



Adaptation to climate risk: Evidence from cyclones and flooding in Bangladesh

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- Climate change is increasing the frequency and intensity of extreme weather events, exposing developing economies to greater economic risk.
- This project uses long-term data on floods and cyclones in Bangladesh to study the importance of adaptation in reducing the impact of rising climate risk on the economy. The project focuses on adaptation along two margins: changes in crop choice and labour reallocation across sectors.
- Findings show that a rise in both flooding and cyclone propensity shifts farmers away from more exposed crops. In addition, while rising cyclone propensity shifts workers out of agriculture, rising flood propensity has no discernible impact on agricultural employment.
- Incorporating long-term adaptation responses in a general equilibrium model shows that, going forward, adaptation can reduce the negative impact of rising climate risk by 17-47%, depending on the size of future shocks and their correlation across regions.

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Introduction

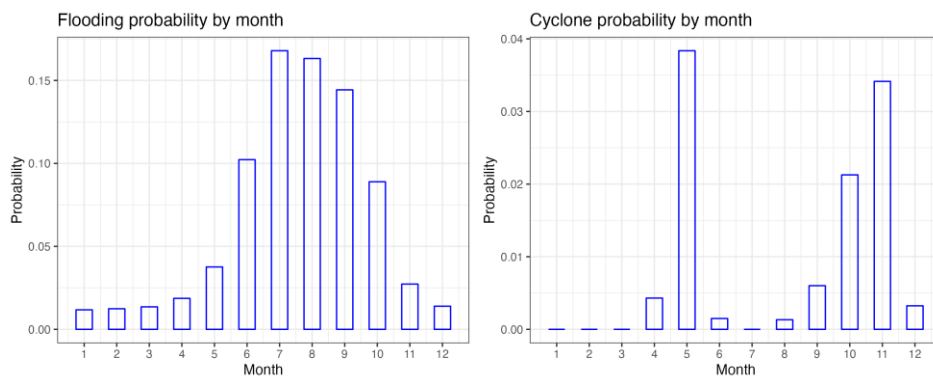
Climate change is expected to increase the frequency and intensity of extreme weather events such as floods, droughts, and cyclones. These changes will expose households and firms, particularly in developing countries, to greater economic risk.

A central question for policymakers is whether economic agents can adapt to worsening climate conditions. If adaptation is significant, projections that ignore behavioural responses may overestimate the economic costs of climate change. At the same time, if adaptation is important but constrained by frictions, there may be an important role for policy in reducing barriers to adjustment and minimising the impact of rising climate risk.

These issues are especially important in developing countries, where agriculture accounts for a large share of employment and where mobility across regions may be limited. In such settings, adaptation is likely to occur primarily through changes within agriculture and sectoral reallocation of workers, which are the two channels of adaptation this project focuses on.

Bangladesh provides a useful setting to study the importance of adaptation in reducing the impact of rising climate risk. The country is consistently ranked among the most climate-vulnerable countries in the world and has experienced frequent flooding and cyclones over the past several decades. Figure 1 shows the probability of an average Bangladeshi *upazila* (sub-district) facing a flood or cyclone event by month. Understanding how households and workers adapt in Bangladesh can provide broader lessons for how countries at a similar level of development will adapt as climate change makes extreme weather events more likely.

FIGURE 1: Probability of an upazila facing a flood or cyclone by month (1960-2010)



Data and methodology

To study long-term adaptation in response to increases in climate risk, original data were obtained from agriculture and population census publications (1980 onwards) and combined with monthly measures of flooding and cyclones (1960-2011). The census data was collected at the level of upazilas, which are the third unit of administration in Bangladesh. Flooding maps were constructed based on readings of water level stations along Bangladeshi rivers, while cyclone paths and windspeed were obtained from the World Bank. Both flood and cyclone maps were converted to shocks at the upazila level.

In the empirical section of the project, these data were used to run panel regressions to identify the impact of increases in baseline flooding and cyclones on crop choice and sectoral employment.

The project then develops a general equilibrium model that incorporates decisions along the two margins of adaptation, and uses the model to answer counterfactual questions. Key elasticities in the model were calibrated to match the adaptation response in the empirical section. The model was used to quantify the extent to which adaptation reduces the impact of rising climate risk on the aggregate economy.

Findings

- 1. Farmers adjust crop choices in response to climate risk:** Increases in flooding and cyclone risk lead farmers to shift away from vulnerable crops. These changes suggest that farmers actively adapt to changing climate conditions by reallocating land across crops.
- 2. Cyclone risk leads to movement out of agriculture:** Higher cyclone risk reduces the share of workers employed in agriculture, suggesting that workers move to non-agricultural sectors as climate risk emanating from cyclones increases.
- 3. Flooding primarily leads to within-agriculture adaptation:** While cyclone risk leads to sectoral shifts, flooding appears to trigger adaptation primarily through crop switching rather than labour reallocation. Corroborating this finding, the project also finds that rising cyclone propensity reduces agricultural land use in an upazila, while an increase in the likelihood of flooding has no impact on land used for agriculture.
- 4. Adaptation substantially reduces welfare losses from climate change:** When climate risk doubles relative to historical levels, welfare losses are significantly larger in a scenario without adaptation. Allowing for crop switching and sectoral reallocation reduces these losses by nearly 30%. The importance of adaptation, however, depends both on the size of future increase in climate risk and the extent to which the increase is correlated across crops and regions, varying between 17-47%.
- 5. Migration further increases adaptation benefits:** When migration is included as an additional adaptation channel in the general equilibrium model, the benefits of adaptation increase, reducing losses from rising climate risk by 41% instead of 30%. This underscores the importance of spatial mobility in responding to climate risk.

Policy recommendations

1. Incorporate adaptation into climate impact projections: This study shows that adaptation significantly reduces the economic costs of rising climate risk. Projections that ignore behavioural responses, such as crop switching and sectoral reallocation, may therefore overestimate future losses. Policymakers should incorporate adaptation into climate impact assessments and cost-benefit analyses. This will lead to more accurate estimates of economic damages and better policy prioritisation.

2. Invest in tools that facilitate adaptation. Given the importance of adaptation, policymakers should invest in tools that help individuals respond to climate risk. Providing farmers with region-crop-specific information on risks can help them make more informed decisions. Expanding agricultural extension services and climate risk mapping can further support adaptation. These investments can reduce the impact of rising climate risk on both households and the aggregate economy.