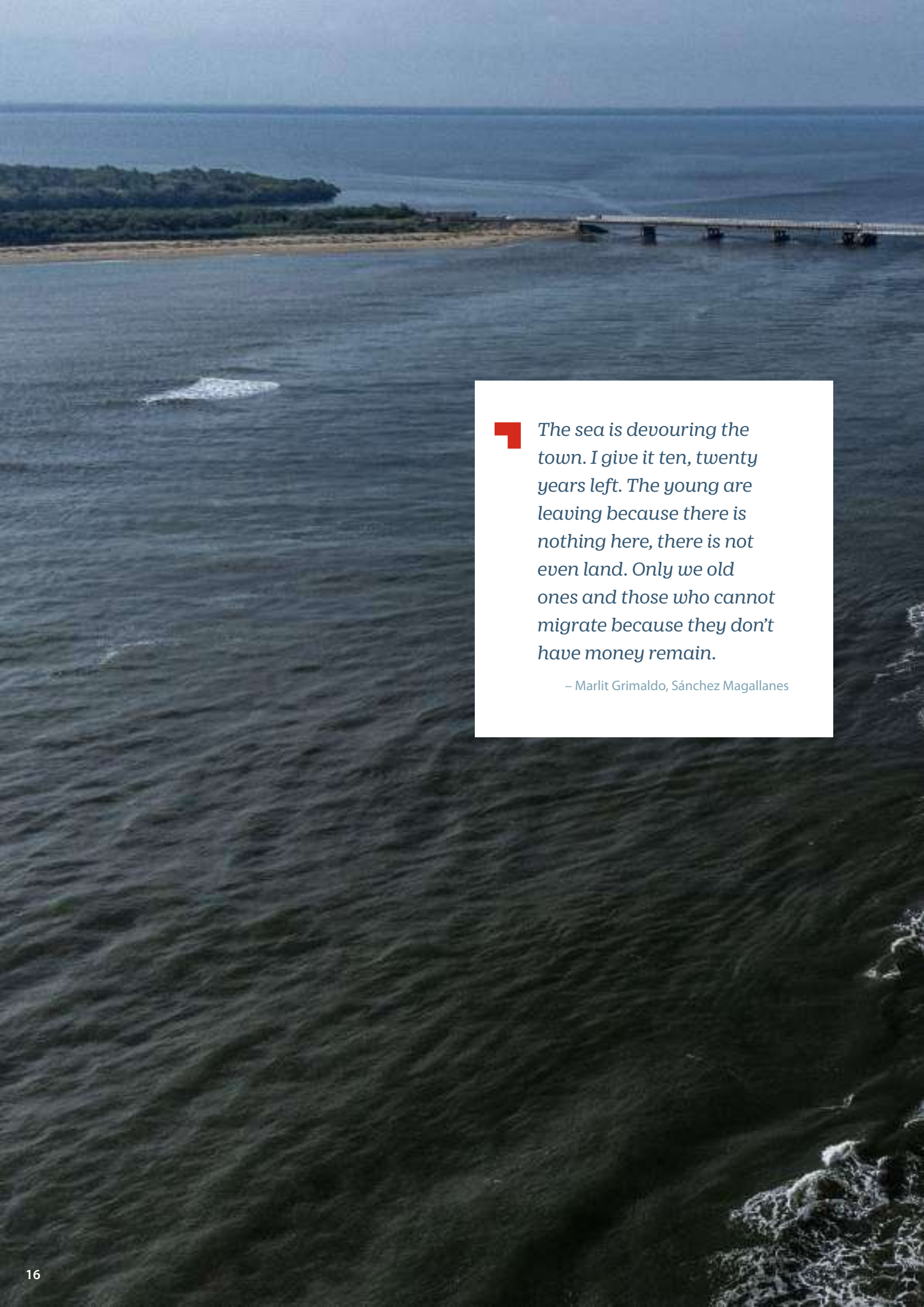


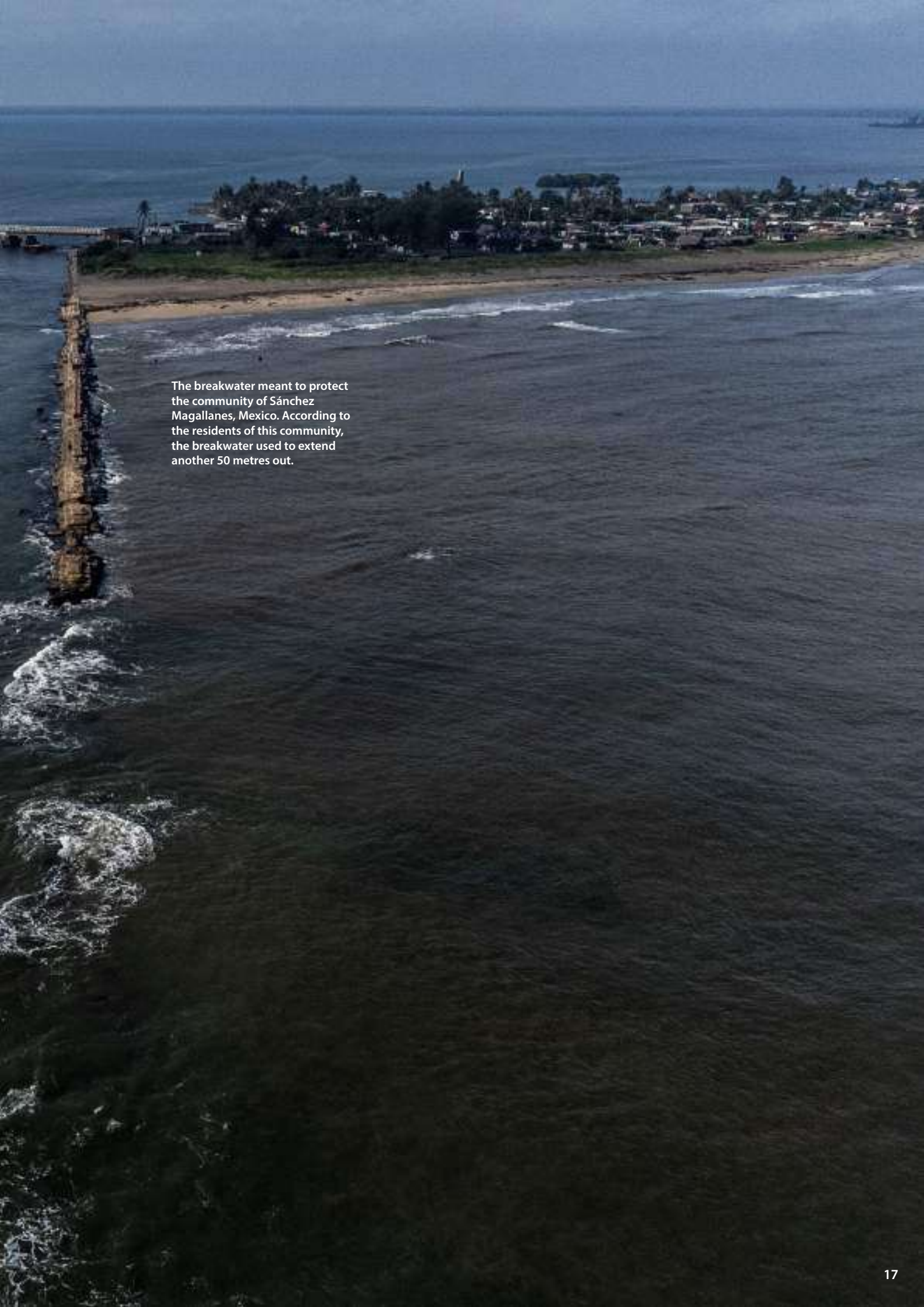
TURNING THE TIDE

ADAPTING TO CLIMATE CHANGE IN COASTAL COMMUNITIES

An aerial photograph showing a coastal town being eroded by the sea. A long pier extends into the water, and the land is being consumed by the ocean. The water is dark blue, and the sky is a pale blue. The town is visible in the distance, with a small island or peninsula to the left.

L *The sea is devouring the town. I give it ten, twenty years left. The young are leaving because there is nothing here, there is not even land. Only we old ones and those who cannot migrate because they don't have money remain.*

– Marlit Grimaldo, Sánchez Magallanes



The breakwater meant to protect the community of Sánchez Magallanes, Mexico. According to the residents of this community, the breakwater used to extend another 50 metres out.

TABASCO, MEXICO

Sánchez Magallanes

Pacific Ocean

Sánchez Magallanes used to be a lively town, on a strip of sand between the ocean and lagoons in the Mexican state of Tabasco. **But now Sánchez Magallanes is partly deserted, because so many residents have left to escape the storms and coastal erosion.** The road to the nearby town of Paraíso has been destroyed. Alicia Garcia and her husband Juan Izquierdo are among the 7,000 residents who have decided to stay – but every night the sea eats away at the sand under the foundations of their house. Six years ago, a storm took the roof off their kitchen and half the other rooms. Afterwards, Alicia says, “there was sand up to the entrance. We passed the corridor and we simply saw the sea, nothing but the sea. Our house was gone, it was sea and sand. My husband hugged me and I just cried.” In the years since, their patio has also been lost to the waves.

The state of Tabasco, in the south-east of the Republic of Mexico, is a middle-income region. It has modernized rapidly since the 1950s, and this has powered economic growth. This means it has some capacity to handle its many coastal risks. Unfortunately, **the growing impacts of climate change mean Tabasco now needs to focus much more on building resilience against floods, storms and coastal erosion.**

Between 2000 and 2020, the population of Tabasco increased from 1.9 million to 2.4 million people, a rise of over 26 per cent. This was driven in part by Tabasco’s modernization programme, which has entailed massive development along its Gulf of Mexico coastline, and along major rivers like the Usumacinta and Grijalva. Much of this construction was unplanned and risks like flooding were not considered. **The result is a society in which hundreds of thousands of people live in flood-prone places,** both on the coast and in-

land, in buildings and communities that are not flood-resilient. During the floods of 2020, Torno Largo Tercera resident Francisco Lopez saw 50 of his cows drowned. He says: “Here one does not know whether to invest in livestock for the next year or not, because we fear the flood. We do not live in peace. The river governs us.”

Tabasco’s economic development has primarily been driven by the petroleum industry.

The state has large oil reserves, and oil extraction accounts for 59.1 per cent of economic activity.⁹ However, the oil industry is unsustainable in the long term. To keep climate change below the internationally agreed targets of 1.5 or 2.0°C, the overwhelming majority of fossil fuel reserves must be left in the ground. Tabasco’s oil reserves are likely to become valueless “stranded assets” as global climate mitigation efforts gather pace.¹⁰ The state’s primary engine of economic growth will inevitably stall.

While the economy needs to transition to a more sustainable path, there is a simultaneous and urgent need for climate adaptation to changing coastal risks. **Tabasco is very exposed to coastal climate impacts.** Fully 92 per cent of the state is low-lying floodplain that never rises more than 30m above sea level, and some regions are below sea level. Furthermore, huge rivers crisscross the floodplains: about 30 per cent of Mexico’s freshwater flows through Tabasco.¹¹ Periods of heavy rainfall often cause these rivers to burst their banks. On top of that, Tabasco is a tropical region and its coastline faces the hurricane-prone Gulf of Mexico. It routinely experiences tropical storms, cold fronts, hurricanes and bouts of extreme rainfall. And, critically, sea-level rise due to climate change is increasing the frequency and severity of coastal floods. Floods have become more common

since records began in the 1860s, with floods that used to happen once a decade now striking every few years. As well as devastating homes and threatening lives, coastal floods bring in saltwater, causing salinization. **The combination of low-lying land, vast rivers, violent weather and rising seas means Tabasco is increasingly prone to severe floods.**

At the same time, **as Tabasco has grown, its natural buffers against flooding have been eroded.** To clear room for the oil industry and growing populations, huge areas of the state have been deforested. It is estimated that only 3 per cent of Tabasco's forests remain.¹² Forests are a crucial moderator of waterflow, buffering the huge inputs of water from bouts of extreme rainfall and thus regulating the flow of rivers. The loss of the forests has increased vulnerability to flooding. Similarly, wetlands that once buffered storm surges have been drained. For example, during the construction of the Tizón Oil Field four hectares of mangrove trees were removed. The result has been the highest coastal erosion rate in Mexico, 6.6m per year, despite thousands of dollars having been invested to prevent such losses.¹³

Many of Tabasco's people are poor and therefore vulnerable to flooding and other climate impacts. While the oil industry has grown rapidly, the resulting wealth has not trickled down to the general public, and poverty remains endemic. In 2010, 57.3 per cent of the population was in poverty, and by 2020 the proportion had only fallen slightly, to 54.5 per cent. Other measures of vulnerability worsened in the same time period. In 2010, 26 per cent of the population did not have access to healthcare, and by 2020 the proportion had increased to 27 per cent. Most people in Tabasco do not have the capital to repair their homes and

businesses if they are damaged, let alone improve them to make them more flood-resilient. Many are also unable to pay for treatment for infections and injuries sustained during extreme weather events. Furthermore, protracted flooding disrupts service provision. In the village of José María Morelos Santa Rita, Ana María Sánchez contracted an infection in her foot when her home was flooded for two weeks. When she finally made it to the doctor, she was told the foot had to be amputated.

Some communities and local government agencies are attempting to adapt, but they are facing soft limits such as lack of funds. Community-level projects rely on techniques and materials that are within reach. Some families have invested in small boats called cayucos, which they use during floods. Similarly, oyster fishers build mounds of oyster shells to reduce coastal erosion. In some cases, more ambitious projects have been attempted. One example is elevated houses dubbed "Palafitos", which are built on wooden columns 2–5m high and can therefore escape the worst of the flood damage. However, so far Palafito construction is only a pilot project. Meanwhile the Mexican Red Cross has been working since 2013 with the Zurich Flood Resilience Alliance, helping to bring together the many people and organizations who need to be involved in adaptation.¹⁴

The overall picture in Tabasco so far is one of patchy and limited adaptation. While rising seas may ultimately mean Tabasco is faced with hard limits to adaptation, at present the more pressing issue is soft limits that prevent people from adapting to threats that can, at least in principle, be handled. A recurring problem with all the projects is scaling them up. Often the people who are most vulnerable to floods are also those with the fewest resources. According to Marlit Grimaldo, who

also lives in Sánchez Magallanes, young people are simply moving away. The people who are left behind are either old or don't have the money to migrate. Although she believes installing new breakwaters could help slow down erosion, Grimaldo thinks the town will only last another decade. "We are forgotten," she says.

In conclusion, **Tabasco needs to develop in a new, more resilient way.** At present many people are leaving the most at-risk communities like Sánchez Magallanes to live in larger cities. But unless the cities are developed in a more risk-informed way, those people will simply have exchanged one set of risks for another. Already, parts of the state capital Villahermosa flood to a depth of 2–3m, because the city is both traversed and bordered by rivers, and its drainage systems are overwhelmed. One resident, Roberto Said, said he lost his car in the latest round of flooding. He has now prepared a shelter for furniture in his home and is prepared to drive his replacement car to higher ground. Said says the government should invest in pumping stations and operators to manage them during storms, to reduce the risk of major floods. It is only through such climate-resilient development that Tabasco can both escape the worst impacts of rising seas and break the cycle of poverty.



Every night, the sea eats away at the sand under the foundation of Alicia Garcia's house in Sánchez Magallanes, Mexico. Every day, her husband Juan Izquierdo tries to put back what the sea took away, using a single shovel. Seven days after the photo was taken, another portion collapsed.







*Here one does not know
whether to invest in livestock
for the next year or not,
because we fear the flood.
We do not live in peace.
The river governs us.*

– Francisco Lopez, Torno Largo Tercera

┐ *What are we going to do with our knowledge about cyclone warning signals, if the roads, embankments and cyclone shelters are weak? What are we going to do with a mere 5–10 kilogrammes of rice after a disaster event if we can't bounce back from the loss of a livelihood? We need mechanisms to regulate shrimp farming – which relies on saltwater – and promote paddy farming, to ensure equity for all the people living in the village. We need to promote coastal afforestation, which would reduce the risks of disasters to a great extent.*

– Prashant Chandra Mandal, Gantirgheri





The area around Kalyanpur village in Satkhira, Bangladesh, was underwater for about 10 months after Cyclone Amphan. Tides still flood the area. Trees and vegetation are dying.

SOUTHWESTERN BANGLADESH

Gantirgheri

Bay of Bengal

In Gantirgheri village in Khulna, Bangladesh, **56-year-old Prashant Chandra Mandal has twice been left homeless and forced to live on an earthen embankment.** Gantirgheri is close to the Sundarbans mangrove region, and the Shakbaria and Kopotaksh rivers flow on either side of it. The people used to make a living by farming shrimp and harvesting paddy, safe behind high and strong embankments. But after Cyclone Aila in 2009, Mandal and his family lived on the embankment for over a year. In May 2021, Cyclone Yaas struck and his family are once again living on the embankment.

In Bangladesh's coastal region, climate-induced disasters are starting to overwhelm attempts at adaptation. The country has made extraordinary efforts to adapt and reduce disaster risk. Its Cyclone Preparedness Programme – a joint initiative by the Ministry of Disaster Management and Relief and the Bangladesh Red Crescent Society – has massively reduced disaster mortality over the last few decades. Furthermore, the government has made significant investments in adaptation. But now coastal communities are running up against hard limits to adaptation. Overlapping crises means it is almost impossible for communities to become resilient. The people affected have been left destitute over and over.

Bangladesh is a lower-income country that is moving towards being middle-income. But while the country's overall economic status is improving, there are major disparities in the way this new wealth is being distributed. A large proportion of the population has seen little or no benefit. In particular, rural coastal populations are still reliant on fishing and homestead agriculture. These people have not seen their economic outlook improve. As a result, they remain highly

vulnerable to climate-related disasters like floods and storms.

Bangladesh is inherently exposed to coastal risks because it has a huge low-lying coastal area. Its southern coast lies on the Indian Ocean and stretches for 710km. The coastal zone spans over 47,150 square kilometres and is home to 38.5 million people.¹⁵ This entire area is only a few metres above sea level: in the south-east the average elevation is 4–5m, and in the more vulnerable south-west it is just 1–2m. While inland regions are less exposed, they are still at risk: about 88 per cent of Bangladesh's landmass is floodplain and delta, and the majority of it is less than 10m above average sea level.¹⁶

The country is frequently hit by violent storms and cyclones. Cyclones typically form in the Bay of Bengal and plough northwards onto Bangladesh's coastal zone. These storms cause tidal surges and vast floods, and damage riverbanks and other key structures. In the last 20 years the country has been repeatedly battered. In 2007, Cyclone Sidr caused estimated losses of 1.7 billion US dollars.¹⁷ Two years later, 2009's Cyclone Aila damaged over 500,000 houses, 7000km of road and over 123,000 hectares of dry land.¹⁸ 2020's Cyclone Amphan was similarly destructive, damaging about 149,000 hectares of farmland, as well as fish farms worth 3.25 billion Bangladeshi taka (36 million Swiss francs).¹⁹

These unremitting impacts have devastating human consequences. The story of Farooq Hossain Gazi is sadly typical. "I lost everything when Cyclone Aila hit in 2009," he said. With no means of earning a living, he went to India with his family. Returning to his village after eleven years, he built a small house. "That house was inunda-

ted by seawater during Cyclone Amphan and just a year later, Cyclone Yaas swept it away, leaving me devastated.” He asks wearily: “How many times can I rebuild my life?”

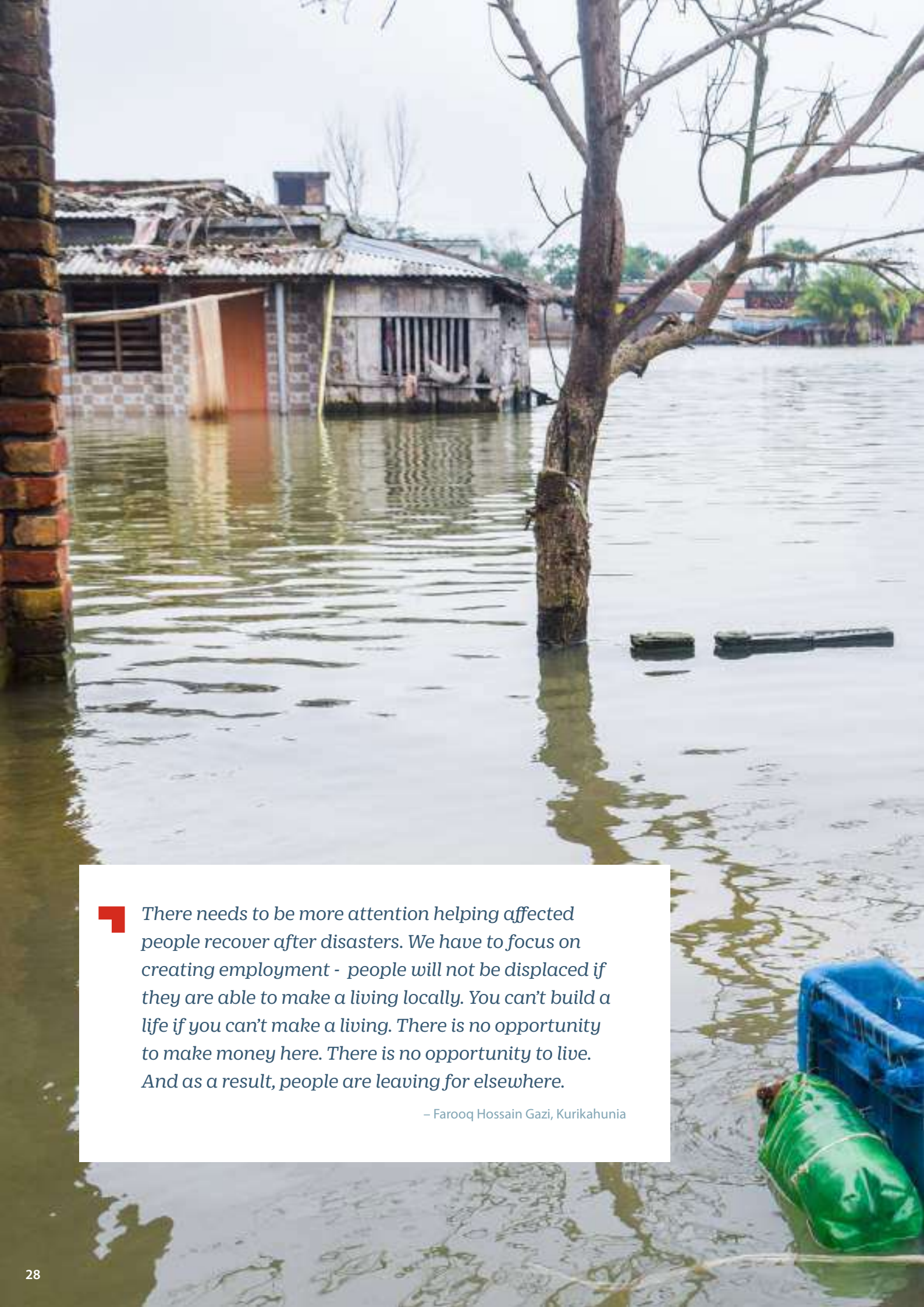
The flood risk is compounded by Bangladesh’s monsoon climate and enormous, constantly shifting rivers. Bangladesh is dominated by three great rivers: the Ganges, Brahmaputra, and Meghna. Over 92 per cent of their combined runoff drains through Bangladesh. But the water does not flow continuously throughout the year: far from it. Almost 80 per cent of the country’s annual precipitation falls during the summer monsoon, from June to mid-October. During that season, the rivers have a combined peak flow of 180,000 cubic metres per second: the second-highest in the world.²⁰ The rivers carry vast quantities of soil and silt from the Himalayas down onto the floodplain. This massive input of sediment, combined with the rapid flow, leads to constantly shifting topography. Frequently one bank of a river will silt up while the other is eroded, so the rivers change course even from one year to the next. On top of this, powerful tides can drive salty seawater over embankments and onto essential farmland – and cyclones that strike at high tide cause more severe floods.

Bangladesh’s coastal floods will become even more severe and relentless due to sea-level rise. Already, there is evidence that the seas around Bangladesh have risen faster than the global average, at 6–21mm/y.²¹ As a result, the country is projected to experience a sea-level rise of 88cm by 2100.²² That would lead to dramatic losses of land: it is estimated that a 1m rise would inundate 18 per cent of Bangladesh.²³ Higher sea levels mean that the same cyclone-driven storm surges can reach higher and further inland, threatening ever more people. Furthermore, as saltwater intrudes

into the land it salinizes the soil and contaminates potable water – so people in coastal regions find themselves unable to grow food or to find safe drinking water.

Bangladesh has tried to protect its people from cyclones and floods, using engineered solutions like polders in addition to early warning systems. The polders are areas of land that would ordinarily be flooded, but which are instead secured by embankments that keep out water. Land in the polders is protected from natural erosion and, in theory, from flooding. However, the combination of sea-level rise and increasingly intense cyclones will lead to higher tidal surges. As a result, many embankments are likely to be overtopped ever more frequently. Furthermore, if the embankments are not maintained and repaired after storms, they will fail. While the polders do offer a measure of protection, they are not sufficient even for present day conditions.

Bangladesh’s government has saved many lives with a series of overlapping coastal protection policies and measures over the last 20 years. These range from the National Water Policy (1999) to the Bangladesh Delta Plan 2100 (2018) and the 8th Five-Year Plan (2020). These have embraced an admirable range of approaches, from risk-proofing the built environment to nature-based solutions and awareness-raising. This has translated into genuine successes. Cyclone-related deaths fell by over a hundredfold between 1970 and 2007.²⁴ The Cyclone Preparedness Programme has early warning volunteers throughout the coastal belt, community risk assessments are institutionalized, and local disaster management committees are established at all levels. The country can mobilize tens of thousands of volunteers when a cyclone looms.



There needs to be more attention helping affected people recover after disasters. We have to focus on creating employment - people will not be displaced if they are able to make a living locally. You can't build a life if you can't make a living. There is no opportunity to make money here. There is no opportunity to live. And as a result, people are leaving for elsewhere.

– Farooq Hossain Gazi, Kurikahunia

After Cyclone Aila, Farooq Hossain Gazi left the country and went to India. Odd jobs in the years that followed allowed him to save money and return to Bangladesh. With the money he saved, he built a house on his own land in the village of Kurikahunia. But these days, his address only exists on paper – his house has been flooded since Cyclone Amphan.



However, adapting to climate change on Bangladesh's coast is enormously challenging. As the risks worsen, the vulnerable spots in Bangladesh's existing system are being exposed, many of which are consistent with challenges faced around the world. For example, cyclone shelters have saved many lives, but many people remain at risk. In particular, vulnerable groups such as women, the elderly and people with disabilities find it difficult to safely evacuate to the shelters. Prashant Chandra Mandal's village of Gantirgheri is a full kilometre away from the nearest cyclone shelter, and the cyclones and floods have left the road to the shelter very fragile. As a result, some of the people of Gantirgheri cannot reach the shelter when the alert is sounded. Furthermore, the shelters do not stop people losing their homes, assets and livelihoods – so people are often wary of leaving their households even when the cyclone threat is dire. Even when people do survive the storms, they often find themselves with little or nothing left with which to rebuild their lives.

On current trends, sea-level rise and extreme weather will displace millions of Bangladeshi people. The country is facing hard limits to adaptation. As sea levels rise and intense cyclones become more common, many regions of coastal Bangladesh risk becoming near-uninhabitable. They will be both hazardous and impossible to farm. It is thought that over 35 million people will be put at risk of displacement by 2050.²⁵ Unless more is done, from reinforcing existing polders and building new ones, to investing in resilient housing and helping people adapt their livelihoods, millions of people are likely to be displaced. Gantirgheri village offers a sample of what is to come. The people of the village used to make a dependable living by farming and fishing. But the village has been hit by many major cyclones: the most recent was

Cyclone Yaas in May 2021, which left thousands of acres of land submerged. Teacher Dharendra Nath Mahato, 79, said the change has been drastic. "There used to be many prosperous families here, but now most of the families in the village are suffering from poverty. Many people have been forced to move away due to lack of work. The village is becoming increasingly uninhabitable."

Displaced people may end up living locally on high ground or move to urban areas, including urban slums. The most immediate form of displacement is when people lose their homes to floods and find themselves living on their local embankment because there is nowhere else locally to go. Some rebuild but many leave. This displacement is likely to become more common as environmental stressors worsen. Many people who are displaced in this way end up in urban areas, including in slums, without proper sanitation or access to health services.²⁶ Furthermore, displaced people often become trapped in cycles of poverty. While many attempt self-recovery strategies, these often include borrowing money, driving the family into debt.

Farmer Farooq Hossain Sardar, 52, previously lived a comfortable life in Chakla village in Satkhira District. But in 2020 Cyclone Amphan swept away what was left of the village, including his house. Sardar and his family chose to move to Khulna – Bangladesh's third largest city. Six members of his family now share one small room, which is used for cooking, sleeping and storage. "After putting everyone to sleep at night, I go to the mosque next to my house to sleep," Sardar said. Housing, employment, education and food are a constant struggle.

Bangladesh is preparing for increasing climate-related displacement. Rising sea levels

present a hard limit to adaptation on the low-lying coast, which compounds the existing threats of frequent cyclones and flooding. Communities are being pushed beyond what they can sustain. The National Strategy on Internal Displacement Management includes a section on preventing displacement. But, crucially, in recognition of the increasing risk, it also sets out mechanisms for protecting people who are displaced, and to find permanent solutions for them. Farooq Hossain Gazi spells out the necessity of such measures: “You can’t build a life if you can’t make a living. There is no opportunity to make money here. There is no opportunity to live. And as a result, people are leaving for elsewhere.”

Bangladesh has demonstrated leadership in coping with rising risks, but is facing a dramatic challenge and needs the world’s help if its

coastal communities are to endure. Major cuts to greenhouse gas emissions would reduce the intensification of cyclones, storm surge and slow sea-level rise, keeping at least some of the hard limits at bay. At the same time, the people on Bangladesh’s coast need help to adapt to the changes that have either already happened or are inevitable. Prashant Chandra Mandal is clear about what he believes must be done: “What are we going to do with the knowledge on cyclone signals, if the roads, embankments and cyclone shelters are weak? What are we going to do with a mere 5–10 kilogrammes of rice after a disaster event if we can’t bounce back from the loss of living? We need mechanisms to regulate shrimp farming, which relies on saltwater, and promote paddy farming to ensure equity for the populations of this village. We need to promote coastal afforestation which will reduce the risks of disaster impacts to a great extent.”

Coastal communities on the Horn of Africa have traditionally relied on fishing and pastoralism for their livelihoods.





I have been a fisherman all my life, but fishing has never been difficult as it is today. With not much success at sea, we are forced to rely on humanitarian aid.

– Ismail Gurrey Mohammed, Bulhar

In Bandarbeyla, the 2005 tsunami left local trade, housing and fishing devastated when the port, 300 houses and boats were damaged. Now the fisheries are failing.



Climate change has altered wind patterns, a situation that has really affected fishing activities. It is difficult to work on schedule as before and, in some instances, fishermen have to postpone their fishing activities indefinitely.

– Rashid Yuusuf, Bandarbeyla

COASTAL SOMALIA

Gulf of Aden

Bulhar

Bandarbeyla

Arabian Sea

For the people of Bulhar, a small town near the coast of Somalia, extreme heat is a constant problem. Bulhar is semi-isolated due to a lack of proper roads, and the people rely on fishing and livestock farming for their livelihoods. But the heat is now scorching. **At the shore, temperatures frequently exceed 40 °C during the day.** The fishermen claim that the fish are moving deeper into the ocean, while the people themselves now live about 2km inland to escape the worst of the heat. But, even there, the people are forced to spend the most productive parts of the day sheltering. At night they often sleep outside, because poverty has trapped them in poorly constructed homes that become extremely hot. The town once had a population of around 2,000 people, but many have now left for cooler climes. “At the moment, there are only 500 people here,” according to Zakaria Hassan Musa, Deputy Mayor of Bulhar District.


In the coastal regions of Somalia, environmental vulnerabilities are exacerbated by the legacy of conflict. Coastal communities face a range of climate-induced threats, from heat and sea-level rise to droughts and storms, and the economy has inherent vulnerabilities. The communities have many options for adaptation, but achieving them poses a considerable governance challenge.

Most Somalis depend on rainfed agriculture but much of the country is arid or semi-arid. Over 70 per cent of the population obtain their main livelihoods from pastoralism, and livestock contributes approximately 40 per cent of the country’s Gross Domestic Product (GDP). Even in coastal communities like Bulhar, agriculture is a critically important livelihood. The pastoralists’ lives are shaped by two rainy seasons: Gu, running from late March / early April until June; and Dayr, lasting from September to early November. The

hot and dry climate brings considerable challenges. In the Bulhar region, even the sea is now too warm. High water temperatures have caused fish to migrate deeper into the sea, making fishing increasingly difficult as well. According to one long-time fisherman in Bulhar, Ismail Gurrey Mohammed, fishing is no longer a feasible occupation.

Extreme weather events like droughts, floods and storms are becoming more common. Nearly 66 per cent of the population was affected by floods between 1961 and 2021.²⁷ Most floods are either storm surges brought on by cyclones hitting the coast, or flash floods caused by intense rainfall – which can also impact coastal communities. In November 2020, the coast was struck by Cyclone Gati: the strongest tropical cyclone ever recorded in the northern Indian Ocean, and the first hurricane-strength storm to hit the coast.²⁸ The ensuing flash floods and other threats affected 120,000 people and 42,100 were temporarily displaced.²⁹ Similarly, droughts are also a major problem because of the semi-arid climate. This is true even in coastal regions, because many people there pursue livestock farming. Droughts cause crop failures and decrease livestock productivity, reducing people’s incomes. They also have lingering effects such as increasing soil erosion. Before the 1990s, droughts occurred about once a decade, but they now occur every other year – or even in consecutive years, as in 2016–17³⁰. Unfortunately, the climate is expected to become drier and warmer, with more unpredictable and extreme weather events. There is already evidence that human-induced climate change helped to drive some recent droughts, and some evidence also suggests that floods are becoming more frequent³¹.

Sea-level rise is making coastal floods worse and eroding the coast. Along the coast, sea levels

 *Bulhar town has a population of about 2,000, but at the moment, there are only 500 people here. The rest have moved in search of cooler places.*

– Zakaria Hassan Musa, Bulhar



Heat waves persist for the better part of the year, and the local population migrates out of Bulhar town in search of places with cooler temperatures and water for livestock.



are rising at about 1.3mm/y. It is expected to rise around 0.71m by 2100, considerably increasing the risk of storm surges and flash floods. Furthermore, much of the coast is low-lying and consists either of sandy sediments or weak cliffs of sedimentary rock. All these substances are prone to coastal erosion, and rising seas are exacerbating this. Even developed regions like the Mogadishu coast are highly vulnerable to erosion.

The town of Bandarbeyla has suffered many of the threats that now hammer the coast. As in Bulhar, the once-thriving fishing industry has become precarious. The district's Mayor, Rashid Yuusuf, says climate change has altered wind patterns. The strong ocean winds now disrupt fishing. "It is difficult to work on schedule as before, and in some instances, fishermen have to postpone their fishing activities indefinitely." This has exacerbated the town's long-standing difficulties. The residents have still not fully recovered from two previous tsunamis. The tsunami of 1975 swept away fishing boats and other equipment, leaving fishers without a way to support themselves and collapsing the town's economy. 30 years later, the tsunami of 2005 destroyed over 3,000 homes: even now, many of the affected families live in makeshift structures because they cannot afford permanent houses. The challenge facing communities like Bandarbeyla is that, because they have not yet recovered from previous disasters, they are less able to build new livelihoods.

The legacy of past conflict has left people vulnerable to climate-induced disasters. The violence of the civil war prior to 2000 created a number of lingering problems. Nearly 2.6 million people are internally displaced and live in temporary settlements. Only 24 per cent of the population has permanent housing made of durable mate-

rials. Many people remain in poverty, without the capital or other resources necessary to adapt to climate-induced threats. The 2017 drought alone wiped out 71 million US dollars by damaging four major crops. Risk management often depends on social cohesion, which has been eroded by the fighting. There is a need for greater cooperation between communities, across districts, and more widely. Furthermore, infrastructure such as roads was often damaged, or has since been neglected and is thus crumbling away. Only 13 per cent of roads are paved, which makes it harder for coastal communities to engage in long-distance trade, or to take part in risk management networks. Furthermore, since 2000 there has been considerable regional variation in the degree of political stability. Some areas are still experiencing conflict and this is affecting people's well-being and poverty levels directly.

The legacy of conflict has left significant gaps in risk governance and people's ability to access information about climate risks. Past conflict, civil unrest or past disasters have left vital infrastructure in need of repairs and improvements. A lack of climate legislation and enforceable policies for land use management, disaster risk management and fisheries allows unsustainable and high-risk practices such as construction in areas prone to coastal erosion to continue unchecked. Access to education, crucial for developing the skill set to understand climate change and its risks, remains inadequate. The literacy rate in Somalia is around 40 per cent, with males significantly more likely to be able to read than females: 49.7 per cent compared to 25.8 per cent. Low literacy and education levels can affect people's understanding of climatic shifts and thus how they choose to adapt.

There are a wide array of adaptation options to manage coastal climate risks in the region. Providing risk information services and developing early warning systems will protect people from disasters like floods when they strike. Enforced regulation of fishing should prevent overfishing along the coast, preventing environmental degradation and helping the fishing industry endure in the long term. Meanwhile, improved access to fishing gear and better roads would boost fishers' livelihoods. Strengthening infrastructure like housing and water management will protect people's health and well-being, and ensure they are not rendered homeless by floods. And nature-based solutions like restoring coral reefs and barrier islands will protect coastal regions from the worst of the storm surges, and from erosion.

The question is whether the context limits the feasibility of those options. The legacy of conflict is a problem, both for the ability to achieve change and for accessing international adaptation funding. According to the 2020 World Disasters Report,³² Somalia is among the countries that are most vulnerable to climate change, yet it ranks only 71st for per-person climate adaptation funding.

Climate change adaptation and improving peaceful governance must happen in parallel. The country faces growing risks from climate change, which threaten its already vulnerable population. It is essential that it adapts to the shifting climate, in order to stave off future humanitarian calamities. Its difficulties with conflict and governance are significant barriers to this adaptation. In the long run, better governance will be key to enabling adaptation and thus increasing communities' resilience. But, in the meantime, humanitarians can make a big difference by helping ordinary people and communities to devise and take up resilient livelihoods. According to Rashif Yuusuf, Mayor of Bandarbeyla district, a crucial step is to help vulnerable people to take part in productive economic activities. He wants to see a port constructed, so that locals can trade with people overseas. Yuusuf also says fishers need high-quality fishing gear that they can use even in strong winds, and they will need support to get it. It is also crucial to ensure that people in coastal communities have access to services like healthcare and education at all times.³³ For example, reliable internet access in rural areas can help people access essential information, including early warnings and forecasts of climate impacts.



It is September; the middle of the school term. Out of 140 pupils, only a meagre six have returned to attend school. As the heat has not gone down, the rest have still not returned to Bulhar after the seasonal move inland.

RECOMMENDATIONS

Although living in very different contexts, the people and communities presented in this report want the same thing – to be able to live safely and prosper. **To support coastal community resilience and sustainability, there is a crucial need for investments in coastal climate adaptation, such as:**



1. Establish early warning systems down to the neighbourhood level.

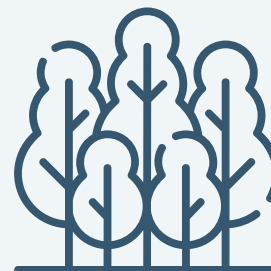
When threats like flash floods or cyclones are imminent, it is vital that people at risk are warned promptly and that the information reaches everyone. Linking improved forecasting capacity at the national level with community-level action and knowledge saves lives, as demonstrated by the Cyclone Preparedness Programme in Bangladesh.

2. Improve connectivity and essential infrastructure. Roads and other infrastructure are vital for boosting communities' resilience. For example, roads enable swift evacuation before cyclones arrive, while also keeping coastal communities connected to markets and services further inland. Connectivity and access to information enables people living in at-risk areas to make informed decisions about how to protect themselves and find aid if needed, and provides avenues for participating in adaptation processes.



3. Protect people's household assets and support their livelihoods so they are more resilient. People in coastal regions need secure homes in which to live, and sustainable ways to make a good living. Improving housing by making it more resilient, especially to inundation and high winds, will save lives and reduce displacement out of coastal zones. Enabling coastal communities to thrive economically, for example through sustainable fishing, will help them to bounce back after disasters like storms.

4. Implement nature-based solutions to protect communities. Ecological restoration and regeneration initiatives like reforestation and coastal dune rehabilitation can reduce the risk of flooding and slow coastal erosion, as well as recreating rich ecosystems. Tangible instruments like the valuation of ecosystem services can discourage environmental destruction.



These in turn point to broader recommendations.

The world's governments have promised to limit warming as close as possible to 1.5°C. **They must keep their promise by cutting greenhouse gas emissions to net-zero as soon as possible.** The impacts of climate change on coastal communities will become much more severe if temperatures go higher than 1.5°C.

We must prepare for the consequences of at least 1.5°C of warming. According to the IPCC's Sixth Assessment Report, it is now effectively inevitable that the global climate will warm by at least 1.5°C above pre-industrial levels during this century, if only temporarily. The world's most vulnerable people urgently need help to prepare for the rising seas, more extreme cyclones, storm surges and other hazards that a warmer world will bring.

It is essential that the world's governments step up to help vulnerable coastal communities adapt. They must significantly increase the amount of finance directed to locally led adaptation and resilience. Most climate funding has been directed at cutting greenhouse gases and other mitigation efforts and, while this is essential, adaptation is also crucial. Many of the most vulnerable countries have so far received little funding for climate action.

We should also recognize that we are already reaching limits to adaptation, and that losses and damages are a reality today. **Where possible, we must help coastal communities overcome the soft limits to adaptation.** In many cases, these limits are shaped by unequal access to information, technology and financing. Where possible, such barriers should be removed and communities should be supported to adapt to rising risks.

However, in some cases, and increasingly so as temperatures and sea levels continue to rise, coastal communities will run up against hard limits to adaptation and may ultimately be forced to leave. Managed retreat from coastlines will carry heavy costs that are not just financial but human – while unplanned displacement triggered by cyclonic floods and other disasters is even more expensive and harmful. **Where hard limits will be reached, it is critical that communities get the time and support to consider their options and are able to choose the least bad options,** literally leaving no one behind.

Community adaptation to coastal threats works best when it is locally led. While the threats facing coastal communities are largely similar all around the world – rising seas, worse storms and floods, faster erosion – the technological and socio-political challenges they face in adapting to those threats are very different. Many of the most effective adaptation options build on existing capacities in the community, and are coupled with programmes to help communities develop in a resilient way. Successful coastal adaptation often includes a combination of approaches, including infrastructure, nature-based solutions, livelihood support, education, early warning systems, and risk transfer measures. It also recognizes differences in vulnerability within communities, ensuring the people most at risk are prioritized and have a say in decision-making.




The embankment around Pratapnagar village in Satkhira, Bangladesh, is so weak that even normal tides overwhelm it.



What we need are cyclone shelters and strong embankments – not five to ten kilos of rice as relief after the cyclone.

– Prashant Chandra Mandal, Gantirgheri



I know that in 5-10 years this house will not exist anymore, but I have no place to go.

– Janet Del Carmen, José María Morelos Santa Rita

Janet Del Carmen and her daughter, from the community of José María Morelos Santa Rita, sit in the remains of their backyard. The river has destroyed almost all of the backyard and now threatens her house.

ACKNOWLEDGEMENTS

This report would not have been possible without the people of Gantirgheri, Kalyanpur, Kuri-kahunia, Pratapnagar, José María Morelos Santa Rita, Sánchez Magallanes, Torno Largo Tercera, Villahermosa, Bandarbeyla, and Bulhar, who told us about their lives and experiences. The advice and support of staff and volunteers in Bangladesh Red Crescent Society (BDRCS), Cruz Roja Mexicana (Mexican Red Cross), and Somali Red Crescent Society (SRCS) has also been invaluable.

The core team involved in the writing of this report were: Michael C. Marshall; Cathrine Tranberg Hårsaker, Norwegian Red Cross (NorCross); Julie Arrighi, Red Cross Red Crescent Climate Centre (RCCC); Maarten Van Aalst, RCCC and Roop Singh, RCCC.

The authors would like to thank the following people (in alphabetical order) for producing the technical reports and photo stories on which the case studies in this report are based:

Southwestern Bangladesh case study: At International Centre for Climate Change and Development, Istiak Ahmed, Fatema Akhter, Maliha Himu, Saleemul Huq, Saqib Huq, Samina Islam, Mizan R Khan, Sarah Farheen Khan, Juel Mahmud, Shohail bin Saifullah, and Rukhsar Sultana.

Southwestern Bangladesh interviews and all photos: Rafiqul Montu.

Tabasco, Mexico case-study: At Proyectos y Desarrollos TDM, Adriana Lucía Trejo-Albuerne, Bonnie Lucía Campos Cámara, Ingrid Zucely Méndez Calijau, Lucía Sol Pravatta Maggioni, and Manuel Jesús Xool Koh.

Tabasco, Mexico interviews and all photos: César Rodríguez.

Coastal Somalia case study: At Tonkin and Taylor, Bapon (Shm) Fakhruddin, Richard Reinen-Hamill and Neeraj Shankar.

Bandarbeyla and Bulhar interviews and all photos: At Switch TV Limited, Luvai Gohar, Samira Kibacha, Hillary Kirui, Kibisu Mulanda, Susan N'ong'a and Halima Sadoo.

The authors would like to thank the following people (in alphabetical order) for their generous time in reviewing the contents of the underlying technical case studies and/or this final report:

Abdulkadir Afi, SRCS; Abdirahman Omer Ahmed, NorCross; Jama Mohamud Ahmed, NorCross; Heidi Kathrine Bang, NorCross; Ramon Olaf Broers, NorCross; Brenda Avila Flores, Cruz Roja Mexicana; Kirsten Hagon, International Federation of Red Cross and Red Crescent Societies (IFRC); Yasif Hasan, American Red Cross (AmCross); Torben Henriksen, NorCross; Kathrine Holden, NorCross; Abdalla Makanna, NorCross; Preben Marcussen, NorCross; Khalid Bin Masud, AmCross; Øistein Mjærum, NorCross; Achala Navaratne, AmCross; Laura Ngo-Fontaine, IFRC; Shahinur Rahman, BDRCS; Jenny Reid, NorCross; Morten Tønnesen-Krokan, NorCross; and Ezekiel Zimperingham, IFRC.

This report was designed by Hilde Strømner Hatt at Wittusen & Jensen, and copy-edited by Sarah Tempest. The cover photo is by César Rodríguez.

The authors also wish to thank the Norwegian Ministry of Foreign Affairs for their financial support. The Coastal Disaster Risk Reduction program of Bangladesh Red Crescent Society, IFRC and American Red Cross in Bangladesh provided additional support for photo editing.

ENDNOTES

- 1 IPCC. Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. 2021. Cambridge University Press.
- 2 Kulp, S.A., Strauss, B.H. 'New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding'. Nature Communications, Issue 10, article number 4844, 2019. <https://doi.org/10.1038/s41467-019-12808-z>
- 3 Neumann, B. et al. PLOS ONE, 2015. <https://doi.org/10.1371/journal.pone.0118571>
- 4 Strauss, B.H. et al. 'Unprecedented threats to cities from multi-century sea level rise'. Environmental Research Letters, 16(11), 114015, 2021. <https://doi.org/10.1088/1748-9326/ac2e6b>
- 5 Oppenheimer, M. et al. 'Sea level rise and implications for low-lying islands, coasts and communities'. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. 2019. <https://www.ipcc.ch/srocc/>
- 6 CRED/UNDRR. Human cost of disasters: An overview of the last 20 years, 2000–2019, 2020. <https://reliefweb.int/sites/reliefweb.int/files/resources/Human%20Cost%20of%20Disasters%202000-2019%20Report%20-%20UN%20Office%20for%20Disaster%20Risk%20Reduction.pdf>
- 7 Mechler, R. et al. 'Loss and damage and limits to adaptation: Recent IPCC insights and implications for climate science and policy'. Sustainability Science, 15, 1245–1251, 2020. <https://doi.org/10.1007/s11625-020-00807-9>
- 8 IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. 2019. <https://www.ipcc.ch/srocc/>
- 9 Secretariat of Economy. Información económica y estatal del estado de Tabasco, 2016. <https://www.gob.mx/cms/uploads/attachment/file/43826/Tabasco.pdf>
- 10 EI, IISD, ODI, E3G and UNEP. The production gap report 2021, 2021. <https://productiongap.org/2021report/>
- 11 Gama, L. et al. 'Flood risk assessment in Tabasco, Mexico'. WIT Transactions on Ecology and the Environment, 145, 631–639, 2011. <https://doi.org/10.2495/WRM110561>
- 12 CONAFOR maps based on INEGI data from 2014, reproduced in Cubas, F.-a. (2020). ¿Por qué se inunda Tabasco?, 2020. <https://nubedemonte.com/por-que-se-inunda-tabasco/>
- 13 Marí, C. 'Proyecto Dos Bocas no contempla la erosión costera'. Connectas, 2019. <https://www.connectas.org/proyecto-dos-bocas-no-contempla-la-erosion-costera/>
- 14 Zurich Flood Alliance. 'Strengthening Mexican communities' resilience to floods aims to protect people, preserve beauty and commerce' in Zurich Magazine, 2019. <https://www.zurich.com/en/media/magazine/2019/strengthening-mexican-communities-resilience-to-floods>
- 15 Bangladesh Bureau of Statistics. Population and housing census 2011, 2011. Accessed at: http://bbs.dhaka.gov.bd/sites/default/files/files/bbs.dhaka.gov.bd/law_policy/6ed6b42c_2015_11e7_8f57_286ed488c766/Socio-Economic%20and%20demographic%20Report%202012.pdf
- 16 Rashid, H.E. Geography of Bangladesh, 2nd ed., 1991. University Press, Dhaka. <https://doi.org/10.4324/9780429048098>

- 17 GoB, EU. Cyclone Sidr in Bangladesh: Damage, loss, and needs assessment for disaster recovery and reconstruction, 2008. Dhaka: Government of Bangladesh, European Union. <https://reliefweb.int/report/bangladesh/cyclone-sidr-bangladesh-damage-loss-and-needs-assessment-disaster-recovery-and>
- 18 Xinhua via ReliefWeb. 'Cyclone Aila losses in Bangladesh estimated at 269 mln USD', 2009. <https://reliefweb.int/report/bangladesh/cyclone-aila-losses-bangladesh-estimated-269-mln-usd>
- 19 IFRC via ReliefWeb. "Operation update report – Bangladesh: Cyclone Amphan", 2020. <https://reliefweb.int/report/bangladesh/bangladesh-cyclone-amphan-operation-update-report-dref-operation-n-mdrbd024>
- 20 World Bank. The cost of adapting to extreme weather events in a changing climate. Bangladesh Development Series, No. 28, 2011. World Bank, Dhaka. <https://openknowledge.worldbank.org/handle/10986/26890>
- 21 Climate Change Cell, Department of Environment, Ministry of Environment and Forests. "Assessment of sea level rise on Bangladesh coast through trend analysis", 2016. Accessible at https://www.researchgate.net/publication/319881270_Assessment_of_Sea_Level_Rise_on_Bangladesh_Coast_through_Trend_Analysis_Department_of_Environment_Ministry_of_Environment_and_Forests
- 22 Water Resources Planning Organization. Coastal development strategy, 2006. Dhaka: Ministry of Water Resources, Government of the People's Republic of Bangladesh. <https://leap.unep.org/countries/bd/national-legislation/coastal-development-strategy-2006>
- 23 Agrawala, S. et al. "Development and climate change in Bangladesh: Focus on coastal flooding and the Sundarbans." OECD, 2003. <https://www.oecd.org/env/cc/21055658.pdf>
- 24 Haque, U. et al. 'Reduced death rates from cyclones in Bangladesh: What more needs to be done?' Bulletin of the World Health Organization, Vol. 90, pp. 150–156, 2012. <https://doi.org/10.2471/BLT.11.088302>
- 25 Ministry of Environment & Forests and Ministry of Finance Government. 'Linking climate science to climate policy and practice', 2018. Retrieved from https://www.climateinvestmentfunds.org/sites/cif_enc/files/dialogue_session_1.1_shamshur_khan_bangladesh.pdf
- 26 Sarker, S. et al. 'Assessing the disaster induced migration and displacement in the south-west of Bangladesh'. Journal of Environmental Science and Natural Resources, 12(1–2), 135–141, 2021. 10.3329/jesnr.v12i1-2.52009
- 27 EM-DAT: The international disaster database, 2021. <https://www.emdat.be/>
- 28 Schwartz, M.S. 'Somalia's strongest tropical cyclone ever recorded could drop 2 years' rain in 2 days' NPR, 2020. <https://www.npr.org/2020/11/22/937790467/somalias-strongest-tropical-cyclone-ever-recorded-could-drop-2-years-rain-in-2-d>
- 29 UNOCHA infographic, 2020. Accessed at <https://reliefweb.int/report/somalia/somalia-cyclone-gati-13-december-2020>
- 30 EM-DAT: The international disaster database, 2021. <https://www.emdat.be/>
- 31 Li, C.-J. et al. 'Spatio-temporal distribution of flood disasters and analysis of influencing factors in Africa'. Natural Hazards, 82(1), 721–731, 2016. <https://doi.org/10.1007/s11069-016-2181-8>
- 32 International Federation of Red Cross and Red Crescent Societies. World disasters report 2020: Come heat or high water – tackling the humanitarian impacts of the climate crisis together, 2020. World Disasters Report 2020: Come Heat or High Water - Tackling the Humanitarian Impacts of the Climate Crisis Together [EN/AR] - World | ReliefWeb
- 33 International Committee of the Red Cross. When rain turns to dust: Understanding and responding to the combined impact of armed conflicts and the climate and environment crisis on people's lives, 2020. <https://www.icrc.org/en/publication/4487-when-rain-turns-dust>

In Kuriakhunia, Bangladesh, Mrs. Abdus Sattar Gazi waits for her husband to return from work. They used to be able to live off the land they owned. Now day labouring is their only option for making a living.





