Regional Environmental Change (2023) 23:96
https://doi.org/10.1007/s10113-023-02086-3

ORIGINAL ARTICLE

# Digging in? Migration preferences in communities affected by climate change — evidence from Bangladesh

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Received: 2 January 2023 / Accepted: 27 May 2023 / Published online: 22 July 2023


## Abstract

We analyse unique survey data on the migration intentions of 400 households in two extremely climate exposed communities in coastal Bangladesh. The results show that few households in these areas expect to relocate elsewhere over the coming 5-year period. Surprisingly, households that have experienced environmental shocks do not express higher migration intentions or expectations of future shocks. These results hold controlling for variables reflecting household constraints, vulnerability, and coping capacity, and likely reflects the population remaining in the region being a highly selected sample whose preferences for mobility are low and remain limited in the face of environmental shocks. Moreover, an embedded discrete choice experiment shows that shock-exposed households are *less* likely to move in scenarios of worse future environmental conditions. We argue that this is hard to explain through selection or increased resilience alone, and may instead reflect preference change among shock-exposed households that have chosen to remain. Our results suggest that in contexts of ongoing exposure to climate shocks, migration may over time become an increasingly unimportant adaptation strategy in affected areas.

**Keywords** Climate change · Migration · Adaptation

## Introduction

Migration is seen as an important adaptation strategy to climate change, and considerable effort is going into predicting the scale of climate-induced migration and displacement — who will move under which conditions, and to where? By some estimates, up to 143 million people in Africa, Asia, and Latin America will become internally displaced by 2050 as a result of climate change (Rigaud et al. 2018). While the accuracy of these estimates and the durability of displacement are debated (Boas et al. 2019), such predictions form an important basis for governments and the international community to prepare for and facilitate relocation. The decision to pack up and leave is typically made by individual households, however, and considerable analysis is going into understanding how climate change affects the factors that feed into household relocation decisions (Hoffmann et al. 2021). Much of this literature focuses on constraints households face in migrating, such as credit constraints, and on the role of vulnerabilities of livelihoods and coping capacity. But environmental change may also impact beliefs about and preferences for migration, at the community level as the less migration-averse households move out, and possibly at the

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individual household level if preferences evolve, e.g. to validate past choices. In this paper, we contribute to the limited but emerging literature analysing the evolution of migration preferences in areas exposed to climate change.

We present results from a survey of 400 households conducted in Gabura and Koyra, two unions of the Satkhira and Khulna districts, respectively, located in South-West Bangladesh. Our data is from one of the most vulnerable parts of one of the world's most climate exposed countries, and the unions in question are highly exposed to and already experiencing the effects of climate change (Didar-Ul Islam et al. 2015; Islam and Hasan, 2016). Our descriptive results show that almost 90% of households report a zero probability of moving over the next 5 years, and we estimate that the average stated probability of moving is less than 5%. Given the increasingly marginal livelihoods and environmental risks faced by households in our study areas, this seems strikingly low.

Further results, however, help put these numbers in context. Comparing households in our sample that have different previous experience with environmental shocks, we find no significant relation between shock experience and stated moving intentions, nor any relation with beliefs about the likelihood of future adverse shocks. This likely reflects our respondents constituting a highly selected sample consisting of households most determined to stay even in the face of environmental adversity. In other words, households whose shock experience has loosened their attachment to place or led them to upwardly revise their beliefs about future shocks have likely left, and are not part of our observed sample. Moreover, results from an embedded discrete choice experiment show that among remaining households, those that have experienced shocks are less likely to leave if future environmental conditions get worse. While selection or increased resilience could make mobility less sensitive to future environmental conditions, these mechanisms do not seem sufficient to explain a *negative* mobility response to future environmental degradation, i.e. lower mobility under worse conditions. Our evidence is instead consistent with the possibility that mobility preferences are dynamic, that preferences for staying in place adapt to past choices. All our results hold conditional on a large set of household characteristics capturing household constraints, vulnerabilities, and coping capacity, indicating that these factors are not behind our findings. In combining regression analysis of how past changes affect mobility with a discrete choice experiment on the effect of future environmental changes, we are able to assess migration as a response to both *ex ante* and *ex post* environmental risk (Dillon et al. 2011).

We contribute to the literature on the impact of environmental shocks on mobility, where a number of studies suggest that environmental shocks have a limited impact on migration. The analyses of flooding in Gray and Mueller (2012), earthquakes in Halliday (2006), cyclones in Pajaron and Vasques (2020), and natural disasters in Bohra Mishra (2014) all find modest effects of exposure to shocks on mobility, though Groeger and Zylberberg (2016) find larger effects. Proposed explanations for the limited impacts include credit constraints (Halliday 2006, Bryan et al 2014; Cattaneo and Peri 2016) and in-site adaptation strategies (Gray and Mueller 2012; Castells-Quintana, 2018). We add to this literature by studying the effects of shocks on migration preferences. Previous studies on this topic have mainly examined the impacts of environmental shocks on risk preferences (Cameron and Shah 2015; Hanaoka et al 2018; Islam et al 2020 and Holden and Tilahun 2021). Controlling for risk aversion, we study the impact of environmental shocks on mobility preferences, both at the population level through self-selection, and the household level through preference change. In this way, we also complement a largely qualitative literature on place attachment (Adams 2016; Raymond et al. 2010, Swapan et al 2021), as well as an emerging literature on staying preferences that seeks to understand why most people do not migrate (Schewel 2020; Ahsan et al. 2022).

In addition, we contribute to the literature on the relationship between household wealth and preferences for migration. In contrast to the literature suggesting that credit constraints limit the mobility of poor households, we find a u-shaped relationship between predicted household mobility and household wealth, suggesting that both the poorest and the wealthiest see themselves as more likely to move than those in the middle of the wealth distribution. These results go against the literature suggesting that credit constraints limit the migration of poor households (Arongo 2000; Adger et al 2015; Black et al 2013; Adams 2016), suggesting that this is not as limiting a factor in the case of the possibly short-distance migration included in our analysis. They also differ from the findings of previous studies of migration intentions, such as Dustmann and Okatenka (2014), who found an inverse U-shaped relationship between assets and migration intentions when using cross-country data.

Our study also has implications for policies to facilitate adaptation to climate change in highly exposed countries and communities. Our results suggest that in communities repeatedly pummelled by environmental shocks, preferences for staying may paradoxically be strengthened at the individual household and community level, as those remaining prefer to dig in rather than leave. Households remaining in these types of communities may hence perceive migration as an increasingly less preferable option over time. This suggests that policies to relax migration constraints may have less of an effect the more durable and desperate the situation of those remaining, and not just due to a lack of household resources, but also due to evolving migration preferences. This raises important and difficult questions on not just the

practical feasibility of migration as an adaptation strategy, but also the justification of potentially paternalistic policies towards this end.

The paper is structured as follows. "Context and relation to the migration literature" section presents a brief conceptual framework for our study and its relation to the literature. "Research design and data" section discusses our data and descriptive results. Results from regression analyses of the link between environmental shocks and migration preferences and beliefs are presented in the "Results from the regression analysis of migration intentions" section. The approach and results from the discrete choice experiment is detailed in the "Results from the discrete choice experiment" section. Limitations and caveats of our analysis are discussed in the "Limitations and caveats" section. "Concluding remarks" section concludes with a discussion of policy implications and directions for further research.

## Context and relation to the migration literature

Climate change has already had a large impact on living conditions in Bangladesh, with people living in coastal areas having been hit particularly hard. The monsoon in the summer of 2017 submerged one third of Bangladesh, affected eight million people, and led to substantial damages to crops and homes.[1] The flood was reportedly the worst in 40 years. A recent super cyclone Amphan hit Eastern India and Bangladesh in May 2020; approximately two million people in Bangladesh were evacuated (The International Federation of Red Cross and Red Crescent (IFCR), 2020). Although internal migration flows are already high in Bangladesh, it has been argued that climate related migration may come to outpace other forms of internal migration in the country. The government of Bangladesh expects that "the greatest single impact of climate change might be on human migration/displacement", estimating that "by 2050 one in every 7 people in Bangladesh will be displaced by climate change" (Comprehensive Disaster Management Programme 2015:4).

Studies of displacement effects of large cyclones in South Asia, such as Aila in 2009 and Sidr in 2007, indicate that households or individuals within households were permanently displaced (Mallick et al. 2017; Mallick and Vogt 2014; Islam and Hasan 2016). Qualitative field work we conducted in our study area in preparation for our data collection suggested that some households had relocated inland in part as a result of environmental change. Other studies indicate, however, that the impact of environmental changes on migration should not be overestimated. In a study from Bangladesh based on self-reported data of floods and crop failure, Gray and Mueller (2012) found that flooding only had a modest impact on migration, while crop failure at the household reduced migration. A study by Chen et al. (2017), using satellite data of inundation in Bangladesh combined with yearly migration data, corroborates these findings.

An important question is what these results mean for likely future household migration responses to environmental changes. Temperatures in Bangladesh will most likely rise in the range of 2.6–4.8° centigrade by 2100 (Caesar et al. 2015). Rise in sea surface temperature and sea level are expected to increase the frequency and severity of tropical cyclones and cause unanticipated shifts in the timing and intensity of the monsoon and of flooding (World Bank 2018:146). One possibility is that as local conditions in coastal areas get progressively worse in coming decades, the incentive for households to relocate further inland or migrate elsewhere get progressively stronger. On the other hand, environmental degradation may further constrain household mobility decisions, at the individual household level by eroding the resources needed for migration, and at the community level through selection as the least migration-restricted households leave the area. There is already evidence that labour migration in Bangladesh is sub-optimally low given differences in wage levels across locations (Bryan et al. 2014), might the same also be the case for future migration flows from climate affected areas?

Canonical economic models of migration pose the household migration decision as a comparison of the expected relative income or wage differences between origin and destination localities, taking into account the costs of migration (Harris and Todaro 1970). In these types of models, the ambiguous impacts of environmental change discussed above emerge clearly; wage differences may increase, but credit constraints may also make the costs of migration more difficult to shoulder (Dustmann and Okatenka 2014; Cattaneo and Peri 2016). A typical feature of these types of models is, however, that they tend to treat household preferences as stable and homogeneous. Relaxing these assumptions produces additional pathways through which environmental change may affect mobility decisions. Environmental change may impact individual household preferences related to mobility, for instance, through weakening an innate preference for living in the current location, loosening an attachment to place whether based on family history, bonds to nature or other physical attributes, or social ties (Raymond et al 2010; Kan 2007; Mulder 2018; Nawrotzki et al 2015). On the other hand, past decisions to stay in the current location can have dynamic effects on preferences which serve to strengthen preferences for remaining in place. Different cognitive biases that are known to affect human decision-making may come into play

[1] https://www.nytimes.com/2017/08/29/world/asia/floods-south-asia-india-bangladesh-nepal-houston.html

here, such as the sunk cost fallacy (Arkes and Ayton 1999). At the community level, outward mobility of the least place-bound households may also lead to a selection effect, where remaining households exhibit progressively more mobility-averse preferences.

The focus of our analysis is on the impact of environmental shocks on mobility preferences, at the individual household and community level. Our aim is hence to expand on a literature which has so far mainly focused on the impact of environmental shocks on risk preferences. We control for risk aversion in our analyses in order to capture other, more general preferences for mobility. Of studies on risk preferences, Cameron and Shah (2015) have found evidence of increased risk aversion after floods and earthquakes in Indonesia. By contrast, Hanaoka et al. (2018) found that earthquakes in Japan made households more risk tolerant, in line with results from a recent lab in the field experiment from rural Bangladesh showing that individuals from disaster-affected villages chose riskier bets (Islam et al 2020). Brown et al. (2018) found that being struck by a cyclone had impacts that were heterogeneous across groups, Indo-Fijian respondents became more risk averse, while iTaukei respondent risk attitudes were not changed, which the authors partly attribute to risk sharing arrangements common for the latter group. This study also found that shock experiences increased expectations of future loss and damage in the former group; though our emphasis is on preferences, our results also speak to the effect of shocks on these types of beliefs.[2]

While our emphasis is on mobility preferences, our analysis explicitly acknowledges and adds to the large existing literature on drivers of and constraints to migration by including the main predictors of migration as covariates. These include credit constraints (assets) and occupation, household vulnerability, demographic variables like age and education, and migration history, social networks, and more. These correspond to three key sets of drivers and constraints of migration as summarized in the review by Black et al. (2011): economic, demographic, and social.[3] The fourth driver mentioned in the Black et al. study — political instability and uncertainty, violent conflict and active, even forced, relocation policies by government — does not really vary within our study area. And the fifth driver, environmental factors, is what our analysis focuses on, with an emphasis on how they affect migration preferences.

The analysis below centres on environmental shocks, i.e. rapid-onset events. In the literature on climate migration, some rapid-onset events like floods are generally perceived as triggers of temporary displacement (Perch-Nielsen, 2008; Koubi et al. 2016a,b), while especially severe tropical cyclones induce permanent migration (Strobl 2011). In contrast, Pajaron and Vasques (2020) find in a study from the Philippines that people stay when adverse weather events (e.g. tropical cyclones) occur or are forecast. The emphasis on rapid-onset events is not to deny the importance of slow onset events, such as salinization of the soil, for evolving living conditions in our areas. We do, however, also supply some supplementary results suggesting that these types of slower changes are relatively unimportant for household migration decisions in our study areas. This is in line with the results from Vietnam presented in Koubi et al. (2016a), who find that households adapt in situ to slow onset events, and the study of Adger et al. (2021) suggesting that perceived changes in drought and economic insecurity due to environmental change reduce migration intentions, but in contrast to findings from Bangladesh and Pakistan where slow onset events have been found to induce permanent migration (Chen and Mueller 2018, Mueller et al. 2014).

## Research design and data

### Study area, sampling, and survey design

Our sample comes from two south-western districts of Bangladesh, in areas close to Sundarbans mangrove forest and among the most vulnerable parts of the country's coastal zone when it comes to climate change. Both districts are exposed to floods and cyclones, and soil salinization is an intensifying problem. The Satkhira and Khulna districts were the worst hit by the dramatic Aila cyclone in 2009. According to the United Nations (2010), Aila affected 3.9 million people, led to 190 deaths, approximately 7100 injuries, the loss of about a hundred thousand livestock and the destruction of infrastructure, and damage to about 350,000 acres of cropland. More recently, and just after our survey, the area was also hit by the cyclones Bulbul in November 2019 and Amphan in May 2020.

We conducted our surveys in March and April 2019 in the Koyra union (Khulna District) and the Gabura union (Satkhira district) (Fig. 1). Prior to the survey, we had conducted two rounds of qualitative interviews with households, local officials, and NGO representatives living in the two unions and other areas in the two districts to inform our choice of survey locations and the design of the survey and discrete choice experiment. Observations of living conditions and findings from the interviews indicated that climate related changes are highly relevant factors in household adaptation

[2] More peripherally, there is a literature on how income shocks affect redistributive preferences (Gibson et al., 2019; Gualtieri et al., 2019), but these types of social preferences are not the emphasis here

[3] On social drivers of migration, see also McKenzie and Rapoport (2007)

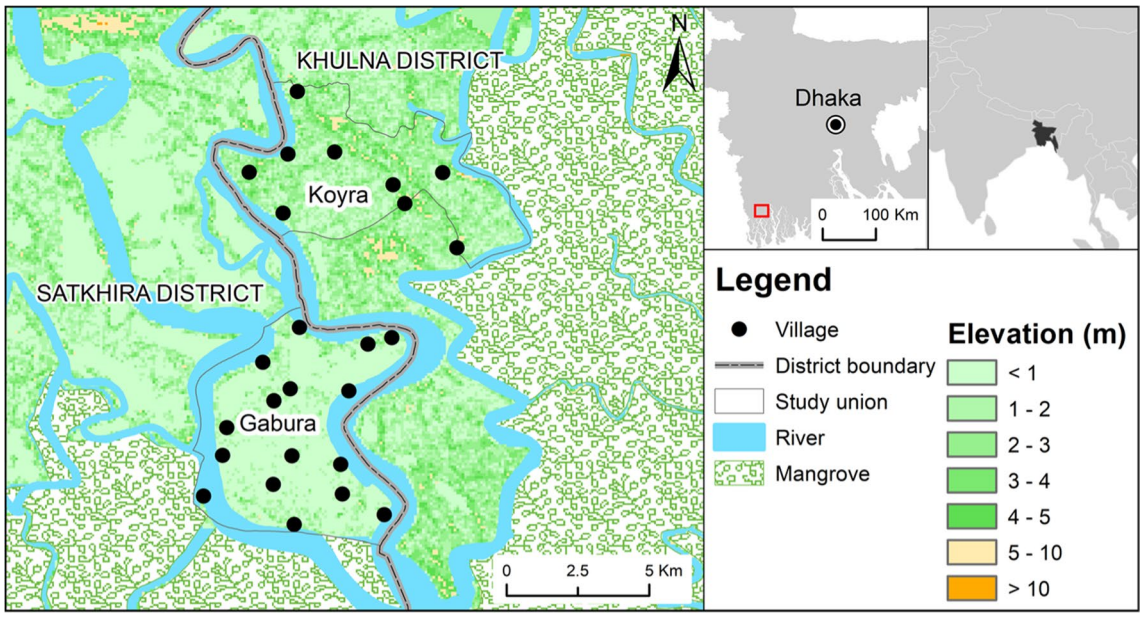


**Fig. 1** Study areas

strategies in the study area, including for their mobility decisions.

Nearly 7800 and 6800 households live in Koyra and Gabura unions, respectively. We included in our sample households from all villages in Koyra (9 villages) and Gabura (16 villages). Our sampling approach was based on the proportion of population in each village, with a minimum of 10 households included from each village. Furthermore, we included an equal percentage of female and male respondents. The households were randomly selected in each village using a skip routine where enumerators approached every 5th household starting from the north-west corner of the villages, circling inwards towards their centre.

Our sample includes 205 respondents above 18 years from each of the two unions, i.e. 410 respondents in total. The survey instrument consisted of two parts: (i) a structured questionnaire that forms the basis of our regression analysis of household migration intentions (see below for details on these data and the "Results from the regression analysis of migration intentions" section for results), and (ii) an embedded discrete choice experiment to elicit households' migration intentions under alternative future scenarios (see the "Results from the discrete choice experiment" section for details and results). The survey instrument and choice scenarios were translated from English to Bengali (local language) and back-translated by a qualified translator to ensure the original meaning of the content was kept in the translation to Bengali. Trained enumerators conducted face-to-face interviews using hand-held tablets. Both the questionnaire and the choice sets for the discrete choice experiment were thoroughly pre-tested and piloted.

## Data and descriptive statistics

We combine two empirical strategies to analyse how environmental shocks affect household migration preferences; a regression analysis of the survey data, and an analysis of our embedded discrete choice experiment (which we present in greater detail in the "Results from the discrete choice experiment" section). The focus of our analysis is on how household migration intentions respond to the environmental changes they are facing. Specifically, in our regression analysis, we study household predictions that the entire household will relocate permanently in the near future (specified as the next 5 years). We are hence looking at more drastic relocation decisions than labour migration of individual household members, which is very common in Bangladesh. Although a household's assessment of the probability that it will relocate is subjective and only an indication of an actual decision to migrate permanently, it serves as a key ex-ante measure of the household's adaptation strategy to climate change. This type of stated preference approach thus facilitates forward-looking analysis of adaptation strategies in a context of potentially evolving individual and community preferences, complementing a revealed preference approach based on past mobility decisions.

Table A1 in the Appendix presents the definitions of the variables used in our regression analysis and Table A2 descriptive statistics. Our main dependent variable in the

**Table 1** Perceived likelihood of moving away permanently from current location

| *Question: How likely is it that your household will move away permanently in the next 5 years?* | | | |
|---|---|---|---|
| Response (probability) | No shock | One or more shocks | Total % |
| Certain we will stay (0%) | 90.9 | 84.9 | 88.8 |
| More likely that we stay than that we move (25%) | 4.6 | 10.3 | 6.6 |
| As likely that we stay as that we move (50%) | 2.3 | 4.1 | 2.9 |
| More likely that we move than that we stay (75%) | 1.5 | 0.0 | 1.0 |
| Certain that we move (100%) | 0.8 | 0.7 | 0.7 |
| % | 100 | 100 | 100 |

regression analysis is based on the question "How likely is it that your household will move away permanently in the next five years?" The answer alternatives included five categories indicating probabilities for such a relocation; the response categories were expressed in verbal terms as stated in the first column of Table 1. In other words, the response categories were not expressed to respondents as numerical probabilities, which many of them would have a hard time comprehending. We translate the responses into probabilities for our analysis, but in additional results also show that results are robust to using ordinal estimation on the original response categories. We use the indicated probability of migration after each statement in Table 1 as our dependent variable in the main regression analysis (i.e. 0%, 25%, 50%, 75%, and 100%).

As shown in the final column of Table 1, household predictions of their own mobility probabilities are very low. The reported average probability of moving is 4.4%, and 89% of the respondents find it certain that their household will stay in the current place for the next 5 years. While the predicted probability of moving among our respondents is higher than the actual internal migration rate in Bangladesh,[4] it seems very low given the environmental circumstances of our households.

The main explanatory variable used in our analyses is a shock experience index that is based on responses to three different questions. The first question is "During the last five years, did you or your household member experience *loss of life or serious injury* because of flooding, river erosion, storm or cyclones?". The second and third question similarly asked for *damages to houses* and for *damages to land and livelihood*. The shock experience index is the sum of the number of yes responses on these three questions. Around 36% of respondents experienced one or more shocks during the period, and as seen in Table A2, the mean number of yes responses on the three questions is about 0.5.

As a first pass at looking into the impact of shock experience on mobility intentions, the middle columns of Table 1 split responses into those who have not experienced shocks, and those that have. This corresponds to splitting the sample at the median (which is zero yes responses on the shock questions). As shown in Table 1, moving intentions do not vary much between groups having different shock experience, and their independence is also confirmed by a chi-square test ($p$=0.34). In the following section, we assess the relation between shock experience and moving intention more carefully using multivariate analysis.

In Table 2, we perform a similar analysis of the relation between shock experience and beliefs about future damages from environmental change. More than half of the respondents expect that it is likely that substantial damage occurs while only 5% expect that it will not. As in the case of mobility intentions, we do not find any significant differences across respondents based on their previous shock experiences ($p$=0.28). In the subsequent section, we revisit this relation through a regression analysis, using the below responses coded as probabilities along the same lines as for our main dependent variable.

As shown in Table A2, our data includes a number of variables reflecting household and individual characteristics related to constraints to mobility, vulnerability, and coping capacity. We include these as covariates in the subsequent analysis. By design, half of our respondents are female. On average, respondents in our sample are 44 years old and have lived 39 years in their community. A little over half are household heads, and the mean household size is five people. Only 56% of respondents have completed primary or secondary school, and the households are generally poor. We measure the level of poverty using an asset index created through factor analysis of the following variables: ownership of house, land, bicycle, radio, TV, mobile phone, computer, motor vehicle or motorcycle, and the number of rooms in the dwelling. Day labourers are the major occupational group (24%), followed by those who farm their own land 10% and the self-employed (9%). In terms of migration history and migration networks, the respondents have seldom moved (10%), but know many others that have migrated (14

[4] While not directly comparable, the latest 2016 household income and expenditure survey (HIES 2016) conducted by the government of Bangladesh estimates that 3.59% of rural, and 1.32% of urban respondents report at least one internal migrant from the household

**Table 2** Perceived likelihood of damages from climatic events

*Question: How likely is it that your land or other livelihood sources will be substantially damaged from flooding salinization, river erosion, mangrove forest degradation, storm, or cyclones?*

| Response (probability) | No shocks | One or more shocks | Total |
|---|---|---|---|
| Almost certain that there will be substantial damage | 8 | 4 | 7 |
| More likely to have substantial damage than not to have | 47 | 52 | 49 |
| As likely that have substantial damage than not to have | 39 | 40 | 39 |
| More likely not to have substantial damage than to have | 3 | 3 | 3 |
| Almost certain that there will be no substantial damage | 3 | 1 | 2 |
| % | 100 | 100 | 100 |

households on average). On average, the mean responses on the risk aversion and time preference questions are on the risk averse and patient side (see Appendix Tables A4 and A5 for an explanation of our risk and time preference indices). We also control for variables capturing the vulnerability of their dwellings, and their social networks (see Table A1 for details on the construction of these indices).

As a backdrop for our analysis, we also collected data on the understanding and perceptions of climate change among our respondents. Few of our respondents are knowledgeable about the formal concept of climate change. When asked directly, nearly 80% of the households do not know what climate change is and a similar percentage do not know how climate change will affect the community or their households in the coming 5 years. Nevertheless, they are worried about the consequences of phenomena associated with it, as seen in Table 2. While the question used for Table 2 does not distinguish between fast- and slow-onset changes, responses to additional questions clearly indicate that it is the fast-onset events that are likely to make our respondents move, not the slow-onset ones like salinization of the soil. We address the relative importance of economic and different types of environmental changes for mobility predictions more closely through our discrete choice experiment analysis (see the "Results from the discrete choice experiment" section).

## Results from the regression analysis of migration intentions

The following specification is used in our regression analysis of respondent migration intentions:

$$y_{ihv} = \alpha_v + \beta_0 \text{Shock experience index}_h + X_h\beta_1 + X_i\beta_2 + \varepsilon_{ihv} \quad (1)$$

As noted, the dependent variable $y_{ihv}$ is the probability (in percentages as defined in Table 1) of the household relocating permanently in the next 5 years according to individual $i$ in household $h$ in village $v$. The main parameter of interest is $\beta_0$, which captures the effect of environmental shocks on migration intentions. $X_h$ is a vector of household characteristics, $X_i$ is a set of individual respondent characteristics, and $\alpha_v$ are the village level fixed effects. The vector of household characteristics captures household vulnerability to climate change and past experience of environmental shocks, as well as variables capturing potential barriers to future migration (in particular household assets and its square). The vector of individual characteristics includes a number of respondent level controls that are likely to correlate with predictions (e.g. gender, age, education, occupation) and variables that measure the respondent's risk and time preferences. The inclusion of village fixed effects is motivated by our observed differences in the general level of exposure, vulnerability, and opportunities between and within the two sampled unions.[5]

We estimate the above equation using ordinary least squares with robust standard errors. Columns one and two in Table 3 report the results from this estimation, column one without covariates, and column two including the full set of covariates. The results show that there is no significant relation between shock experience and mobility intentions in our sample. This remains the case when the large set of covariates reflecting mobility constraints, vulnerability and coping capacity are added. In columns three and four of Table 3, we add the results from a similar analysis where the dependent variable reflects the beliefs about future damages from environmental shocks captured in Table 2. Responses are analysed as probabilities along the same line as for migration intentions, and where a higher probability reflects greater expected future harm or damage. Results for beliefs are the same as for intentions, having experienced environmental shocks in the past does not relate significantly to expectations of future shocks, with or without covariates included.

[5] Households perceive that water access, schools, health conditions, early warning system, and the protection offered by dykes are better in Koyra than in Gabura. Koyra is also accessible by road, while Gabura is a rather remote, low-lying river island (Fig. 1), with no road connection to Shyamnagar, the upazila centre. Households in Gabura consider damages from environmental changes to be larger than in Koyra

**Table 3** Mobility intentions: results from OLS regression

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent variable | Intention to migrate | Intention to migrate | Expectation damages | Expectation damages |
| Shock experience index | 0.009 (0.01) | 0.013 (0.01) | 0.001 (0.01) | 0.006 (0.01) |
| Asset index | | −0.043** (0.02) | | −0.009 (0.02) |
| Asset index squared | | 0.004* (0.00) | | 0.002 (0.00) |
| House vulnerability index | | 0.005 (0.01) | | −0.025*** (0.01) |
| Household size | | 0.000 (0.00) | | −0.000 (0.00) |
| Primary | | 0.007 (0.02) | | −0.034* (0.02) |
| Secondary | | 0.035 (0.03) | | −0.006 (0.03) |
| Higher secondary school | | 0.151 (0.10) | | −0.183** (0.07) |
| Tertiary | | 0.075* (0.05) | | 0.016 (0.05) |
| Farming own land | | 0.035 (0.03) | | 0.056 (0.04) |
| Gathering | | −0.006 (0.03) | | 0.059 (0.04) |
| Day labour | | 0.009 (0.02) | | 0.053* (0.03) |
| Employee | | −0.043 (0.06) | | −0.046 (0.08) |
| Self employed | | −0.009 (0.03) | | 0.024 (0.04) |
| Male | | 0.047* (0.03) | | −0.095** (0.04) |
| Age | | −0.001 (0.00) | | 0.001 (0.00) |
| Head | | −0.057** (0.02) | | 0.066* (0.04) |
| Years lived in community | | 0.000 (0.00) | | −0.000 (0.00) |
| Times moved | | 0.029 (0.02) | | −0.033** (0.01) |
| Impatience index | | 0.004 (0.01) | | 0.003 (0.01) |
| Risk index | | −0.009 (0.01) | | 0.004 (0.01) |
| Network migrants | | 0.000 (0.00) | | −0.000 (0.00) |
| Social network | | −0.002 (0.01) | | −0.004 (0.01) |
| Constant | 0.041*** (0.01) | 0.184** (0.09) | 0.638*** (0.01) | 0.710*** (0.06) |
| Village fixed effect | No | Yes | No | Yes |
| r2 | 0.002 | 0.165 | 0.000 | 0.423 |
| *N* | 410 | 409 | 410 | 409 |

The table shows results from OLS regressions. Robust standard errors in parentheses. Variables as defined in Appendix Tables A1, A4, and A5. *** indicates significance at the 1% level, ** at 5%, * at 10%

The above results appear surprising, as it would be natural to expect that households that have experienced environmental shocks would see their current location as relatively less attractive compared to other locations, and hence be more inclined to move than households that have not experienced such shocks. Similarly, households that have experienced shocks would be expected to update and upwardly revise their beliefs about future damage, and hence have comparatively higher expectations of future damage than households that have not experienced shocks. However, our results do not contradict these conjectures, but are instead consistent with selection of households into our sample, where those households that have moved out as a results of prior shocks are no longer a part of the households remaining in the area. A likely interpretation of the above lack of relation between environmental shocks and migration preferences and beliefs is thus one of selection; shocks operate on the distribution of preferences in our community through the least migration-averse households moving out of the villages, leaving the most migration-averse households in place. This suggests that over time, preferences to stay in place are strengthened at the community level as exposed areas experience repeated environmental shocks.

As shown in Table 3, the results for the shock experience variable are robust to a large set of other covariates at the household level and at the individual respondent level. The results are hence not driven by, e.g. assets and social connections at the household level, or by education, occupation, or risk or time preferences of the respondent. As shown in Appendix Table A3, the results are also robust to performing an ordered logit or an ordered probit analysis. Due to the uncovered heterogeneities in responses at different shock experience levels, we further explore distinctions in responses in our discrete choice experiment in the "Results from the discrete choice experiment" section.

For the covariates, our results also address the literature suggesting that poorer households are unable to move due to a lack of resources. If this is the case, we should see lower intentions to move among the less wealthy in our sample. The coefficients for our asset index and its square are both significant, and their signs suggest a u-shaped relationship

of mobility intentions with wealth. In other words, the poorest and the wealthiest are more likely to predict that they will move in the near future than households in the middle of the wealth distribution. The generally low mobility intentions among our households are thus unlikely to be due to resource or credit constraints. And while selection may affect the comparison of migration intentions of poor and rich households, it is harder to see as an explanation of why households at medium asset levels have the lowest migration intentions. In other words, our results do not suggest that the poor perceive themselves as trapped by their lack of assets, as suggested by a number of studies in the climate migration literature (Foresight: Migration and Global Environmental Change 2011:14; Arongo 2000; Adger et al 2015; Black et al 2013; Adams 2016). Rather, our results suggest that an observed lack of mobility in locations with a history of adverse environmental events may be due to preferences rather than constraints of those remaining.

In terms of demographic and social variables, few of our other household or individual level variables have any significant relation to predicted mobility; while the education variables have positive coefficients, they are too imprecise to be significant, and there is no consistent pattern across our occupation categories. Nor do we find that household social connections matter, or respondent's gender, age, risk, and time preferences. Past migration history is significant in the ordered logit and probit analyses (see Appendix Table A3), but not in our main results using OLS. For relations between covariates and beliefs in future damages in columns three and four, male respondents are less concerned which is consistent with overconfidence, some levels of education lowers beliefs in coming harm (compared to the excluded category of no education), as does previous migration experience which may be due to better abilities to weather damage done to the household.

## Results from the discrete choice experiment

The above regression analysis allows us to assess how migration preferences vary based on past experiences and current characteristics of households in our sample. In this way, they also say something about likely migration responses to future environmental shocks, changes to the household asset situation, and so on. To get a more detailed sense of the conditions under which households in our sample would prefer to leave, however, we added a discrete choice experiment to our survey. This allows us to study the relative importance of different environmental changes in mobility preferences and decisions, including how households with different experience from past shocks may differ in their responses to different changes in living conditions locally. A strength of discrete choice experiments is exactly this; it enables us to reveal the relative strength of several attributes that may impact the respondents' migration choice and use this to understand how the assessment of these attributes varies across different groups of respondents.

In the discrete choice experiment, we presented the respondents with comparisons that included two alternative scenarios describing future conditions at their current location. An example of such a comparison, called choice set, is given in Fig. 2. For each comparison, the respondents were asked the following question:

> Assume conditions are the same in the areas you could move to under the two scenarios and that the cost of moving remain the same. Under which scenario would you be more likely to move away permanently with your household?

The choice sets comprised seven attributes including wages/earnings at the current location, changes resulting

| Attribute | Explanation | ScenarioA | ScenarioB |
|---|---|---|---|
| House | State of your house | Damaged, in need of considerable and costly repair | Destroyed, needs to be completely rebuilt |
| Wages/earnings | What you can earn in a day through employment or running a business | For every 100 Taka you earn today, you only earn 80 Taka | Same as today |
| Protection | Protection provided by, for example, shelters and dykes | Much worse than today | Same as today |
| Prospects for children/health and education | Prospects for the children and grandchildren in your household | Same as today | Much worse than today |
| Nature-based livelihood sources (other than agriculture) | Ability to use the natural environment to hunt, fish and gather | For every 10 kg hunted/fished/gathered today, only able to hunt/fish/gather 8 kg | Able to hunt/fish/gather half the quantities compared to today |
| Agricultural productivity | Agricultural production in your village | Same as today | For every 10 kg produced today, only able to produce 8 kg |
| Water | Access to clean drinking water | Price much higher or access much worse than today | Same as today |
| choice_set 23 block 4 | | | |

**Fig. 2** Sample choice set in discrete choice experiment

from fast onset events such as damage to property, changes due to slow processes such as reduced agricultural productivity, and several other relevant factors. Each attribute is measured at two or three levels that are altered in each choice set the respondents is presented with, and the levels are relative to the respondent's current situation (see Table 4 for the full set of attributes and levels). Through the respondents' choices of the scenarios under which they would be more likely to move, we can analyse the attributes that reflect their migration preferences.

For the experiment, the respondents were randomized into one of 10 blocks. Blocks were balanced across respondents with an equal number of respondents assigned to each block. Each respondent was given six choice sets (each of which was structured as exemplified in Fig. 2). The order of the attributes was randomized across blocks to avoid order effects and an orthogonal design approach was used to design the experiment in order to make the attribute levels independent. The design generates 12 observations (six comparisons of two scenarios) for each respondent. Thus, in total, we have 4920 observations in our sample.

We use conditional logit estimation to analyse the effect of the attributes on the choice of scenario under which migration is more likely. Our specification is:

$$\Pr(y_{ijt} = 1 \left| x_{ijt}) = F(\alpha_{ij} + x_{ijt}\beta) \right. \quad (2)$$

where $y_{ijt}$ is our dichotomous dependent variable indicating whether the household would be more likely to move under scenario A or scenario B, and $x_{ijt}$ is the vector of attribute levels for individual *i*'s choice set *j* and alternative *t*. This is essentially a logit estimation with fixed effects at the choice set level, where F is the cumulative logistic distribution $F(z) = \frac{\exp(z)}{1+\exp(z)}$. This implies that we are using only within-respondent variation in responses in the estimation of the impact of attributes on choices, hence controlling for respondent characteristics. We also run estimations for subgroups of respondents with different past shock experience to analyse differences in their mobility preferences.

The results from the discrete choice experiment are presented in Table 5. The estimates are presented in terms of odds ratios, to ease interpretation. An estimate above one indicates that scenarios including an attribute level was

**Table 4** Attributes, levels, and variable types in discrete choice experiment

| Attribute | Explanation | Levels | Variable type |
|---|---|---|---|
| Wages/earnings | What you can earn in a day through employment or running a business | Same as today (1) | Continuous |
| | | For every 100 Taka you earn today, you only earn 80 Taka (.8) | |
| | | For every 100 Taka you earn today, you only earn 50 Taka (.5) | |
| House | State of your house | Intact | Ordinal |
| | | Damaged, in need of considerable and costly repair | |
| | | Destroyed, needs to be completely rebuilt | |
| Agricultural productivity | Agricultural production in your village | Same as today (1) | Continuous |
| | | For every 10 kg produced today, only able to produce 8 kg (.8) | |
| | | Able to produce half the food compared to today (.5) | |
| Nature-based livelihood sources (other than agriculture) | Ability to use the natural environment to hunt, fish and gather | As today (1) | Continuous |
| | | For every 10 kg hunted/fished/gathered today, only able to hunt/fish/gather 8 kg (.8) | |
| | | Able to hunt/fish/gather half the quantities compared to today (.5) | |
| Water | Access to clean drinking water | As today | Dummy |
| | | Price much higher or access much worse than today | |
| Prospects for children / health and education | Prospects for the children and grandchildren in your household | As today | Dummy |
| | | Much worse than today | |
| Protection | Protection provided by, for example, shelters and dykes | As today | Dummy |
| | | Much worse than today | |

**Table 5** Results from discrete choice experiment: conditional logit analysis

| | All | No shock | One or more shocks |
|---|---|---|---|
| Wages | 0.997 (0.11) | 0.955 (0.14) | 1.151 (0.23) |
| House damaged | 1.067 (0.06) | 1.249*** (0.09) | 0.805** (0.08) |
| House destroyed | 1.139** (0.07) | 1.239*** (0.09) | 1.031 (0.10) |
| Agricultural productivity | 0.925 (0.11) | 0.781* (0.11) | 1.267 (0.25) |
| Nature-based livelihood sources | 1.135 (0.13) | 1.043 (0.15) | 1.367 (0.26) |
| Access to water (higher price) | 0.993 (0.04) | 1.122** (0.06) | 0.793*** (0.06) |
| Prospects children (getting worse) | 0.918** (0.04) | 0.945 (0.05) | 0.870** (0.06) |
| Protection (getting worse) | 0.938 (0.04) | 0.916* (0.05) | 0.991 (0.07) |
| r2_p | 0.004 | 0.011 | 0.023 |
| *N* | 4920 | 3168 | 1752 |

*The table shows odds ratios from conditional logit estimations. Robust standard errors in parentheses. *** indicates significance at the 1% level, ** at 5%, * at 10%*

more likely to be chosen by our respondents, and estimates below one indicate the opposite. The first column presents the results for our full sample. The strongest finding across all respondents is that the destruction of the household's dwelling has a considerable influence on prospective mobility; the odds of choosing to move in a scenario under which the house is destroyed are almost 14% higher than the odds of the excluded category, which is that the house is intact. This finding closely mirrors responses to survey questions comparing the importance of fast- versus slow-onset events mentioned at the end of the "Research design and data" section; large scale destruction brought by fast onset events is the most likely to make people move. Other environmental attributes reflecting slower environmental degradation, such as reduced agricultural productivity, impaired access to water as well as ecosystem services (i.e. nature-based livelihood sources attribute), appear to play a rather insignificant role in future migrant decisions.

More nuance is, however, added to these results when we break down the sample into those without and with environmental shock experience. Columns two and three present results for the households with none and one or more experiences of shocks, respectively. Splitting the sample this way suggests that the full sample results conceal important heterogeneities in preferences. An increased inclination to leave if the dwelling is damaged or destroyed is only present among the group without shock experience. The subsample with past shock experience are in fact *less* likely to leave if their house is damaged. They are also less likely to leave if access to water or prospects for children get worse, in contrast to those without shock experience who are more likely to leave if water access is impaired. Overall, the results for the two subsamples suggest that while mobility of those without shock experience responds to future deterioration of environmental conditions, respondents that have experienced shocks tend to stay or dig in when environmental conditions get worse.

It is difficult to explain this difference in preferences across shock experience levels as a result of selection alone. Under selection, the shock affected households that are more sensitive to impairment of environmental conditions would be likely to have moved away. The implication of this would be that the subsample with shock experience would contain respondents who are less sensitive to these conditions, i.e. with coefficients closer to one than for the subsample without shock experience. It is more difficult to understand why selection would make the remaining shock exposed respondents become *less* likely to move when environmental conditions get worse, i.e. lead to coefficients significantly below one in the above analysis. A similar argument can be made for the idea that past shock experience may have made remaining households more resilient to future shocks. While this would make their mobility decisions less sensitive to future environmental degradation, i.e. bring coefficients closer to one, it does not really explain a reversal of mobility responses to worse environmental conditions from positive to negative. Our results are instead consistent with the idea that households that have chosen to stay after suffering environmental shocks have adapted their preferences to validate past choices, for instance, as a result of a sunk cost fallacy. There is here then a suggestion of dynamic preferences, where households that have experienced shocks and elected to stay develop stronger preferences for staying in place in the face of future environmental adversity. This is a stronger conclusion than the one suggested by the regression analysis of the previous section, as it further intensified the disinclination of the population remaining in areas repeatedly hit by environmental shocks to move to other locations.

## Limitations and caveats

While based on original data from a highly relevant area for studying migration responses to environmental change, our analysis has some limitations which should be taken

into account when considering the implications. Our data is cross-sectional, and while we control for a number of covariates relevant to migration decisions, there would be a clear advantage to complementing our analysis by using longitudinal data to study the evolution of preferences in climate affected populations. We have chosen to focus on effects of more recent environmental shocks (experiences in the last 5 years), since more recent shocks are more likely to affect current migration preferences than more distant shocks. Our 5-year period in this respect mirrors that of other studies (e.g. Adger et al. 2021). It should nevertheless be noted that more temporally distant shock may also have long-term effects on current preferences, e.g. through mental health impacts (Mulchandani et al. 2020). However, to the extent that more distant shocks are positively correlated with more recent shocks and with intentions to migrate, this would mean that our regression estimates overstate the effect of recent shocks on migration: So even controlling for more distant shocks, the effect of recent shocks on migration intentions is unlikely to be positive.

In our analyses, we have opted to study movements of whole households. This is motivated by our focus on the potentially disruptive impacts of climate change on highly vulnerable communities, and their implications for human settlement in these areas. This is not to say that migration of individual household members is uninteresting or unaffected by climate change, but migration of individuals is not our focus here. Moreover, we use migration intentions to study preferences for future migration. It has been argued that migration predictions can be indicative of actual migration flows in the future (Creighton 2013), and Tjaden et al. (2018) document a positive association between intentions and flows at the country level. However, it remains a challenge that actual migration decisions are constrained by conditions, available information, and resources at a given point in time which may be hard to foresee (Lu 1999).

Applying a discrete choice experiment to understand migration preferences and behaviour is an original approach which permits the analysis of the relative importance of different environmental factors for migration, and can help us better understand the trade-offs people make between important livelihood and environmental conditions. We nevertheless note that discrete choice experiments have inherent limitations in the number of attributes that can be mentally processed by respondents. As noted in the "Context and relation to the migration literature" section, migration decisions are affected by a number of factors in both sending and receiving areas. Our focus is on how changing conditions at the current locations of our respondents affect their migration intentions, and we include in particular changing environmental conditions found to be relevant in the qualitative pre-study. We have therefore stressed in the discrete choice question that costs and conditions in areas they would move to are to be considered the same in both scenarios. The experimental approach used may still not include aspects of the migration context which could affect the migration choices of the respondents, and it is also possible that some of our attributes may be proxies for other aspects respondents associate with them.

## Concluding remarks

Climate-induced displacement and migration is a huge policy concern internationally and particularly so in countries heavily exposed to negative consequences of climate change such as Bangladesh. A lack of substantive data and evidence on the likelihood and drivers of climate-induced migration, i.e. which households are likely to choose migration as an adaptation strategy and under what conditions, remain a challenge for appropriate and effective policymaking (Boas et al. 2019). Our analysis underscores the importance of evolving preferences and the complications this introduces in this context. As the natural environment changes, communities and people change with it. From our results, there is an indication that when communities and households are repeatedly hit by environmental shocks, rather than loosen their attachment to their current location, these types of events may make people more determined to stay. As indicated by our regression and discrete choice experimental analyses, this is likely a result of both selection, where the least migration-averse households leave, further intensified by dynamic preferences among those households that decide to stay.

Our analysis has several important implications. One of the more difficult questions in research on climate change and migration is to what extent migration responses to past environmental changes can be used to predict future climate migration. An important aspect of this discussion concerns the scale and nature of coming environmental impacts of global warming; if the changes are outside the range of past human experience, studying past migration responses to changes in, e.g. temperature or precipitation, may not say much about future migration flows. Our analysis adds a possible further complication to this issue. As exposed communities are continually hit by climate change induced shocks, the composition and individual preferences of those living in these communities may also change, in the direction of less responsiveness to further shocks and changes. While the purpose of our article is not to pass judgment on macro level predictions of how many million people will be displaced or migrate as a result of climate change, our results on the dynamics of preferences in vulnerable communities do suggest that migration responses may be more muted than one would otherwise expect.

The implications for adaptation policy are also not straightforward. In light of the preferences uncovered here,

it would seem that the relative returns to policy measures that help people adapt in situ may be increasing relative to measures to facilitate migration as an adaptation choice, in communities that are repeatedly affected by negative environmental events. This would over time point to greater use of government support for in situ adaptation instead of support for migration and resettlement. However, for the type of locations studied here, livelihoods are extremely marginal to begin with, and there are clear natural limits to the mileage one can get from improved seeds, agricultural practices, protective measures, and other in situ adaptation measures in the face of continued environmental degradation. Migration may therefore have to remain on the table as an adaptation strategy, which raises difficult dilemmas when households have a preference for staying in place. Policy measures to promote migration then have a paternalistic tinge, overriding the preferences of those they are directed at. While soft paternalism in the form of nudges, information, and awareness raising may be less problematic to promote migration as an adaptation strategy, these measures may also not be very effective, which means that harder paternalistic measures may come to be discussed. This raises real ethical dilemmas with no obvious resolution, also in light of problematic policies of forced resettlement in various countries in the past (Walelign et al. 2021).

In both our descriptive and discrete choice data, we have noted that migration decisions appear more responsive to fast-onset events like cyclones that lead to the destruction of property than to slow-onset changes such as soil salinization that may have more profound long-term effects on livelihoods. It is important that this apparent under-emphasis on slow-onset environmental change is examined in further research, including whether households face informational or cognitive processing limitations in responding to more long-term phenomena. The preferences of potential climate migrants may also affect how they are viewed by host populations in the areas in which they come to settle, which is a complex topic that requires more research (Kolstad et al. 2023; Lujala et al. 2020). Finally, while a strength of our study is that it addresses migration decisions in two extremely climate exposed areas of Bangladesh, our analysis primarily addresses short-distance rather than international migration, and whether our results generalize to other areas and migration flows merits further attention.

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s10113-023-02086-3.

**Acknowledgements** The authors thank Nicola Coniglio, Rune Jansen Hagen, Katrin Millock, Mads Greaker, Solomon Walelign, Magnus Hatlebakk and two anonymous reviewers for helpful suggestions and comments. The research was completed when Minhaj Mahmud was at the Bangladesh Institute of Development Studies. Views presented in this paper do not represent the position of the institutions with which the authors are affiliated.

**Funding** Open access funding provided by Norwegian School Of Economics. Funding from the Research Council of Norway is gratefully acknowledged (Grant number 274702).

**Data availability** Data sets available from the corresponding author on reasonable request.

## Declarations

**Competing interests** The authors declare no competing interests.



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