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Can shrimp farming unlock a sustainable future?

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Executive Summary

Climate models predict that Bangladesh faces severe climate risks that threaten to undermine the country's recent progress in growth, poverty reduction and human development. One key manifestation of this threat expected by climate scientists is increased groundwater salinity, caused in part by climate change-induced sea-level rise. In the coastal districts of southwestern Bangladesh, land operators have responded by converting the land of rice fields into *ghers*, or shallow saltwater ponds used to cultivate shrimp and other saltwater fish.

To better understand the context of this form of climate adaptation, we have conducted ten focus group discussions and a survey of 739 households in a rural coastal district of Bangladesh where salinity levels are expected to rise. In our setting, respondents report high levels of concern about the changing climate and widely believe that future increases in salinity will lead to lower yields for existing rice varieties. They expect these impacts to be especially severe in areas where agricultural plots have been converted to saltwater *ghers*, which suggests that they are aware of production spillovers (i.e. negative externalities) which will affect those who remain in rice cultivation and agriculture.

Survey results show that rice farmers and shrimp cultivators are similar in age, gender and education, but that the annual income for those farming shrimp is 37% higher than for those farming rice. We identify land conversion costs, from previous agricultural plots into *ghers*, as a potential barrier to the adoption of the new technology (i.e. shrimp cultivation). On average, survey respondents estimate that converting a rice plot into a *gher* takes more than three weeks, and only 17% report currently having the savings necessary to finance the switch.

1 - Introduction

Climate change poses a major threat to the livelihoods of the global poor, especially those working in agriculture. Coastal districts of Bangladesh, the context of this project, are predicted to be especially vulnerable to climate shocks. Because the country is low-lying, coastal, tropical and a large share of the population works in agriculture, Bangladesh is exposed to a wide range of climatic events including floods, droughts, erosion and sea-level rise, among others (World Bank, 2022). Government estimates place the number of people in Bangladesh who will be displaced by climate change by 2051 at one-in-seven (Bangladesh Ministry of Foreign Affairs, 2022). To avoid large-scale displacement in the next two decades, it is critical to develop a better understanding of the feasibility of adaptation methods available to those on the front lines of climate change.

One such promising form of adaptation that may provide better outcomes for those living near the southwestern coast of Bangladesh is shrimp farming in saltwater ponds, or *ghers*. As sea-level rise drives increases in groundwater salinity, yields from traditional rice varieties decline, reducing incomes for farmers. However, landowners and operators may respond to the increased salinity of available water by flooding their land with this newly saline water and instead cultivate shrimp, using either wild-caught fry or fry purchased from hatcheries. Although the transition from rice farming to shrimp cultivation requires considerable financial and human capital investment, it provides an instructive case study of climate adaptation for three reasons.

First, shrimp cultivation allows people to adapt in situ to changing climate conditions rather than making the risky choice of migrating to cities. In situ adaptation is also an important objective for policymakers as the large-scale movement of people into cities may lead to overcrowding, congestion or other unfavourable outcomes. Second, while rice farmed in this region is primarily cultivated to be sold at local or regional markets, 20-40% of shrimp produced in Bangladesh is for export (Mamun, 2021). A local climate shock harms rice farmers even if their crops are spared because local buyers of the crop are still affected. By contract, shrimp demand is influenced by international markets. Since shrimp is largely exported, demand will not be driven by local shocks, but instead in part by demand shocks in the importing country. If we expect that shrimp demand in South Korea, for example, is uncorrelated with demand shocks in southwestern Bangladesh, then the switch from rice farming to shrimp cultivation may act like a form of insurance. Third, shrimp farming may allow people to work with, rather than against, the changing climate. Better information on when to switch to shrimp farming may help farmers avoid years of declining rice yields and profits.

However, it is important to note that shrimp farming is unlikely to be a silver bullet against climate change in this region. Shrimp farming may be more volatile than rice farming due to disease outbreaks and poor cultivation techniques. Second, differences in the labour intensiveness of shrimp cultivation relative to rice farming may lead to lower wages for those working in shrimp farming, post-switch. Likewise, those least able to migrate may work in such casual shrimp jobs (i.e. women, the poor). Third, there may be negative production spillovers onto those who remain in rice, if nearby shrimp cultivation leads to increased saline intrusion. The latter two of these three caveats are discussed in detail in the report below.

The findings discussed below are drawn from a series of focus group discussions (hereafter FGDs) with shrimp farmers, workers and other stakeholders conducted in March and April of 2024, as well as a survey of approximately 739 shrimp cultivators and rice farmers in salinity-affected regions conducted in May and June of 2025.

We observe four main findings from the FGDs. First, discussants believe in climate change and report witnessing both increases in temperature and increases in salinity. Second, they report that rising salinity is a primary cause of the increase of shrimp farms. Third, there are concerns about the distribution consequences of shrimp farming. One common belief is that because shrimp cultivation requires less labour, the profits may more often fall in the hands of elites. Fourth, those with experience in shrimp cultivation report that saltwater used for their ponds could have externalities for those operating rice plots in nearby areas.

From the follow-up survey conducted after the FGDs, we find that while shrimp cultivators and rice farmers are balanced in age, gender and education, the former group has 37% higher earnings. It is also notable that in this setting, 78% of respondents report the highest level of climate concern on our scale. In keeping with the qualitative finding that increases in salinity may hurt yields, we find that 95% of respondents expect that the conversion of a neighbouring plot from paddy to saltwater *gher* would increase the salinity on their land and 98% expect that this would decrease yields. We also find that the cost of converting land from a rice paddy to a saltwater gher may inhibit the adoption of shrimp farming. Only 18% of respondents report that they have enough savings to convert a plot from an agricultural field to an aquacultural *gher*. However, a higher share (75%) report that they could cover the costs with a loan.

The remainder of the report is as follows: Section 2 outlines the academic literature to which this project contributes. Section 3 describes the methodology of both the qualitative and quantitative work carried out to date. Section 4 presents the results of the project. Section 5 concludes and lays out next steps for the project.

2 - Literature Review

A large body of economic research suggests that the effects of climate change will be both large and disproportionately concentrated in developing countries. Carleton et al. (2022) find that under a high-emissions scenario the increase in mortality due to climate change will be valued at 3.2% of global GDP in 2100, with the greatest damages experienced by low income countries. One primary driver of this difference is the adverse effects of higher temperatures which may both lower the productivity of workers and reduce agricultural output (Acevedo et al. 2017).

At the household level, the choice of how to buffer productivity against changing environmental fundamentals such as heat and access to water is often a question of land use. There is a long literature in economics about interventions to support agriculture and many of these projects can be categorized as climate related. Emerick et al. (2016) show that the uptake of rice varieties which are resistant to floods increases other modern farming practices in India. Patel (2025) shows that farmers are willing to pay for information about the soil salinity on their plots and in turn use this information to make investment decisions about salinity-resistant rice seeds. However, the literature also notes various barriers to adoption of adaptive technology. Aker and Jack (2023) find that training addressing technical and behavioral constraints increases adoption of rainwater harvesting (an adaptation strategy in areas of increasing water scarcity) in Niger, but cash transfers do not. Jones et al. (2022) show that labour market frictions limit irrigation use in Rwanda, and Oliva et al. (2020) document that high initial take-up of a subsidized technology (tree-planting) can nevertheless be followed by low follow-through as uncertainty and idiosyncratic shocks lead many adopters to abandon the technology.

Finally, our study also contributes to the literature on spillovers in agricultural technology adoption. There is a large literature in understanding the effects of networks in the take-up of new technology - the importance of neighbours with good experiences (Conley and Udry, 2010), a multiplicity of early adopters (Beaman et al., 2021) and information dissipation at the village level (Emerick and Dar, 2021) have all been noted. On the production side there exists evidence of positive spillovers from the production of genetically modified cotton on other neighbouring fields (Lu et al., 2021), but also negative spillovers in other settings due to phenomena such as pesticide drift (Albaseer et al., 2025).

Our study adds to these literatures by going beyond innovation within traditional agricultural crops and instead studying the adaptation potential of goods (i.e. fish and shrimp) which thrive under the conditions created by climate change. We also characterise spillover patterns in technology adoption that arise not only from physical and network-induced spillovers, but also from *beliefs* about physical spillovers that may be noisy.

3 - Methodology

3.1 Focus Group Discussions

In March and April 2024, the primary investigators carried out ten focus group discussions (FGDs) in the Satkhira and Jessore District of southwestern Bangladesh that are variously affected by rises in salinity. Each focus group was made up of between five and fifteen respondents who were interviewed as a group following a semi-structured approach. Locations were selected in partnership with the BRAC Institute of Governance and Development (BIGD), and the BRAC Climate Change Programme which operate and monitor a range of interventions in this context. Discussions ranged from a low of 15 minutes to a high of 59 minutes.

The following FGDs were held:

1. Shyamnagar Upazila: Village members in a location which had previously worked primarily in shrimp farming and within the past five years had returned to agriculture.
2. Shyamnagar Upazila: Male plot owners and operators currently cultivating shrimp plots.
3. Shyamnagar Upazila: Female who work as day laborers on shrimp plots.
4. Assasuni Upazila: Farmers who undertake a mix of aquaculture and agriculture.
5. Assasuni Upazila: Female day-laborers who work on both shrimp plots and in traditional agriculture depending on the season.
6. Assasuni Upazila: Tenant shrimp farmers.
7. Assasuni Upazila: Shrimp input suppliers at a market in Bardal Union.
8. Kalaroa Upazila: Landowners and casual agricultural laborers in a low-salinity area.
9. Keshabpur Upazila: Landowners and casual agricultural laborers in a low-salinity area.
10. Keshabpur Upazila: Shopkeepers and landholders who derive some income from aquaculture.

These locations were selected to represent a large range of stakeholders in the shrimp cultivation sector. Focus group discussions were recorded and transcripts were translated by staff at partner organization BRAC Institute of Governance and Development (BIGD).

3.2 Quantitative Methodology

From 18 May 2025 to 24 June 2025 we conducted a survey of 739 households who have either aquaculture (i.e. shrimp/fish cultivation) or rice plots in the Dmuria, Assasuni, Tala, Shyamnagar, and Kaliganj Upazilas. The questionnaire was made up of two major sections: (a) an interview with a person who operates land and (b) a physical measurement of soil salinity taken using handheld electrical conductivity meters. All meters were calibrated by the research team prior to the survey. The interview section of the questionnaire was made up of the following subsections:

Module A: Demographic Information
Module B: Plot Use History
Module C: Farming Inputs
Module D: Farming Outputs
Module E: Land Conversion Costs
Module F: Climate and Salinity Beliefs
Module G: Network Module
Module J: Plot Level Salinity Measurements

Sample unions were selected from those with a high share of both agricultural workers and aquaculture workers in the Bangladesh Integrated Household Survey (BIHS) 2015 survey. Of those eligible unions in our target districts, we sampled every union which falls between those unions as shown in orange below. This ensured that enumerators were able to reach a sample of at least 700 households.

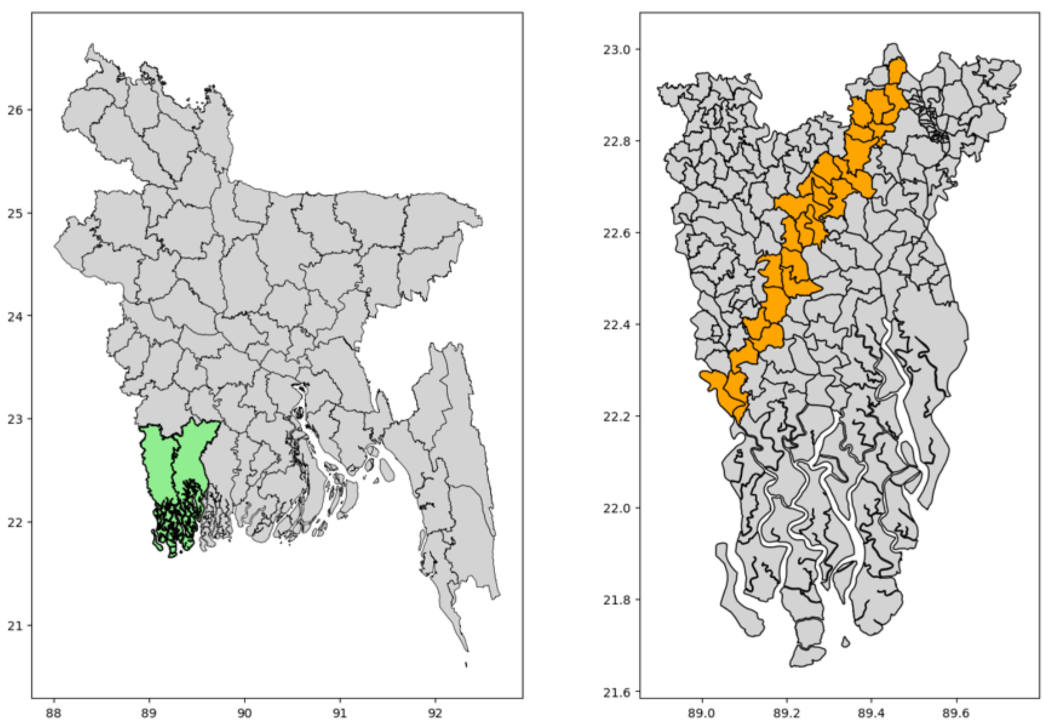

Figure 1.
Surveyed Unions in Khulna and Satkhira Districts .

The enumerator protocol directed the survey team to find plots within villages where shrimp cultivation plots bordered rice cultivation plots in sample Upazilas and to interview the operator of both plots. Once the interview was completed the enumerator would take soil salinity readings of both plots as well as one additional plot from each respondent randomly selected from their respective plot rosters.

4 - Results

4.1 Qualitative Results

This section describes four findings from the FGDs conducted during March 2024.

1. Discussants believe in climate change and report witnessing both increases in temperature and increases in salinity. One village member in the Shyamnagar Upazila, who had previously maintained both shrimp plots and rice plots in the area, observed: 'Salinity is increasing after the seasons change and the temperature rises. And this is not just happening here in our salt areas, it is happening in the whole area because of increased temperature and that is causing salinity.' [AL1] This opinion was mirrored in other discussions as well. One of the women who works as a day labourer on shrimp plots told us: '[Over time] the production of [rice] paddies decreased…As a result of climate change, the water drainage system gradually got very poor. If any flood hit any time of the year, the paddy fields used to get flooded and the whole cultivation was wasted.'

2. Discussants report that rising salinity is a primary cause of the increase of shrimp farms. Notably, these changes in conditions were also connected to the decision by shrimp cultivators to adopt shrimp cultivation in the first place. One of the women engaged in casual labour in both shrimp cultivation and on rice plots, depending on the season, in Assasuni said: 'Earlier the [rice] paddy cultivation was good but now the salt water has increased, so we have to find another way to make a living and as a result [rice] paddy cultivation is cancelled and it is [shrimp] enclosure now.'

3. Discussants expressed concerns about the distribution consequences of shrimp farming. Shrimp cultivation requires less labour. They worry profits will be in the hands of elites. This class of concerns came up frequently across FGDs. In an area of Shyamnagar where people work in both shrimp cultivation and rice farming we were told by one discussant that shared ownership was less common in his village for shrimp plots: 'Five people [may] own the land for paddy cultivation, but the [shrimp] enclosure is done by one person. Shrimp farming is done by a single person so that both the profit and loss is that one person's.' There were also concerns that the fact that fewer labourers are needed for shrimp cultivation would lead to people to migrate more for work and to receive lower pay for those (especially women) who stayed. In one discussion group in Syamnagar between men who worked in shrimp cultivation, we were told that approximately 10% of the men in the village now travel away from home to work in brick kilns because there is not enough work nearby. Finally, we were told by women that the typical daily wage for women working on the shrimp plots was considerably lower than for men. For example, in one union women would work for 250 taka/day, whereas men were paid 350 taka/day.

4. Discussants with experience in shrimp cultivation reported that saltwater used for their ponds could have externalities for those operating rice plots in nearby areas. Cultivators of shrimp ponds told us how the process of spillovers worked in practice: 'The situation of the land deteriorated for one to two years as salt water entered the land,' said one farmer in Shyamnagar. Another man in the same group told us that the deterioration in shrimp land led those who were previously in rice agriculture to switch to shrimp farming as well: ' Later on, the [rice] cultivators gave land to shrimp farmers because the paddies were not growing well and salt water was coming in.' Farmers theorised that this saltwater contamination of the rice fields could take place through groundwater or canals because 'shrimp farming requires saline water, where paddy cultivation requires fresh water. Saline water is such a kind of thing that you cannot hold it together in a restricted place.'

4.2 Quantitative Results

Are these findings from the focus group discussions borne out by the followup survey?

The table below shows the demographic differences between those respondents to the survey working in agriculture and those working in shrimp cultivation. Because the sample was constructed to have an approximately equal number of 'pond to rice' plot boundaries as 'rice to rice' plot boundaries we can see that roughly one third (36%) of the respondents work in shrimp cultivation. The two groups are balanced across age and gender, with an average age of 46 years, and 28% having completed secondary school across the entire sample. Notably those working in shrimp cultivation have annual incomes 37% higher than those in agriculture.

	(1) Agriculture		(2) Shrimp Cultivation		(1)-(2) Pairwise t-test	
	N	Mean/(SE)	N	Mean/(SE)	N	Mean difference
Age	474	46.437 (0.604)	265	46.087 (0.770)	739	0.350
Gender	474	0.960 (0.009)	265	0.977 (0.009)	739	-0.017
Secondary School	474	0.266 (0.020)	265	0.302 (0.028)	739	-0.036
Income (USD PPP)	474	7617 (8965.379)	265	9933 (16226.950)	739	-.001***

Gender is a dummy variable which =1 if the respondent is male. Secondary School is a dummy variable which =1 if the respondent has completed Year 9. Income is PPP adjusted individual income in the last year winsorized at the 1% level. We use 1 USD = 29.88 BTD PPP. Significance: ***=.01, **=.05, *=.1.

Balance Between Agricultural Workers and Shrimp Cultivators

We also see that the climate concerns expressed by the focus group discussants are also reflected in the survey data. When asked whether ‘climate change is a very serious threat, a somewhat serious threat, or not a threat at all to the people in this country in the next 20 years’, 78% of respondents select ‘very serious threat’ – the highest score on a three-level response scale. Not only are people concerned about climate change, but also they are cognizant of spillover risks because of adaptation behaviours of their neighbours. In our sample, 95% of respondents working in agriculture expect there would be an increase in salinity if a neighbouring plot to their plot converted their land to saltwater ponds for shrimp farming. Likewise, 98% of those respondents say that they would expect the yields of their rice seeds to decline in this scenario.

Respondents report that converting land from agriculture to shrimp plots is costly. The average respondents report that to convert their plot would take over three weeks. Only 18% of those surveyed say that they currently have enough savings to cover the cost of the conversion, however 75% believe they would be able to take out a loan to cover the associated costs.

5 - Conclusion

In summary, Bangladesh’s coastal districts are already adapting to rising salinity by converting rice fields to saltwater *ghers* for shrimp and fish. To understand this transition, we conducted ten focus group discussions and surveyed 739 rural households in a high-risk area. Respondents report substantial concern about climate change and anticipate that further salinity increases will depress yields of current rice varieties, with sharper losses near converted *ghers*. This suggests that farmers recognise negative production spillovers for those who remain in agriculture. Despite the apparent returns of shrimp cultivation, adoption is constrained by upfront conversion costs and time: households expect the switch from rice plots to *ghers* to take more than three weeks, and only 17% report having sufficient savings to finance the transition. These findings suggest that adaptation policy should simultaneously mitigate spillovers on remaining rice producers (e.g. salinity-tolerant varieties, drainage and embankment maintenance) and ease barriers to efficient switching where appropriate (e.g. targeted credit, phased cost-sharing and technical support). Supporting households on both margins – those who adapt in place and those who transition – will be critical to safeguarding livelihoods as salinity intensifies.

This is a fertile area for future work. The next steps for this project will be to use remote sensing to create maps of where shrimp cultivation has begun in the past eight years with the goal of predicting where yields of plots still in agriculture have changed. We also plan to use salinity meter readings from both *ghers* and agricultural plots in saline-affected regions to benchmark the magnitude of externalities against the beliefs of farmers.

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