders also restrict our movements on the canal banks.*

Box 1. Transformative food system in Kultoli village, Munshiganj Union.

Village Kultoli, located about 8 km from Munshiganj Township, was an agricultural village consisting of a community belonging to a minority ethnicity. Influential and wealthy farmers have leased in the water canals running across the village for intensive shrimp farming. This has led to a scarcity of water for farming, open-source fishing and other domestic uses. Smallholder farmers can cultivate only during the wet season, and across households, adult men migrate to urban centres seeking alternative livelihoods during most parts of the year or increasingly depend on 'legally protected' Sundarbans Forest resources. Supported by civil society organizations, a legal case of water appropriation was registered with the court, which, after several years of hearings, resulted in the cancellation of the canal lease. This has allowed farmers to 'reclaim' the canal by operating the sluice gates, regulating the water flow as per requirement, and allowing farming (Figure 2).

Figure 2. Agriculture Transformation Before and After Restoration of Canal Capture at Kultoli Village, Munshigonj, Bangladesh (Credit: Rahul Rahman/CNRS, Bangladesh).

5. Discussion

As our analysis shows, power imbalances blatant in socio-ecological crises result from controversial policies, a fuzziness of laws and legislation, programmatic investments and interventions, and a highly unequal local socio-political context. Two key interventions in this region – the laying out of embankments as flood control infrastructure and the shift to shrimp farming land (both backed by international investments) – have enabled elite capture of scarce freshwater resources. These transitions were driven by top-down political decisions and policies that focused overly on singular issues (flood protection, the green revolution, the blue revolution) and failed to recognize the interconnectedness of social and environmental issues, as well as the diversity and fragility of local livelihoods. This is a prime case of how the short-sightedness of engineering and economic drivers led to significant adverse environmental impacts and intensified the capture of resources by a privileged few. Infrastructure-driven structural interventions (Nowreen et al., 2014) can also be tied to international donor preferences for large-scale projects, which tend to overlook complex socio-ecological realities and issues of equity and inclusion in water and land governance (Barbour et al., 2022). More worrying is the blatant blind spots that allowed for the promotion of shrimp farming driven by structural adjustment programmes, with scant prior environmental and social impact assessments that would have revealed the potential unequal distributions of benefits and detriments (Pokrant, 2014). Bhattacharyya (2018) sums this situation well: 'An alien and intrusive structure of state with its own understanding of nature, river, soil, and deltaic ecology, has a capacity to disturb, unsettle, and unequivocally transform landscapes, water bodies and the people living there' (p. 201).

We raise these issues here to signal that while Bangladesh's policy landscape shifts

to a more integrated approach to resilient food systems, the practice of 'statecraft' (Scott, 1998) has not changed. Progress is relatively slow in understanding uncertainties, complexities and inequalities in diverse local contexts. Policies are still narrowly sectoral and often focused on short-sighted, short-term gains. This, we argue, paves the way for adverse socio-ecological outcomes such as loss of livelihoods and elite capture, emphasized by enclosure, exclusion, encroachment and entrenchment of common pool resources (Sovacool, 2018). Our case study reflects all these challenges.

While SES approaches can provide a practical tool to ensure attention to interlinked nature–society challenges, there is an urgent need to revisit and extend the rather technical and apolitical SES narrative and approach. Cotte and Nightingale (2012) point out that the overt focus on the structures and 'functionality' of an institutional system, which is devoid of political, historical and cultural meaning, is a crucial reason why the conceptualization of the SES is so problematic. At their heart, ecological transformations result from complex anthropogenic changes shaped over time by political and economic drivers, inevitably resulting in different groups of winners and losers. Highly hierarchical and heterogeneous communities – such as those living in the coastal regions of Bangladesh – have experienced elite appropriation of resources and power hierarchies historically. Capturing these complexities and planning for transformative change will require 'politicizing' the SES approach: understanding how the highly active waterscape and landscape of Bangladesh's delta have been reshaped by colonial and postcolonial histories of water control infrastructure and food production systems and how this 'rough and tumble of actual [nature–society] struggles and the [unequal] relations between households, communities, and powerful state and corporate agents' in new and unpredictable contexts of change (Peet et al., 2010, in: Dewan, 2021, p. 6). In other words, politicizing the SES will require a transformative decolonizing of science, policy and practice in the deltas.

Some researchers suggest that technical interventions could be designed to address ecological and social externalities. For example, environmentally sustainable shrimp farming is said to be possible by adopting measures such as zoning, land management and using freshwater species as an alternative to saltwater ones (Hasan et al., 2020). Land zoning is similarly suggested to address the conflicts between shrimp farming and rice cultivation (Islam & Tabeta, 2019). Others argue that TRM in certain locations can be an ideal adaptation strategy to mitigate drainage congestion (Islam et al., 2021). These solutions do not consider two key issues.

Firstly, climate impacts, that is, rising sea levels and increasing risk of flooding and saline intrusion, will likely complicate the operation of the polder and shrimp farming systems (Barbour et al., 2022; Nath et al., 2019). Secondly, it would be careless to reduce all challenges and problems to climate impacts or, as Hulme (2011) terms, 'climate reductionism', a 'heightened' obsessiveness with climate, complemented by assumptions that simplistic technical interventions will address the complex nature–society relations that are profoundly intertwined and equally social, political and ecological.

Clearly, the issues at stake in the southern coastal deltas of Bangladesh go well be-

yond appropriate technical methods and approaches and financial interjections of climate financing (Dewan, 2021). D'Souza explains that steady economic growth happens in emerging economies like Bangladesh with large and economically heterogeneous populations precisely because the institutional capacity and incentive to regulate and enforce the already weak environmental regulations are limited. In other words, there is often little scope to prioritize environmental justice over economic growth, except in policy rhetoric. In Bangladesh, moving towards more sustainable approaches might require finding a middle path, where the focus is on 'brown environmentalism' or more people-centred ecological approaches. This would allow for a more critical assessment of the contradictions (or rhetoric) in popular calls, policies and agendas for inclusive, sustainable development. At its fundamental level, this would translate to asking, 'who benefits from large development [interventions like aquaculture] projects and how decisions to ban or allow them are made?' (Caplan, 2016, p. 330) or who will benefit from more climate [adaptation] financing (Dewan, 2021).

Our findings in this article echo D'Souza's (2005, p. 239) view that 'rational behaviors, scientifically nurtured environmental relationships, human ingenuity, and business ethics' – which are essentially 'an assemblage' of normative, prescriptive solutions – that make for contemporary development interventions have been proved to be increasingly unfit to address the complexity of challenges in a contemporary, fast-evolving and increasingly unequal world.

6. Conclusion

This article combines insights from policy and institutional analyses and ground realities to demonstrate the complexity of social-ecological relations that shape coastal agri-food systems in the unique landscape and waterscape of Bangladesh. By revisiting the history of land and water management transitions, we show how various economic, social and political factors have reshaped the efficiency, inclusivity and sustainability of production and consumption of the agri-food systems in coastal Bangladesh. The introduction of the polder system in the 1960s increased food productivity but altered the hydro-morphological realities in the delta, with inadequate management leading to livelihood losses through sediment accumulation, waterlogging and soil salinity. The shift that took place in the 1990s to commercial, export-oriented shrimp farming boosted economic growth but created significant challenges for traditional paddy farmers, the landless and the fisherfolk in and around many polders. This resulted in contradictions and conflicts between export-oriented economic growth goals, poverty alleviation, nutrition, and ecological balance (Shamsuzzaman et al., 2022). The shrimp boom shows how expert-driven mechanisms in managing productive resources are mostly ignorant of local social dynamics and heterogeneity of local communities. What happened thereafter, including elite captures of freshwater resources in the coastal regions, signifies the deliberateness of policy blind spots in their inadequate attention to complex ground realities. In practice, it is evident that major demographical factors such as class, gender, ethnicity and religion shape who gains and losses from the cycle of anthropogenic and ecological changes.

Our findings point to two key issues.

Firstly, as Bhattacharyya (2018) outlines the agenda of 'taming an unruly delta', trying to contain the evolving, fluid land and water through obscure legal, bureaucratic and governance mechanisms is by design and by default problematic. An improved understanding of the complexity of these interrelationships is a prerequisite for creating a more inclusive and sustainable water–land governance and agri-food systems in the coastal regions of Bangladesh. To end, we borrow from Mukhopadhyay (2022), who calls for policies,

policy actors, strategies and interventions to move away from the 'hard edges' of abstract knowledge distinctions to develop an understanding that is more sensitive to ground realities and considers it important to utilize embodied local ecologies as a means for mitigating complex food–systems–environment challenges.

Secondly, policy incoherence, as Scott (1998) suggested, is perhaps not a blind spot but by design deliberate. These policy loopholes, therefore, cannot resolve complex ground realities, but there is a gain here: the perpetual 'vulnerability is of low-lying Bangladesh … as a vulnerable victim [now especially of climate change] is appealing to donors' perceptions' (Dewan, 2021, p. 3). Such programmes always attempt to address poverty and to empower women, but, in practice, these 'climate reductive translations' do the opposite (e.g., Dewan, 2021). As we described above, in the local context, synergistic relationships between local elites and local decision-makers (both primarily comprising men) serve to appropriate common pool resources – water, wetlands and common land resources. Marginalized groups, particularly landless, subsidence farmers and fisherfolk, and women with limited assets, resources and social or political capital, cannot question and challenge this resource grab, even when what is rhetorically written in policies speaks in their favour. The persistence of elite capture of common pool resources signifies a systemic challenge to inclusive governance in Bangladesh, underscoring the fact that 'the commons' are complex evolving spaces shaped by plural interests, in which the needs, vulnerabilities and agency of marginalized groups often do not count (Clement et al., 2019). This leads us to stress the need to politicize SES approaches by integrating critical insights into agency, power and knowledge in the understanding of socio-ecological relations. An improved understanding of the complexity of these interrelationships is a prerequisite for creating a more inclusive and sustainable water–land governance and agri-food systems in the coastal regions of Bangladesh. There are a few examples of positive change, such as the shift towards agricultural diversity in policies and the case of canal lease cancellations by court decisions; however, these are too far and few in between.

Bangladesh's National Adaptation Plan offers an opportunity to integrate diverse

policies and establish coordination at multiple levels (Ashton, 2022). However, 'successful adaptation will require removing political, economic barriers to good environmental stewardship while advancing solutions that center the needs of the most socially vulnerable' (Lam et al., 2022, p. 244). At a local level, the question to ask is – how can the SES approach facilitate a more accurate reflection of the ecological realities and deeply sociopolitical challenges of Bangladesh's unique waterscape and landscape? Yet, the issue is essentially of (re-)politicizing not just the SES but also the (inter)national development to ensure that 'too difficult' or 'too political' challenges are not conveniently ignored.

Acknowledgements

This work was implemented as part of the CGIAR Initiative on Securing the Food Systems of Asian Mega-Deltas for Climate and Livelihood Resilience (INIT-18), which is carried out with support from funders through their contributions to the CGIAR Trust Fund. For details, please visit: https://www.cgiar.org/funders/.

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