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Contextualisation of salinisation and adaptation preferences in the coastal areas of Bangladesh: Bringing together farmers' salinity perspectives into place-based policy initiatives

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Abstract

The salinisation of coastal areas in Bangladesh reduces livelihood options for rice intensification but offers a more suitable environment for shrimp and salt farming. Thus, farmers' salinity perspectives might vary resulting in contested land use settings that may create uncertainties for policymakers in planning adaptation initiatives to address salinisation. The aim of this study was to examine co-located farmers' salinisation perspectives (e.g., trends, causes, impacts), and to demonstrate its potential for place-based policy initiatives and research prioritisation for sustainable agricultural development in the coastal areas. Primary data were collected from randomly selected rice, shrimp and salt prodcrs/farmers in two coastal sub-districts through semi-structured interviews at the household level. Furthermore, key informant interviews were conducted with personnel from research and extension organisations at national and local levels to complement the survey results. Perceptions of the salinity extent contrasted starkly among the various types of farmers. While the majority of rice farmers (87%) perceived increased salinity, just over half of the salt and shrimp farmers perceived that salinity had decreased over the last 20 years. There was also a lack of agreement on the causes of salinity, with most rice farmers (62%) indicating anthropogenic factors as the main causes, while the majority of shrimp and salt farmers focused more on natural factors. Rice farmers (42%) also perceived a reduction in yield followed by less income (30%) under saline conditions, while shrimp farmers (70%) and salt farmers (55%) perceived production gains when high salinity prevailed. The adaptation preferences to combat salinity were also at odds between different types of farmers, with rice farmers having adaptation preferences for the development of salinity-tolerant rice varieties that should have greater tolerance at the reproductive stages, while shrimp and salt farmers' preferences were for engineering-based solutions to prevent seawater inundation during cyclones. Thus, research and extension services on integrated coastal resources management need to consider tailoring their approach to accommodate varied livelihood perspectives of salinity, as this place-based approach could accelerate the pace of achieving the

sustainable development goals (SDGs), such as SDG-1, SDG-2 and SDG-3 due to a more strategic targeting of farmer types and their context.

1 | INTRODUCTION

Coastal saline areas generate substantial ecosystem services that provide livelihood options for thousands of millions of people, particularly in the developing regions of the world (Visbeck et al., 2014). These regions are undergoing ever-changing biophysical conditions and impulsive socioeconomic development (Betcherman & Marschke, 2016). Moreover, the increasing population and competing demands for coastal resources present urgent challenges for those policymakers responsible for adaptation planning to address the sustainable development agenda (Neumann et al., 2017). In addition, climate change-induced natural disasters pose significant threats that make these coastal areas vulnerable to environmental stresses (Dessai et al., 2009; Lempert & Groves, 2010). The coastal areas of Bangladesh which are some of the most vulnerable regions of the world (Yohe et al., 2006) are also exposed to repeated natural disasters (Khan et al., 2015; Talukder & Saifuzzaman, 2016). Among these disasters, salinisation is the most opaque in its origins and ongoing risk factors, with varying input from both natural and anthropogenic drivers (Hossain et al., 2018). Salinisation also exhibits highly variable temporal and spatial stochastic variations (Clarke et al., 2015), and affects coastal livelihoods in diverse ways (Lázár et al., 2015). Hence, salinity is considered one of the greatest challenges for sustaining agricultural productivity in the coastal areas (Kabir et al., 2016; Wassmann et al., 2009), and is placing increasing pressure on the sustainability of agricultural productivity, further threatening the function of the ecosystem services (Flörke et al., 2019). Despite these negative consequences on agriculture and biodiversity, coastal saline environments offer opportunities for other livelihoods which are not adversely affected by salinity such as shrimp aquaculture and salt farming (Lázár et al., 2015). Thus, it is imperative to have comprehensive adaptation planning that presents various alternatives that reflect the diverse preferences of all farming groups affected by the salinisation process (Haasnoot et al., 2013; Herman et al., 2015; Kwakkel et al., 2016). Efficient adaptation planning for combating salinisation will explicitly trigger the potential of the coastal areas to achieve the sustainable development goals (SDGs) of no poverty (SDG-1), zero hunger (SDG-2), and good health and wellbeing (SDG-3) through proper and integrated utilisation of these resources (Hussain et al., 2018; Islam & Shamsuddoha, 2018).

In terms of achieving these SDGs, the coastal areas of Bangladesh offer significant potential as these areas occupy around 30% of the total land area of the Country (SRDI, 2010), and are characterised by diversified land use opportunities (MoA, 2013). Sustainability in coastal resource utilisation and reaching the SDGs could be achieved more effectively by recognising all the livelihood options that exist in the coastal environment for people living there, as well as understanding the diversity of their perspectives. However, it is also recognised that potential synergies and trade-offs might arise in achieving these SDGs due to the interconnectedness of the targets embedded in these SDGs (Fader et al., 2018), and also how the diversity of perspectives require tailored approaches to achieve SDGs for their sector.

Three major livelihood options co-exist in the coastal areas of Bangladesh: cropping, shrimp aquaculture and salt farming. Until the 1970s, rice cropping in coastal environments was dominated by monsoon season rice (i.e. *aman* season) cultivation. However, during that decade, due to the adoption of irrigation technologies and the development of modern, high-yielding rice varieties, a new cropping opportunity emerged in the country during the dry season (i.e., *boro* season) that significantly increased rice production (Ahmed & Diana, 2015). Unfortunately, widespread adoption of dry season rice cultivation in the coastal areas did not occur as expected, due to increasing salinisation (Rahman et al., 2011; Szabo et al., 2016). The biggest breakthrough came in early 2000s with the development of salt-tolerant rice varieties that were seen as having the potential to increase the area sown with dry season rice in the coastal areas (Islam & Gregorio, 2013); this influenced policymakers to adopt saline tolerant rice variety development as part of their adaptation planning. However, these varieties have certain limitations in terms of coping with salinity stress during the reproductive stages (Islam et al., 2020), which also coincide with the period of highest salinity in the coastal areas (Clarke et al., 2015). In addition, the scarcity of fresh water for irrigation is an issue that has emerged along with salinity, and this might pose further challenges for sustaining dry season rice cultivation (Islam et al., 2020; Rahman et al., 2017). Thus, a number of obstacles have emerged to the sustaining of rice productivity, including increasing salinity threats and water security issues, which could further limit the expansion of dry season rice cultivation.

In contrast, shrimp and salt farming have been practised for hundreds of years in the coastal environment and were well established before the inception of dry season rice cultivation in the coastal areas, do not require fresh water; instead, they use brackish water (Al Mamun et al., 2014; Datta et al., 2010; Pokrant, 2014). These farming enterprises have thus encroached into monsoon season (i.e., *aman* season) rice cropping areas in the coastal regions of Bangladesh due to the suitable sub-tropical climate and easy access to tidal saline water as well as the low yield potential of rice during this season (Ahmed, 2013; Ahmed et al., 2010; Ahmed & Diana, 2015; Bagchi & Jha, 2011; Pokrant, 2014). Furthermore, these fast-growing farming enterprises contribute to the socioeconomic status of the local people and society in general through employment and enhancement of household incomes (Al Mamun et al., 2014; BSCIC, 2020;

FRSS, 2018). However, once land has been developed for brackish water shrimp or salt farming, it no longer offers a viable option for rice farming (Islam et al., 2021).

Thus, adaptation decisions that could address salinisation in the coastal areas of Bangladesh are complex, as this problem affects farming systems in diverse ways, and not necessarily in adverse ways, with some farming systems affected disproportionally one way or the other. For example, salinisation reduces the options for rice intensification while offering a more suitable environment for brackish water-dependent farming enterprises, for example, shrimp and salt farming (Lázár et al., 2015). In addition, different levels of government (e.g., the Ministry of Agriculture, Ministry of Fisheries and Livestock, Bangladesh Small and Cottage Industries Corporation) favour certain solutions to the salinity issue: promoting the use of salinity-tolerant rice varieties and promoting shrimp and salt farming where rice can no longer be grown profitably. Under these contested land use options, and the possibly contrasting salinity perspectives, adaptation decisions that can address salinisation may face uncertainties (e.g., opposing perspectives, with both positive and negative impacts (Kwakkel et al., 2010). Thus, research is required to examine all types of farmers' salinisation perspectives, especially those affected by an increasingly saline environment and their preferred adaptation responses to coping with salinity (Ramm et al., 2018). In addition, adaptation options generated from the farmers' perspectives and their particular contexts would enable decision makers to choose from a range of alternative options interconnected with socioeconomic and natural systems, which would make them more adoptable and less contested (Eakin & Patt, 2011; Wise et al., 2014). However, current policy planning [e.g. National Agriculture Policy (NAP); National Fisheries Policy (NFP)] in the Country to address coastal livelihoods, in the context of salinisation, is predominantly influenced by sector-based interests of particular government agencies that do not take into account the location-specific adaptation preferences of farmers (NAP, 2018; NFP, 1998). For example, the saline-tolerant crops advocated by the research and extension organisations under the Ministry of Agriculture can only meet the objectives of the crop growers, while measures recommended by other departments (e.g., the Fisheries Department, Small and Cottage Industries) can be attractive to shrimp and salt farmers, but could potentially have negative impacts on salinity ingress (DAE, 2021; DoF, 2021). Thus, sectoral resource planning in the coastal areas of Bangladesh could have the potential for the emergence of synergies and trade-offs in achieving the major SDGs targetting food security and agricultural sustainability, that is, SDG-1, SDG-2 and SDG-3 (Fader et al., 2018; Pradhan et al., 2017).

It is therefore imperative to adopt a policy planning approach that acknowledges location-specific farming perspectives and to move away from 'one-size-fits-all' strategies. A 'place-based policy' could be a good fit for the policy-makers, who are facing immense challenges in addressing the complex salinisation issues resulting from natural-anthropogenic drivers as well as offering tailored land use options. Place-based policy is a bottom-up approach that aims to deepen the understanding of the place-specific constraints and opportunities, focusing on the collaborative efforts to bring about positive

impacts to each of the regions (Barca et al., 2012). It also emphasises tailor-made policy directives that address the community-driven socioeconomic needs of each place or region, particularly focusing on the assets and actors embedded in each location (Ayres, 2019; Beer et al., 2020a). In addition, the advantage of policy with greater emphasis on local context is to enable locally derived solutions or adaptations to be scaled up more effectively and therefore address SDGs more in keeping with local constraints and opportunities. However, while the place-based policy has attracted much attention among the policy-makers of Western and developed countries and has predominantly focused on the business domain (Ayres, 2019; Beer et al., 2020b), it has not received much attention in developing countries or in agricultural systems. Thus, it is necessary to understand how challenges and opportunities in the coastal areas of Bangladesh with persistent salinisation could be addressed through implementing a place-based policy approach; which requires an understanding of local farmers' perspectives on this pernicious problem.

However, research efforts that explore farmers' perspectives of salinisation and the incorporation of these perspectives into salinity adaptation policy planning have not attracted much attention in the existing literature. Furthermore, most studies on the coastal areas of Bangladesh and other regions of the world have investigated farmers' perceptions of salinity based on a single livelihood option such as either cropping or shrimp farming (Betcherman & Marschke, 2016; Hossain et al., 2018; Islam & Tabeta, 2019; Joffre et al., 2018; Kabir et al., 2017; Rahman et al., 2017; Ziaul Haider & Zaber Hossain, 2013). Most of these studies confined their analysis to the farmers' perceptions of salinity in terms of farm risk and overlooked their preferred options for coping with salinisation problems. Understanding these preferences could direct decision-makers to undertake holistic salinity adaptation planning. In addition, divergent perspectives of salinisation that involve all farming groups from the separate coastal areas are absent in the existing literature. Furthermore, the way salinity affects the livelihood options of the different farming groups in the coastal areas of Bangladesh has not been adequately addressed in previous studies. A recent study showed the importance of salinisation perceptions and adaptation strategies in the coastal areas of Bangladesh (Islam et al., 2020); however, this study only considered the perceptions of the single livelihood of rice farmers, and therefore the perspectives on salinisation from other farming groups such as shrimp and salt farmers were not included.

By examining farmers' perceptions of salinisation and the preferred adaptation options of all coastal resource user groups, including rice, shrimp and salt farmers, the scientific understanding of salinisation in the coastal areas will be improved. At the same time, this local knowledge will also inform policymakers about resource users' context and preferences with regard to adaptation planning for addressing the opaque salinity issues. This study, therefore, has the following aims

- to examine how salinisation is framed by different types of farmers in the coastal areas,
- to investigate how salinity affects the livelihood options of the various coastal farming communities, and

- to investigate farmers' preferred adaptation strategies for combating salinisation at a community level.

These insights will be considered as to the ways they can assist policy-makers in incorporating such local knowledge and context into relevant place-based policy initiatives, and in turn, triggering the achievement of the SDGs.

2 | CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

This section describes the conceptual research framework and research methods applied in this study. The conceptual research framework includes introducing the 'place-based' policy approach and its key elements following how these elements have been adopted to fulfil the research aims of this study. Following the conceptual framework, the research methodologies (i.e., study area, data sources and data collection methods, and data analysis) are described.

2.1 | Place-based policy and its key elements

The place-based policy is a bottom-up approach that acknowledges that policy interventions have a great potential to address social exclusion, as these strategies have evolved from local-level knowledge (Barca et al., 2012). This approach also recognises that in order to operationalise policies, a mix of appropriate socially inclusive and integrated strategies are necessary, as these reflect local desires and are targeted

towards competitive regional advantages (Beer et al., 2020b; Gibb, 1993). The key characteristics of the place-based policy are engagement with local-level institutions focusing on location-specific governance and leadership (Ayres, 2019). The place-based approach emphasises the need for strategies and programmes tailored to the circumstances of each place, having sensitivity to the local environment and opportunities. In addition, policies must be responsive to structural opportunities as well as local constraints (Rodríguez-Pose, 2018). Four main elements such as places, governance, leadership and community well-being have been highlighted in the existing body of literature on the place-based policy approach (Ayres, 2019; Beer et al., 2020b; Collinge et al., 2013). The conceptual framework of the place-based approach adopted for this study is schematically presented in Figure 1.

Place is the most critical element of the place-based policy approach; it provides comperative advantages for the people living therein, where society and people intersect (Bridger & Alter, 2008; Sonnino et al., 2016). 'Place' represents a sense of belonging, which includes three fundamental dimensions: location—which signifies geographical units; locale—provides physical settings for societal relations; and sense—represents the emotional linkage of people where the individuals live (Collinge et al., 2013). This study considered two separate coastal regions of Bangladesh as places with distinct land-use practices influenced by different socio-economic settings under similar environmental stresses.

Secondly, to achieve the goals of the place-based policy, it is imperative to arrange an effective and targeted governance system in order to operationalise the place-based policy approach (Beer et al., 2020b). To bring about positive livelihood outcomes, the governance structure should also acknowledge the inclusiveness of
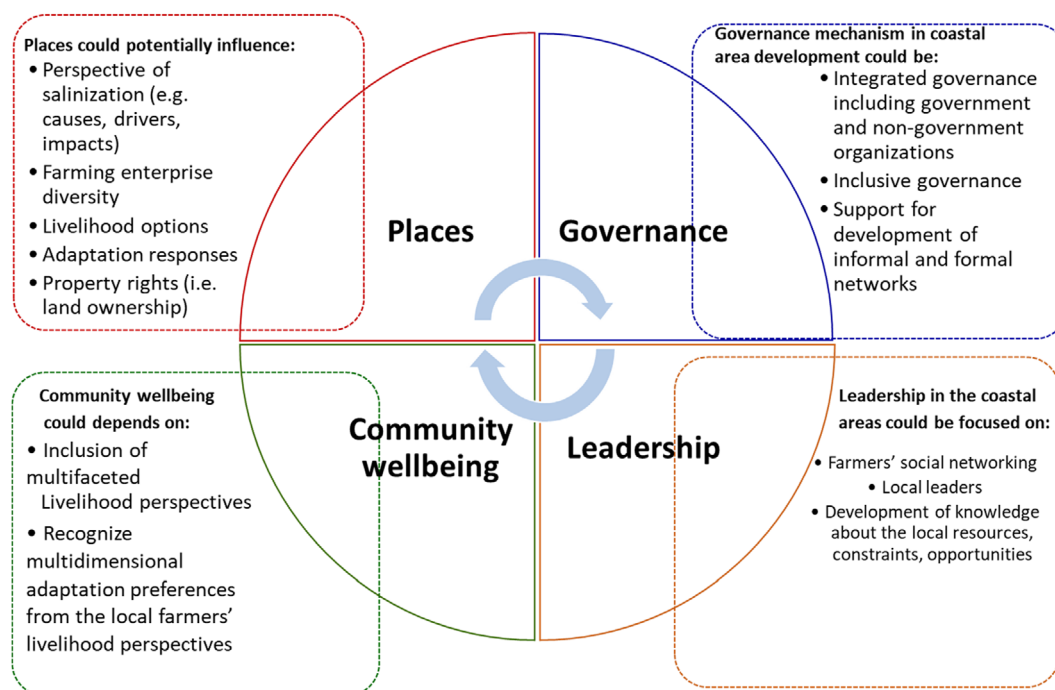

FIGURE 1 Conceptual research framework of the place-based policy approach showing the influence of places on governance, leadership and community wellbeing in a cyclic nature (adapted from [Beer et al., 2020a], author's own construction) [Colour figure can be viewed at wileyonlinelibrary.com]

multi-actors mutual understanding of common regional development goals as well as develop formal and informal collaboration between stakeholder groups (Sotarauta, 2018). This study considered the role of three focal government organisations: the Department of Agricultural Extension (DAE), Department of Fisheries (DoF) and Bangladesh Small and Cottage Industries Corporation (BSCIC) as governance system in constructing coastal development plans and delivering organisational support to the three major livelihood- dependent coastal communities (i.e., rice, shrimp and salt farmers).

Thirdly, the successful implementation of the place-based policy requires innovative leadership to mobilise a wide range of local stakeholders to manage their resources for positive livelihood outcomes (Ayres, 2019). Local leaders can play a significant role due to location-specific knowledge, long-term social perspectives and the ability to influence the actions of the local people (Sotarauta, 2018). This study considered local leaders might have a significant influence on farmers' choices in terms of adaptation actions towards environmental stresses (e.g., salinisation).

Lastly, community wellbeing is crucial for the overall livelihood development of a region which has been defined as the contemporary socioeconomic development of the society in the existing discourses of the place-based policy. It is also argued that community wellbeing depends on the recognition of multifaceted livelihood perspectives of the local people living together in a complex socioeconomic context (Tomaney, 2017). Thus, this study considered community well-being as creating enabling environment for local people's livelihood options to flourish in an equal and just manner.

2.2 | Research methodology

2.2.1 | Selection and description of the study area

The coastal areas of Bangladesh are divided into three main regions such as western, central and eastern based on distinct biophysical and geographical characteristics (Karim & Mimura, 2008). In the southeastern coastal area, most of the land falls under the shallow piedmont zone along with the Chittagong Hill Tracts and is more stable in nature. The major river of this region is the Karnafuli and its tributaries (BWDB, 2013). The southwestern coastal zone is an active delta characterised by the Ganges tidal flood plain and the convergence of a large number of creeks and channels. The major river of this region is the Gorai and its tributaries (BWDB, 2013; Rahman & Rahman, 2015). Due to a wide range of variations in land topography, river systems and livelihood activities, the salinity dynamics vary significantly in these regions (SRDI, 2010).

Two districts from distinct coastal locations of Bangladesh were selected for this study, such as the Satkhira District is one of the most salinity-affected districts of the southwestern region, while Chittagong is one of the least-affected districts of the southeastern coastal region (Table S1). The Assasuni sub-District from the Satkhira District and the Banskhali sub-istrict from the Chittagong District were then selected, as these two sub-districts represent the most salinity-affected areas within these two districts, and also have diversified land use practices (rice farming, shrimp farming and salt farming) (SRDI, 2010). Finally, two villages from two unions of the Assasuni sub-District and two villages from two unions of the Banskhali sub-District were selected for the administration of the household survey (Figure 2).

2.2.2 | Data sources and data collection methods

The major sources of data for this study were primary and secondary data. The primary data were collected through formal household surveys and key informant interviews (KIIs). The household surveys were conducted from February to April 2018 and in 2019 during the dry season in Bangladesh (i.e., from December to May). Prior to conducting household surveys and key informant interviews, human research ethics approval (HREA) was sought and received at the University of New England, Australia (Approval No. HE17-272). A pre-tested and semi-structured interview schedule was used to collect primary data from 109 rice farmers, 107 shrimp farmers and 64 salt farmers. The secondary data were gathered from books, journal articles and reports. The respective sub-district agriculture officer and fisheries officer provided advice on the villages where rice farming was affected by salinity, as well as where shrimp and salt farming had emerged as potential land use. The lists of farmers were obtained from the records of the Agriculture and Fisheries offices in each of the sub-districts. A multi-stage stratified random sampling procedure was followed to select the respondents for the face-to-face interview (Table S2). A similar sampling procedure had been followed by other studies that had investigated farmers' perceptions of salinity and climate change in the coastal areas of Bangladesh (Hasan & Kumar, 2020; Islam et al., 2020). The male farmer from each household was selected as the interview respondent, as men are traditionally the household head in Bangladesh.

The farmers were interviewed about their perception of salinity trends in their locality over the last 20 years and whether salinity had increased, decreased or there had been no change. Their perceptions of the current salinity level, as well as conditions 20 years in the past in their locality were also covered. The farmers' perceived causes/drivers of increased salinity, the impacts of salinity on their farming enterprises and their adaptation preferences for coping with the expected extremes of salinisation were explored by a series of open-ended questions on those topics.

To complement the farmer household surveys, 22 key informant interviews (KIIs) were conducted among a wide range of professionals: agricultural extension department personnel, fisheries officers, rice breeders, soil scientists and NGO personnel from the national, district and sub-district levels. These interviews were conducted at the respective offices of the participants, and their voluntary participation was confirmed before the interview. A series of open-ended questions were posed in order to explore their opinions on the causes of salinisation and the adaptation options needed to combat the expected increase in salinity in the future.
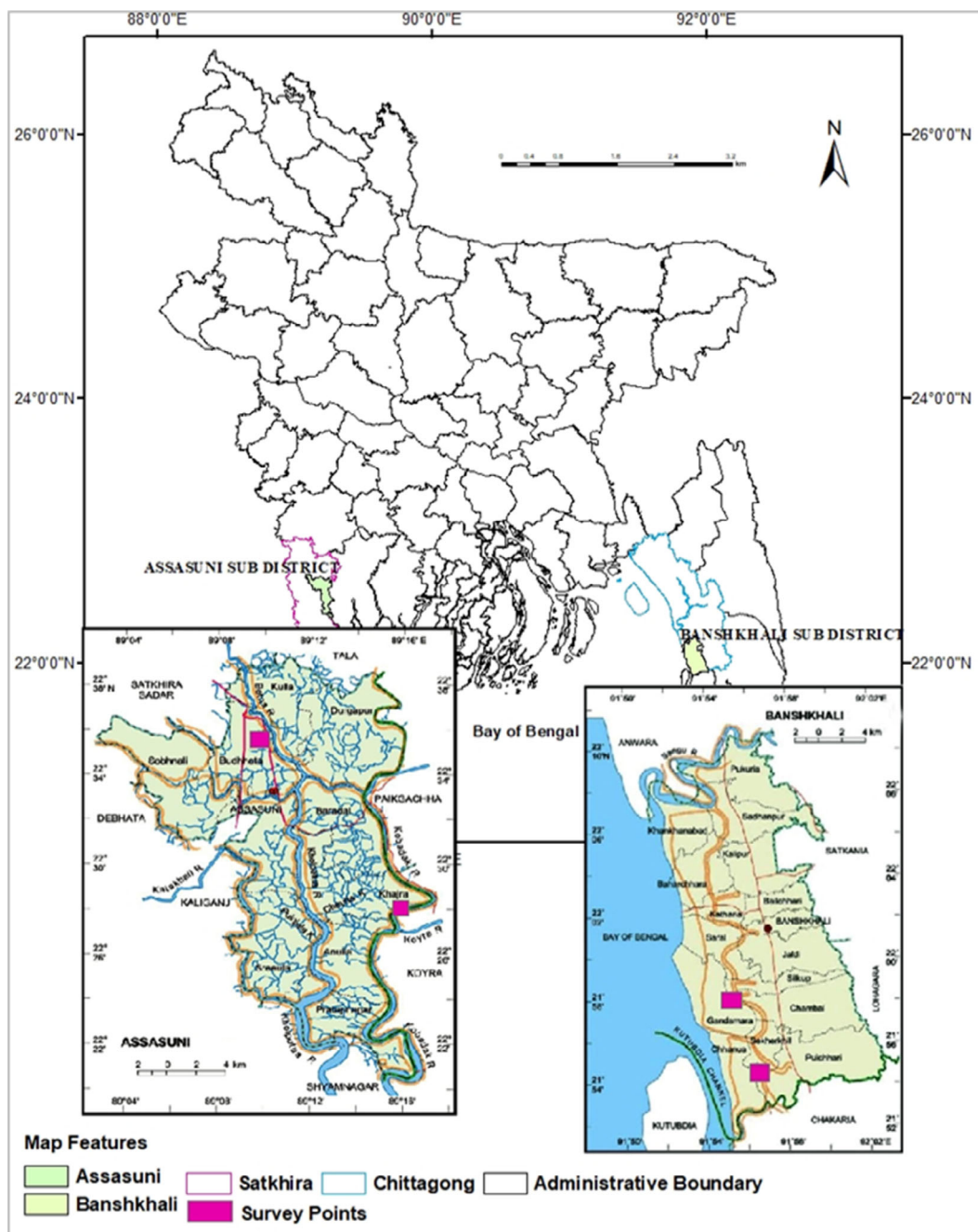
FIGURE 2   Study locations in the coastal areas of Bangladesh. Assasuni sub-District in Satkhira District (bottom left) and Banskhali sub-District in Chittagong istrict (bottom right). The locations of data collection villages are indicated by pink squares. [Colour figure can be viewed at wileyonlinelibrary.com]

2.2.3 | Data analysis

The data collected from the interviews with the household heads were transferred to a usable format by coding the responses. Responses were transcribed from Bengali to English by the lead author who is fluent in Bengali. For open-ended questions, a thematic response matrix was developed and similar responses were placed into these common thematic responses. These were then coded with a number and analysed using IBM SPSS statistical software (Bryman &

Cramer, 2012; Seale & Kelly, 2004). ANOVAs were conducted in order to examine the differences in the independent variables among the different types of farmers. The independent variables examined were age, educational qualifications, total farm size, land ownership, farming experience and monthly average income. The farmers' perspectives of salinity, with particular focus on the trends and causes of salinity and its impacts on their farming enterprises, and their preferred adaptation options were analysed using cross-tab analysis. Chi-square tests were carried out for these categorical variables in order

TABLE 1 Socioeconomic characteristics of the rice, shrimp and salt farmers in the two coastal study areas

Characteristics (unit of measurement)	Rice farmer (N = 109)		Shrimp farmer (N = 107)		Salt farmer (N = 64)		
	Mean	SD	Mean	SD	Mean	SD	F-value
Age (yr)	47.44	8.82	46.70	8.56	47.73	8.40	0.35[NS]
Education (schooling yr)	6.70	5.42	8.43	4.51	3.03	3.04	27.44**
Total farm size (ha)	1.08	0.72	3.90	3.74	1.04	0.75	46.76**
Land ownership (ha)	0.64	0.59	1.76	2.54	0.30	0.30	20.82**
Farming experience (yr)	23.02	8.31	22.23	7.90	25.58	7.14	3.73*
Monthly income ($USD)	137.2	46.27	228.9	38.69	146.3	5.54	139.95**

Note: ** = significant at 1% level of significance, NS = not significant.

to test whether farmers' salinity perspectives varied among the different types of farmers (i.e., frequencies against each category). Similar Chi-square tests were also reported in previous studies investigating farmers' perceptions of climate change and salinity to examine differences among the categorical variables (Al-Amin et al., 2019; Hasan & Kumar, 2020; Islam et al., 2020), and are also reported as a good statistical test to compare categorical variables (Pardo & Pardo, 2018).

The data gathered from the KIIs were transcribed verbatim from Bengali to English and analysed using NVIVO 12 PLUS software. To complement the survey results, they were coded against the themes of causes of salinisation, key considerations in the development and promotion of salt-tolerant varieties and adaptation options to cope with the likely increased salinity in future. Several nodes were created under these themes and the responses under each theme were coded into the respective nodes. Word frequency search queries were conducted in order to recall the most important words or phrases mentioned by the key informants when addressing the specific issues of causes of salinisation and adaptation options. Matrix coding queries were also carried out in order to observe the variations in salinity perspectives (e.g., the causes of salinity) of the different key informants working in different organisations.

3 | RESULTS

3.1 | Socioeconomic features of the different types of farmers

The socioeconomic and demographic features were significantly different between the rice, shrimp and salt farmers in the areas studied (Table 1). Among the three groups of farmers, the shrimp farmers had the greatest average number of years at school (8.4) when compared to the rice and salt farmers, who had 6.7 and 3 years of schooling on average, respectively. The total farm size of the shrimp farmers was four-fold higher when compared with the land holdings of rice and salt farmers. The shrimp farmers owned the greatest area of land, on average 1.76 ha, while rice and salt farmers owned 0.76 and 0.30 ha of land, respectively. All farmers had been farming in their location for at least two decades, with salt farmers having the longest farming experience of 26 years. The shrimp farmers earned almost 1.5 times

higher monthly income compared to the rice and salt farmers. The average age of farmers in all groups was between 46 and 48 years old (Table 1).

3.2 | Context of salinity as perceived by farmer type

The perspectives of the trend in salinity varied between the different types of farmers in the two coastal study areas (Table 2). Only a small proportion of farmers, regardless of land use, reported no change in salinity in the last 20 years, while a stark difference was observed in the case of farmers' opinion on the salinity trend (i.e. increase or decrease in salinity). While 87% of rice farmers reported that salinity had increased over the past 20 years, only 35% of shrimp farmers indicated this. Shrimp farmers were more likely to state that salinity had decreased in the past 20 years (52%). A higher proportion of salt farmers (44%) than shrimp farmers (35%) stated that salinity had increased, but the majority of salt farmers (52%) reported that salinity had declined in the last 20 years. Among the rice farmers, around 90% reported that the current salinity level in their locality was high, with only a small proportion indicating that the current salinity level was low. In contrast to rice farmers, there was a lower proportion of shrimp farmers (47%) and salt farmers (61%) who reported the current salinity level as high. Therefore, a much higher proportion of shrimp farmers (53%) and salt farmers (39%) considered the current salinity level to be low. This result aligns with the farmers' perception of the salinity level 20 years ago, which most rice farmers (84%) said was low; in contrast, 64% of shrimp farmers and 47% of salt farmers reported it as being higher 20 years ago when compared to the present salinity level.

In terms of the main drivers of increased salinity, 62% of rice farmers considered that the human interventions of shrimp farming, salt farming and faulty sluice gates were the main drivers, with less emphasis (27%) placed on natural causes such as cyclones, coastal floods, siltation of rivers and less rainfall. Only a small proportion (10%) mentioned both anthropogenic and natural causes. In contrast to rice farmers, shrimp farmers placed more emphasis on natural causes as the main drivers of increased salinity (39%). A higher proportion (34%) mentioned both human interventions and natural

TABLE 2 Context of salinity among the different types of farmers in the two coastal study areas

Issues of salinity problem	% of the respondents			
	Rice farmer (N = 109)	Shrimp farmer (N = 107)	Salt farmer (N = 64)	Overall (N = 280)
Trend of salinity over the last 20 years				
Salinity increased	87.2	35.5	43.8	55.7
Salinity decreased	9.2	52.3	51.6	36.8
No changes in salinity	3.7	12.1	4.7	7.5
Chi-square = 68.51**				
Current salinity level				
High	89.9	46.7	60.9	66.8
Low	10.1	53.3	39.1	33.2
Chi-square = 46.66**				
Salinity level 20 years ago				
High	15.6	64.5	46.9	41.4
Low	84.4	35.5	53.1	58.6
Chi-square = 54.20**				
Drivers of increased salinity				
Human interventions (e.g., shrimp farming, salt farming, faulty sluice gate)	62.1	26.8	30.8	46.9
Natural events (e.g. cyclones, coastal floods, siltation of rivers, less rainfall)	27.4	39.0	10.2	26.2
Human interventions and natural events	10.5	34.2	59.0	26.9
Chi-square = 41.98**				

Note: ** indicates significant at 1% level of significance.

causes as the drivers than those who mentioned human interventions alone (27%). Among the salt farmers, the main drivers of increased salinity were human interventions (47%), while almost equal emphasis was placed on natural causes and human interventions together (27%) and natural causes alone (26%) (Table 2).

Following the perceived salinisation (i.e., trends, causes), this study then explored how these perceptions varied according to the salient features of different types of farmers (i.e., ascertaining which socioeconomic characteristics of the farmers contributed more to their perceptions of salinity) (Table 3). The results showed that there were different socioeconomic features that had an influence on farmers' salinity perceptions. Among these socioeconomic characteristics, the effects of the respondent's farm size on their salinity perceptions varied statistically. Among the farmers who said salinity had increased (i.e., 56%), farmers with medium-sized farms represented the highest proportion (17%), while the lowest proportion (11%) came from the respondents with large farms. Similarly, farmers with medium size farms made up the highest proportion of the farmers who reported the current salinity as high. Similar trends were observed in the case of farmers' perceptions of drivers of increased salinity as natural causes, except on the basis of educational qualification, where secondary to higher secondary level educated farmers made up the highest proportion of natural drivers of increased salinity (Table 3).

The findings from the household interviews followed similar trends to the key informant interviews in terms of the perspective that anthropogenic drivers had a major role in increasing salinity. However, there was a clear polarisation between the representatives of the Fisheries and Agriculture Departments in terms of their views on the role of natural causes in increasing salinity. The majority of the coded responses (92%) from the Fisheries Department officers' KIIs referred to the natural drivers of salinity, while only 8% of the coded responses from the Agriculture Department KIIs stated that the natural drivers contributed to increased salinity (Figure 3).

With regards to the anthropogenic drivers of increased salinity, the KIIs reported the same type of anthropogenic drivers of increased salinity causes as reported by farmers: increases in shrimp and salt farming and faulty management of embankments. However, the majority of the KIIs more often spoke about the way the unplanned expansion of shrimp and salt farming had been the greatest anthropogenic driver of increased salinity (Figure 4a). With regards to the natural drivers of increased salinity, some of the mentioned drivers were climate change, sea level rise, reduced rainfall, higher temperatures, inundation with saline water and siltation of rivers. However, the coded references of the KIIs indicated that they mostly mentioned climate change-induced sea level rise and less rainfall as the greatest drivers of increased salinity in the coastal areas (Figure 4b).

Farmers who stated that salinity had declined over the last 20 years, were asked why they thought salinity had decreased. Among the rice farmers who said salinity had decreased, which was only a small proportion, 70% reported that 'rainfall had increased
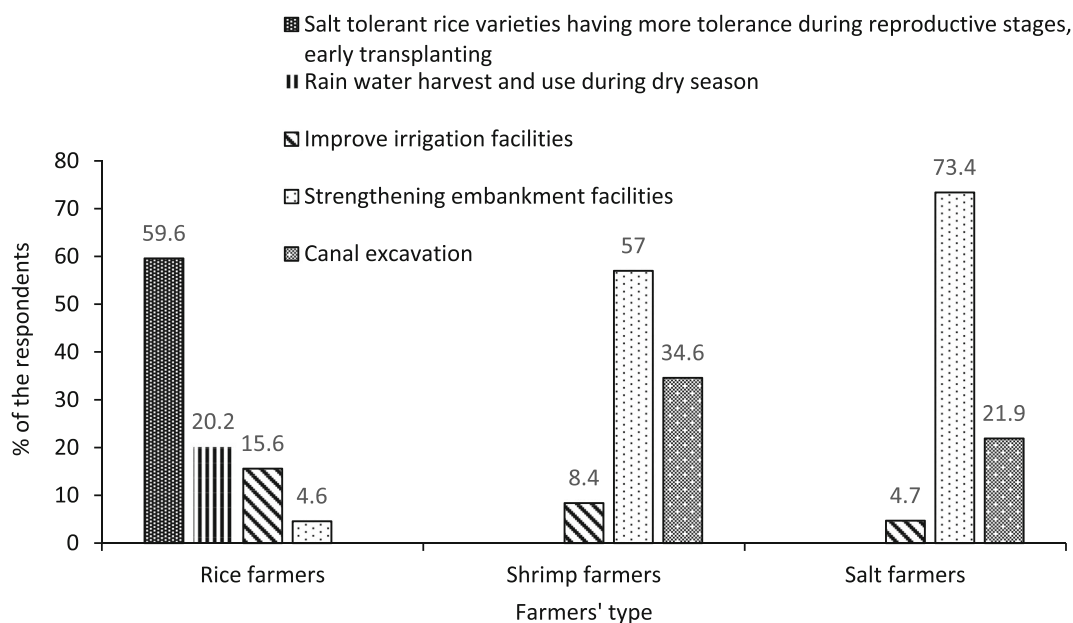
TABLE 3 Farmers' perceived salinity context as influenced by the different socioeconomic features

Issues of salinity problem (% of the respondents)		Age			Farming experience (years)			Landholding size				Educational qualification		
		<40 yr	40–55 yr	56–70 yr	<15 yrs	15–20 yr	>20 years	Marginal (0.1–0.5 ha)	Small (0.51–1.0 ha)	Medium (1.01–2.0 ha)	Large (>2.0 ha)	Up to primary	Secondary to higher secondary	Graduate to post graduate
Trends of salinity	Increased (55.7)	10.7	34.6	10.4	7.5	20.0	28.2	12.5	15.0	16.8	11.4	29.6	21.8	4.3
	Decreased (36.8)	7.9	23.2	5.7	4.3	11.8	20.7	5.7	7.1	10.4	13.6	19.3	13.2	4.3
	No Change (7.5)	1.1	5.4	1.1	1.1	2.9	3.6	1.4	1.4	3.2	1.4	3.2	3.6	0.7
	Chi-square	1.17^{ns}			1.02^{ns}			11.2^{**}				2.07^{ns}		
Current salinity	High (66.8)	14.3	41.4	11.1	9.3	22.9	34.6	13.2	18.2	22.5	12.9	35.0	25.4	6.4
	Low (33.2)	5.4	21.8	6.1	3.6	11.8	17.9	6.4	5.4	7.9	13.6	17.1	13.2	2.9
	Chi-square	1.1^{ns}			0.55^{ns}			16.31^{**}				0.13^{ns}		
Salinity 20 years ago	High (41.4)	6.8	27.9	6.8	5.0	15.0	21.4	7.9	7.5	11.4	14.6	20.8	17.5	3.6
	Low (58.6)	12.9	35.4	10.4	7.9	19.6	31.1	11.8	16.1	18.9	11.8	31.8	21.1	5.7
	Chi-square	1.64^{ns}			0.25^{ns}			9.01^{**}				1.12^{ns}		
Drivers of increased salinity	Human interventions (46.9)	9.1	29.1	8.6	6.3	16.6	24.0	12.0	12.0	16.0	6.9	26.3	14.9	5.7
	Natural causes (26.2)	6.9	13.1	6.2	2.2	12.0	12.0	5.7	5.7	7.4	7.3	10.3	13.1	2.9
	Human interventions and natural causes (26.9)	6.3	17.1	3.4	5.7	5.7	15.4	4.0	8.6	8.6	5.7	18.3	7.4	1.1
	Chi-square	3.1^{ns}			7.3^{*}			5.6^{ns}				4.4^{**}		

Note: ns indicates not significant, ** indicates significant at 1% level of significance.

compared to the last few decades', and 30% mentioned, 'less risk of inundation of saline water due to siltation of rivers and canals'. A similar proportion of salt farmers reported the same reasons for the decline in salinity. In contrast, shrimp farmers who stated salinity had declined placed greater emphasis (69.6%) on 'less risk of inundation of saline water due to siltation of rivers and canals' (Table 4).

3.3 | Impacts of high salinity on farming enterprise by farmer type

The perceived impacts of high salinity by the different farmer types in the coastal areas of Bangladesh were very much focused on their main enterprise, with most of them concerned about impacts on yield. For rice farmers, high salinity had negative consequences on yield, with 42.2% reporting that 'rice plants dry up, unfilled grain, lower yield, income reduced', 30.3% also stated that 'crop cultivation

becomes difficult, lower yield, income reduced' and 27.5% observed 'damage to soil fertility, lower yield, less income'. In contrast, the increased salinity had positive impacts on yield and income potential for shrimp farmers, with 69.2% mentioning that 'movement of fish in the pond is noticeable, higher yield, more income', while 30.8% reported that 'growth of fish is good, higher yield, more income'. Similarly, salt farmers reported positive impacts of increased salinity on yield, with 54.7% reporting 'density of water increase, higher yield', and the remainder that they had received a 'higher yield of salt' (Table 5).

3.4 | Adaptation preferences to cope with expected high salinity

The household interviews showed significant differences in the adaptation preferences for likely high salinity in future among the different farmer types in the two coastal areas of Bangladesh. Rice farmers placed the greatest emphasis on agronomic solutions to likely high salinity, with approximately 60% referring to 'salt-tolerant rice varieties with greater tolerance during the reproductive stages, and early

FIGURE 3 Coding references from the key informant interviews (*n* = 22) of representatives of the agriculture (*n* = 19) and fisheries departments (*n* = 3) on the drivers of increased salinity

TABLE 4 Farmers' perceived causes of decline in salinity

Farmer type (*n*)	% of the respondents	
	Rainfall increased compared to the previous decades	Less inundation by saline water due to siltation of rivers and canals
Rice farmers (10 of 109)	70.0	30.0
Shrimp farmers (56 of 107)	30.4	69.6
Salt farmers (28 of 64)	67.9	32.1

FIGURE 4 The drivers of increased salinity as reported in KIIs (*n* = 22). (a) Anthropogenic and (b) natural drivers

TABLE 5 Impacts of high salinity on farming enterprises

	(% of the respondents)						
Farmer types (n)	Rice plants dry up, unfilled grain, lower yield, income reduced	Damaged soil fertility, lower yield, less income	Crop cultivation becomes difficult, less yield, income reduced	Growth of fish is good, higher yield, more income	Movement of fish in the pond is noticeable, higher yield, more income	Density of water increases, higher yield	Higher salt yield
Rice farmers (109)	42.2	27.5	30.3	0.0	0.0	0.0	0.0
Shrimp farmers (107)	0.0	0.0	0.0	30.8	69.2	0.0	0.0
Salt farmers (64)	0.0	0.0	0.0	0.0	0.0	54.7	45.3

FIGURE 5 Adaptation preferences for coping with expected high salinity among the different types of farmers

transplanting', while a smaller proportion (around 20%) mentioned 'developing facilities to harvest rain water during monsoon and use it during the dry season' and around 16% suggested, 'improved irrigation facilities'. There was little emphasis (4%) on engineering solutions such as 'strengthening embankments facilities'. This result contrasts with the adaptation preferences for higher salinity reported by most shrimp farmers (57%), who suggested engineering solutions such as 'strengthening embankment facilities' be used to mitigate increasing salinity, while 35% preferred 'canal excavation'. Salt farmers placed an even greater emphasis than shrimp farmers on engineering solutions to deal with the increase in salinity, with around 74% suggesting 'strengthening embankment facilities', and only around 22% suggesting 'canal excavation' as their preferred adaptation options (Figure 5).

Adaptation preferences for coping with the expected high salinity mentioned by the farmer types were also found to align with the KIIs with the service providers for the main enterprises of rice, shrimp and salt farming. A higher proportion of coded responses were from the Agriculture Extension (43%) personnel and research organisations (39%) compared with the Fisheries Department (10%). Word clouds

showed the most preferred options to cope with high salinity were the use of salt-tolerant rice varieties and irrigation techniques (Figure 6a). The specific options mentioned by the agriculture extension staff were mostly agronomic technical options such as the use of salt-tolerant rice varieties, application of irrigation regularly and early transplanting. In contrast, KIIs from the non-crop sectors (e.g., Fisheries Department, NGOs) spoke mostly of engineering solutions such as canal excavation and strengthening of embankment facilities (Figure 6b), although they had only minor representation in the KIIs ($n = 7$).

3.5 | Sources of information/farming advice

Farmers in the coastal study areas used a number of sources for advice and information for their farming enterprises, but there is very little crossover between government departments and enterprises, and a high reliance on neighbouring farmers. Rice farmers (50.5%) have a substantial reliance on information and farming advice

FIGURE 6   Adaptation options that emerged from the KIIs from the industry-specific organisations. (a) Cropping sector ($n = 15$), and (b) non-cropping sector ($n = 7$)

TABLE 6   Sources of information and farming advice of the different types of farmers

Farmer type (n)	% of the respondents				
	Agriculture office and local sub-assistant agriculture officer	Neighbouring farmers	Neighbouring farmers and local input dealers	Neighbouring farmers and local fisheries office	Neighbouring farmers and government personnel
Rice farmers (109)	50.5	22.9	26.6	0	0
Shrimp farmers (107)	0	51.4	3.7	44.9	0
Salt farmers (64)	0	92.2	0	0	7.8

obtained from the sub-district Agriculture office and the local sub-assistant agriculture officer, and to a lesser extent from neighbouring farmers and local input dealers (26.6%) and neighbouring farmers only (22.9%). Among the shrimp farmers, 51.4% obtain farming advice from neighbouring farmers and 44.9% obtain information from neighbouring farmers and the sub-district Fisheries Office. In contrast, salt farmers almost exclusively obtain farming advice from neighbouring farmers (92.2%), while the remainder also mentioned neighbouring farmers and government personnel (Table 6).

4 | DISCUSSION

The coastal salinisation presents an immense challenge to crop agriculture, but at the same time, it offers opportunities for shrimp aquaculture and salt farming resulting in opposing salinity perspectives between farming enterprises. Thus, the existing 'one size fits all' strategy to deal with the pernicious nature of increasing salinisation might be ineffective to achieve local farmers' salinity adaptation needs, which in turn could improve their wellbeing. The place-based policy approach could be a better choice for policy-makers and planners as

this approach takes into account divergent framing of the environmental issue influenced by location-specific constraints and opportunities, and focuses on collaborative efforts to bring about positive livelihood outcomes for the local community. Firstly, this section will discuss the diverse perspectives of salinisation (i.e., trends, causes, impacts) by the different farmer types (i.e., rice, shrimp and salt farmer) located in distinct coastal regions. Then the potential of distinct salinity framing to support adaptation preferences through operationalising the place-based policy initiatives will be discussed.

4.1 | Farmers' distinctive framing of salinisation and its impacts on their livelihood in the coastal areas of Bangladesh

This study has shown that rice, shrimp and salt farmers have distinctively framed the process and impacts of salinisation. While the majority of rice farmers and almost 50% of salt farmers perceived that salinity had increased over the last 20 years, just over half of shrimp farmers believed that salinity had decreased over the same period. Land size could have played a significant role in rice and salt farmers'

perceptions of salinity increasing over the last two decades. As rice farmers have a quarter of the land compared to the shrimp farmers, a loss of yield or farm income due to salinity has a greater negative impact on their livelihoods, which heightened their concern over salinity increasing. Furthermore, the stark contrast in the framing of salinisation among the rice, shrimp and salt farmers could be due to the relative dependence of their farming livelihoods options on saline and/or non-saline water resources. For instance, shrimp and salt farmers use brackish saline water for their farming enterprises, which might influence their perceptions of a declining salinity trend as they could face difficulties in pulling saline water due to the siltation of rivers (Deb, 1998). In contrast, a slight increase in soil salinity negatively affects rice yields (Zeng et al., 2003), thus rice farmers who perceived increasing trends in salinity might experience effects of salinity during the dry season for rice growing. Rice farmers from the study area have reported that salinity has been the most significant barrier to dry-season rice farming (Islam et al., 2020).

The findings of this study also showed that the perceived causes of salinity in the coastal areas varied according to farm enterprise. The majority of the rice farmers perceived that the expansion of shrimp farms into the adjacent cropping fields was resulting in increased localised salinity, as well as reducing the land that was available for rice farming. These shrimp farms were typically four times the size of rice farms. A large body of literature also indicated that shrimp farmers are socioeconomically more powerful and that they have not only converted their own rice fields into shrimp farming but also actively bought up neighbouring farmers' land for shrimp farming, a process that has ultimately increased salinity in the coastal areas (Kabir et al., 2018; Kabir et al., 2021).

In contrast, the shrimp and salt farmers attributed the increased salinity to natural causes rather than considering that their own farming enterprise was a contributing factor. In addition, a trigger to the conversion of their land to shrimp and salt farming could have been when they did grow rice, and yields declined by natural causes, like cyclones and frequent inundation, which then led to a search for a more economic enterprise under saline conditions. This is another reason why the shrimp and salt farmers' emphasised natural drivers when asked about causes of salinity in the coastal areas. The literature clearly indicates that salinity lowers rice yields and that these lower yields have influenced those farmers in the coastal areas to convert their cropping land to shrimp and salt farms (Ahmed, 2013; Amin et al., 2011). Farmers who stated that salinity had decreased also mentioned that the reasons behind their thinking were related to the level of dependency of their livelihood options on the availability of saline water. As those farmers might encounter difficulty in accessing saline water due to siltation of rivers and canals from lower water flows, thus their perceptions of the salinity trends could have been shaped by these experiences of difficulties in getting saline water for their farming (Mertz et al., 2009).

Distinctive farmer types with divergent or opposing impacts on the livelihood options as a result of increasing salinity were found in the studied regions. The most noted negative impact for rice farmers was a reduction in rice yields in their farming enterprise due to high salinity. As yields have declined due to salinity, their overall income from the rice was less. Yield reduction due to high salinity has been reported in the literature (Hasanuzzaman et al., 2009; Joseph & Mohanan, 2013; Zeng et al., 2003), which supports the farmers' experience. In addition, as the average farm size of the rice farmers was a quarter of the shrimp farmers so they would be more disadvantaged due to increased salinity which could reduce their overall farm income. On the other hand, the shrimp and salt farmers considered high salinity to have a positive impact on their livelihood options mostly due to the requirement of saline water for these farming enterprises, which ultimately led to more stable and increased farm income (Anik et al., 2018).

4.2 | Farmers' distinctive framing of salinity adaptation preferences and support network for their farming enterprises

This study has demonstrated that there were stark contrasts in farmers' adaptation preferences for coping with expected high salinity, and they vary according to their farming type and perception of the problem. The rice farmers' preferred options to cope with the increasing salinity were to use salt-tolerant rice varieties with greater tolerance during the reproductive stages, and improved irrigation facilities. These adaptation preferences might be influenced by their rice farming experiences under saline conditions that showed farmers in the coastal areas reported salinity was more severe during the reproductive stages of rice crops (Islam et al., 2020). In addition, these adaptation options preferred by the rice farmers offer plausible and practical solutions to their situation, as they own small areas of land and have a low monthly income. Rice farmers may also have fewer options to move to other cost-intensive livelihoods and prefer to use salt-tolerant rice varieties to extend the time they can continue the cultivation of their current landholding, even though they expect salinity conditions to worsen. Despite the fact that the rice farmers were concerned about anthropogenic drivers (e.g., increased land conversion to shrimp and salt farming) as the causes of salinisation, they did not suggest the cessation of these enterprises in their localities as a solution. However, some of them mentioned the need to create facilities for rainwater storage in the wet season that could be used for irrigation in the dry season. As the conversion of cropland to brackish water for shrimp and salt farms is almost irreversible, their preferred options are concentrated on their own farming opportunities rather than a complete shift to other enterprises. This might be due to the fact that rice farmers in the coastal areas of Bangladesh, who are socioeconomically poor and disadvantaged, did not want to suggest the cessation of shrimp farming, as shrimp farmers are richer, more powerful and more socio-economically advantaged (Ahmed et al., 2010; Ali, 2006). In contrast to the rice farmers, the shrimp and salt farmers' preferred salinity adaptation options are predominantly associated with the engineering solutions of strengthening embankment facilities and canal excavation that will protect them from cyclones. As shrimp and salt farmers are more concerned with the natural drivers of the increased salinity,

these perceived causes have probably influenced their preferred adaptation options to cope with increasing or high salinity.

Rice farmers, out of all the enterprises studied, have the strongest link to local level extension staff combined with neighbouring farmers. As Agriculture Extension Department has one of the largest extension service-providing organisations in Bangladesh, they are well placed with field staff at the local level to provide ongoing access to information. On the other hand, shrimp and salt farmers relied heavily on neighbouring farmers for their farming advice and livelihood options. All farmer types, to a greater degree, relied on neighbouring farmers for farming information, which signifies the importance of local leadership. It has also been reported elsewhere that farmers placed most trust in other farmers to learn about new soil practices and were less trusting of traditional 'experts', particularly agricultural researchers from academic and government institutions, who they believed were not empathetic towards farmers' needs (Rust et al., 2021). Based on this and our own research findings it would be the important first step for government departments in Bangladesh to build connections to the farmers' social network and identify the type of support progressive farmers, regardless of the farm type, in the coastal areas of Bangladesh.

4.3 | Implications of the farmers' salinity perspectives to the use of place-based policy initiatives to achieve SDGs

Achieving sustainable development goals (SDGs) is the key policy objective of the Bangladesh government. Among these goals, SDG-1 (no poverty), SDG-2 (no hunger) and SDG-3 (good health and wellbeing) are explicitly linked to sustainable agricultural development. In achieving these goals, agricultural development in the coastal areas is the key focus of research and extension initiatives, particularly for sustainable land use management in these regions. However, salinisation in these areas presents immense challenges to achieving the SDGs signifying that one single solution will not address all enterprises equally or justly as salinisation affects livelihood in diverse ways. Therefore, an integrated and bottom-up approach is required which acknowledges the different and unequal impacts of salinisation in each and every region requiring location-specific policy interventions tailored to the specific context. However, the existing policy initiatives [e.g. National Agriculture Policy (NAP), National Fisheries Policy NFP)] are highly top-down and overlook heterogeneity in the coastal farming system, which requires farm-specific extension advice to improve livelihood as well as to address salinisation (Sarker et al., 2021). Thus, policy initiatives to address salinisation must consider the divergent impacts from multiple farming perspectives equally while considering the ramifications of one group over another with a place-based approach that could resolve these differing situations. The following sections discuss the implications of place-based policy initiatives to address salinisation and thus contribute to achieving sustainable development goals. A proposed place-based policy initiative is schematically presented in Figure 7 based on research findings of the coastal farmers' salinity perspectives and adaptation preferences that have multiple livelihood options.

Previous studies have reported that various levels of trade-offs and synergies occurred when countries around the world changed their policy in order to progress the sustainable development goals (SDGs). For example, fulfilling various targets of the SDG-6 (clean water and sanitation) was reported to have the greatest synergies, and mutual benefits for achieving other SDGs, while achieving the SDG-2 could have the potential trade-offs with the SDG-3 through limiting ecosystem services necessary for the societal well-being (Fader et al., 2018; Pradhan et al., 2017). Diverse salinisation perspectives shown in this study also demonstrated that synergies and trade-offs could emerge and also signifies the necessity of a place-based policy approach, which can address these and at the same time achieve the aforementioned SDGs. For example, mutual benefits (e.g., boosting agricultural productivity) will occur when achieving SDG-1 and SDG-2 through maintaining diversified land uses but if salinity worsens it could also limit the ecosystem services of the coastal resources, which then negatively impacts SDG-3 (health and wellbeing), and negates the gains made in SDG-1 and SDG-2.

In addition, as shrimp farmers operate on greater land areas their farming livelihood is less likely to be impacted by salinisation, and they could continue to expand shrimp farming, which ultimately could reduce the options for rice farmers who are already disadvantaged by the salinity ingress. Another concern with shrimp farming is the high proportion of leased land per landholder, which could affect land stewardship and ongoing farmer commitment to sustainable agriculture development. However, it is also necessary to acknowledge the economic importance of shrimp and salt farming as well as the dynamic nexus of saline and fresh water in the coastal areas which signifies the obvious co-existence of rice-shrimp-salt farming (Abdullah et al., 2021). Thus, policy initiatives should be nested in a blended farming system which could regulate the unplanned expansion of brackish water-dependent shrimp-salt farming, and at the same time improve irrigation facilities and introduce saline tolerant crops based on rice farmers' salinity adaptation preferences. Through a place-based policy initiative, these locally derived adaptation preferences can be scaled up more effectively and therefore address SDGs more in keeping with local constraints and opportunities. For successful implementation of such policy initiatives, it is imperative to have a governance structure that is capable of translating scientific information into actions at the local scale. To achieve this, an on-farm and participatory governance mechanism need to be appraised consisting of interactive communication efforts among the policy-implementing stakeholders (e.g., land managers, extension personnel, scientists) and farmers. In addition, the involvement of private sectors (e.g. NGOs) in a public-private partnership is also required to promote innovative ideas of sustainable land and water resources management (Lal et al., 2021), particularly integrated water resources management. Thus, a functional governance mechanism involving government organisations (e.g., DAE, DoF, BSCIC) and NGOs is required in constructing integrated coastal development plans and delivering organisational support to the three major livelihood-dependent coastal communities
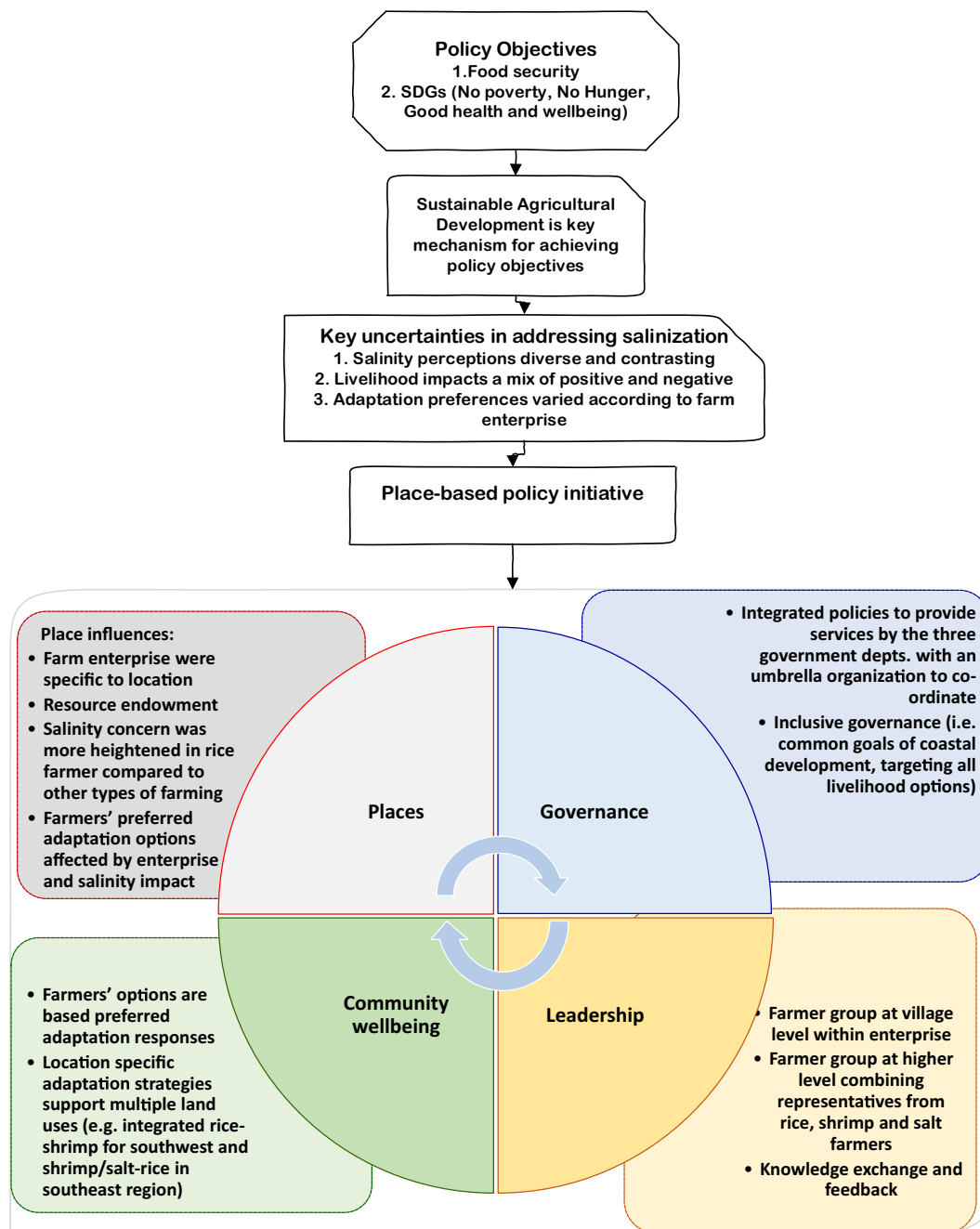
FIGURE 7 Proposed place-based policy initiatives to address the salinisation problem in the coastal areas of Bangladesh [Colour figure can be viewed at wileyonlinelibrary.com]

(e.g., rice, shrimp and salt farmers). While we argue that three focal service-providing organisations (i.e. DAE, DoF, BSCIC) have their own vested interest, at least an umbrella organisation could be established to integrate planning and implementation for coastal region management activities across enterprises.

A place-based policy requires leadership with a comprehensive knowledge of the local resources and the capacity to mobilise resource users (e.g., local farmers). Thus, this study argues for creating farmer groups at the village level that are enterprise-specific and at a higher level (e.g. sub-districts) a farmer group consisting of representatives from all farming types (e.g., rice, shrimp and salt farmers). The

groups at the village level could act as a resource centre for the local farmer with their neighbours or peers for farming advice, and the combined enterprise group at a higher level could provide feedback to the government for broader land use planning. Literature also suggested that opportunities for sharing or exchange of knowledge between farmers are worthwhile as studies in other developing countries have shown that it is the most often used and relied upon source of information (Huynh et al., 2021).

Achieving the SDGs requires that all farmer types must maintain or improve land conditions to use their land sustainably in order to ensure their farm productivity, and thus contribute to household food

security as well as overall community development in coastal Bangladesh. As findings of this study have shown multifaceted adaptation preferences occur under high salinity, thus, research and extension policy initiatives for rice, shrimp and salt farmers need to be more place-based so that the initiatives are customised to the local contexts and inherent land capabilities (Dam et al., 2021). To meet the rice farmers' livelihood objectives, the most vulnerable farming group to increasing salinity, a suggested farmer initiative was to develop salt-tolerant rice varieties that are tolerant during the reproductive stages when salinity levels are highest and not exclusively focusing on the germination and seedling emergence stages (Islam et al., 2020). Another suggested farmer initiative was the improvement and strengthening of the embankments, and canal excavation which could protect the land from frequent saline water inundation, as well as store monsoon rainwater, useful for irrigation in dry season rice farming. In addition, efficient sluice gate management and equitable land zoning and its strict implementation could help ensure proper utilisation of coastal resources for all types of farmers.

5 | CONCLUSIONS

Salinisation has been caused by both natural and anthropogenic drivers and is one of the crucial risk factors for the sustainable development of coastal livelihoods in Bangladesh. The impacts of salinisation have resulted in highly spatial–temporal variations and contested land uses as well as contrasting framing from the various farming types (e.g., rice, shrimp and salt farmers), which has created uncertainty in the outcomes of adaptation decisions. The findings of this study demonstrated the importance of place and farming type in the perceptions of salinity. While the majority of the rice farmers perceived an increasing trend in salinity, half of the shrimp and salt farmers perceived it to have declined. There was a lack of agreement also on the causes of salinity with most rice farmers indicating anthropogenic factors as the main causes, while the majority of shrimp and salt farmers focused more on natural factors. Rice farmers also perceived a reduction in yield, followed by less income under saline conditions, while shrimp farmers and salt farmers perceived production gains when high salinity prevailed. The adaptation preferences to combat salinity were also at odds between farmers with rice farmers' adaptation preferences for the development of salinity-tolerant rice varieties that have greater tolerance at the reproductive stages, while shrimp and salt farmers' preferences are engineering-based solutions to prevent seawater inundation during cyclones. Limitation of this study is that it did not consider property rights which could have an impact on land degradation (i.e., salinisation). As shrimp and salt farmers' landholding includes a substantial amount of leased land, they might be less committed to preventing the degradation of these lands due to their farming action (i.e., shrimp farming). Thus, future research could be carried out to examine the effects of property rights on land stewardship and land degradation impacts. Findings also indicated that farmers' sources of information for farming enterprises predominantly rely on neighbouring farmers from the same enterprise, and local level extension personnel, signifying the need for farmer-led innovation to operationalise place-based policy initiatives. Thus, research and extension services on integrated coastal resources management need to consider tailoring their approach to accommodate varied livelihood perspectives of salinity, as this place-based approach could accelerate the pace of achieving the SDGs (i.e. SDG-1, SDG-2 and SDG-3) due to a more strategic targeting of farmer types and their salinisation context.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data is confidential and could be made available upon request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.