

How will people move as climate changes?

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Large tracts of productive farmland in low-lying Bangladesh could be inundated by sea-level rise in coming years. Here, the shore of the Jamuna River, not far from the coast. Credit: Kevin Krajick

In coming decades, climate change is expected to displace millions of

people through sea level rise, crop failures, more frequent extreme weather and other impacts. But scientists are still struggling to accurately predict how many climate migrants there will be, and where they are likely to go. A new study published this week in the journal *Environmental Research Letters* seeks to address these questions by incorporating climate impacts into a universal model of human mobility. The model also seeks to predict the effects migrants might have on the places to which they move.

To demonstrate the efficacy of the new approach, the authors focused on [sea-level rise](#) and human migration in Bangladesh. Here, they estimated that more than 2 million people may be displaced from their homes by 2100 because of permanent inundation by rising sea levels alone. The study used a probabilistic model combined with population, geographic and climate data to predict the sources, destinations and flux of potential migrants.

Lead author Kyle F. Davis, a postdoctoral fellow at Columbia University's Earth Institute, said that more than 40 percent of Bangladesh's population is vulnerable to future sea level rise, as so many people live in low-lying areas that are often exposed to extreme natural events. However, he said, "sea-level rise is a very different type of migration driver from short-lived natural hazards, in that it will make certain areas permanently uninhabitable."

The team's results showed that mean predicted sea-level rise will cause population displacements in 33 percent of Bangladesh's districts—53 percent under more intensive scenarios. By mid-century, they estimated, nearly 900,000 people are likely to migrate because of direct inundation from mean sea level alone. Under the most extreme scenario, of up to 2 meters of mean sea-level rise, the number of migrants driven by direct inundation could rise to as many as 2.1 million people by the year 2100. For all scenarios, five districts – Barisal, Chandpur, Munshiganj,

Narayanganj, and Shariatpur – would be the source for 59 percent of all migrants. The analysis considered mean sea-level rise without normal high tides, so the results, both in terms of inundated area and displaced population, are conservative.



Both agriculture and aquaculture could be battered by sea-level rise, driving people out. Near the southern city of Khulna, residents use flooded areas to raise both rice and shrimp. Credit: Kevin Krajick

The researchers also estimated the extra jobs, housing and food needed to accommodate these migrants at their destinations. They found that to

cope with the numbers likely to be displaced by 2050, 600,000 additional jobs, 200,000 residences and 784 billion food calories will be needed.

These results have clear implications for migrant destinations, said Davis. "Migrants are unlikely to search far for an attractive place to move to, and the destination will generally be a trade-off between employment opportunities, distance from the migrants' origin, and how vulnerable it is to [sea-level rise](#) itself," he said.

Davis said that the already huge and crowded capital city of Dhaka is consistently favored, coming out as the top destination in all scenarios. This means the city will need to prepare. Dhaka's population has already rapidly expanded in recent years; with at least 18 million people in its wider metropolitan area, it is one of the most densely populated cities on earth.

Davis said inundation and the out-migration it causes will also have significant effects on both agriculture and aquaculture. Some 1,000 square kilometers of Bangladesh's cultivated land could be underwater by the end of the century, with a much larger area made unusable by saltwater intrusion. Given that 48 percent of the labor force works in agriculture, the impact of this would be keenly felt. Similarly, much of the country's coastal aquaculture is vulnerable to climate change, and this will probably have powerful nutritional and economic consequences. Nearly 60 percent of the animal protein in the Bangladeshi diet comes from seafood, and the country is the world's fifth largest aquaculture producer.

"Ultimately, we hope that the modelling tool we have developed can be used by researchers and planners to accurately predict the relocation of climate-induced [migrants](#), and to enable the development of political and economic strategies to face the challenge," said Davis.

More information: Kyle Frankel Davis et al. A universal model for predicting human migration under climate change: examining future sea level rise in Bangladesh, *Environmental Research Letters* (2018). [DOI: 10.1088/1748-9326/aac4d4](https://doi.org/10.1088/1748-9326/aac4d4)

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