



Bangladeshis use the ubiquitous hyacinth weed to build floating, flood-proof crop gardens.

NO GOING BACK

With nations doing little to slow climate change, many people are ramping up plans to adapt to the inevitable.

When Superstorm Sandy hit the US coast last month, it blew millions of New Yorkers back into the nineteenth century. The southern part of Manhattan went black after floodwaters shorted out electrical systems. With the subway system disabled, many residents resorted to traversing the island by foot, and water supplies in some areas became contaminated with bacteria and pollutants.

The largest Atlantic hurricane on record, Sandy wreaked US\$50 billion in economic losses along the US northeast coast, providing a costly reminder of how ill-prepared even the richest nations are for weather extremes. Some recent weather disasters have now been attributed, at least in part, to human activity, including the 2003 European heatwave¹ and the floods in England in 2000 (ref. 2). According to the Intergovernmental Panel on Climate Change (IPCC), storms, floods and droughts will strike more frequently and with greater strength as the climate warms³. And if nations are struggling to cope now, how will they manage in a warmer, harsher future?

Just a decade ago, 'adaptation' was something of a dirty word in the climate arena — an insinuation that nations could continue with

BY OLIVE HEFFERNAN

business as usual and deal with the mess later. But greenhouse-gas emissions are increasing at an unprecedented rate and countries have failed to negotiate a successor to the Kyoto Protocol climate treaty. That stark reality has forced climate researchers and policy-makers to explore ways to weather some of the inevitable changes.

"As progress to reduce emissions has slowed in most countries, there has been a turn towards adaptation," says Jon Barnett, a political geographer at the University of Melbourne in Australia.

Adaptation has tended to focus on hard defences, such as shoring up sea walls and building dams. But as awareness of adaptation has grown, so too has the concept. "Adaptation means different things to different people, and is extremely location specific," says Neil Adger, an environmental and economic geographer at the University of Exeter, UK. Although residents in Bangladesh can raise their houses on stilts to survive floods, some settlements in Alaska and the Maldives must move in the face of rising sea levels.

Increasingly, it is local people who are deciding how to make their communities more resilient — and that is increasing the chances



AFTER KYOTO
The legacy of a climate treaty
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of success. “A solely top-down approach to adaptation — focusing on heavy investment in engineering and infrastructure — will not work as it is expensive and impractical,” says Robert Lempert, who researches decision-making at the RAND corporation, a think tank in Santa Monica, California.

FEARSOME FLOODS

With its low-lying deltas, Bangladesh has always been threatened by storms that blow in from the Bay of Bengal. But the cyclone that hit the southeastern edge of the nation on 29 April 1991 caused massive flooding and killed some 138,000 people, mainly children and older women. Twenty-one years earlier, a cyclone had claimed up to a half million lives.

Rising sea levels are increasing the risks to Bengalis, both from cyclones and from the spread of saline groundwater, which ruins aquifers and kills off crops. Projections by the IPCC indicate that a sea-level rise of 1 metre — expected sometime within a century — would inundate up to 20% of the country’s land area and displace 14% of the total population⁴.

In response, the country is busy building and strengthening its 13,000-kilometre network of embankments, planting salt-resilient crops and storing fresh water. One project, supported by the United Nations Development Programme, taught 18,000 households in coastal communities to plant mangroves and fruit trees and to harvest rainwater by digging ditches. The project aims to provide fresh water and income as well as to protect against flooding and erosion. In 2005, the country became one of the first to complete a national adaptation programme of action, and it later established a climate-change trust fund for financing local, small-scale projects in adaptation and mitigation.

Although Bangladesh’s per capita income ranks the nation among the world’s poorest, the country has mounted such a strong response to climate change that it has become something of a model for other nations, says Saleemul Huq, a Bangladeshi scientist and senior fellow in the Climate Change Group at the International Institute for Environment and Development in London. “In the past few years, the level of

“A SOLELY TOP-DOWN APPROACH TO ADAPTATION — FOCUSING ON HEAVY INVESTMENT IN ENGINEERING AND INFRASTRUCTURE — WILL NOT WORK.”

public awareness about climate change in Bangladesh has skyrocketed and it is now probably higher there than in any other country,” Huq says. But here and in other developing countries, it is hard to separate adaptation efforts from development that would have happened anyway. This confusion permeates discussions on financing adaptation efforts; of the \$125 million that Bangladesh has received in climate funds from overseas, it remains unclear how much is in addition to development aid.

And like almost everywhere, Bangladesh is having to play catch-up with the climate. “There is an adaptation deficit out there right now to current climate variability,” says Kristie Ebi, an expert on climate and health impacts at Stanford University in California.

Still, many experts say that Bangladesh has made significant progress. “What we can say is that there is collective action in the most climate-vulnerable country in the world,” says Huq. “The issue has galvanized people even across the political spectrum.”

Whereas Bangladesh has focused on involving citizens in many small-scale projects, the city of Melbourne has sought to head off problems through a massive engineering venture. Over the past decade, southern Australia has been hit by the worst drought in a century. After water restrictions implemented in 2007 angered thousands of farmers, the state of Victoria announced it would invest Aus\$3.5 billion (US\$2.9 billion)

in a new desalination plant at the site of Wonthaggi and commissioned a pipeline to bring water to the region from a river in the north. Overdue and over budget, the desalination project will take decades to pay off and is eating up the region’s adaptation resources, argue critics.

It is a clear case of maladaptation and will increase overall vulnerability to climate change, says Barnett, who has studied the project⁵. By investing so heavily in the desalination plant, the Victorian government has effectively shut off the possibility of funding other adaptation options, such as harvesting rainfall and recycling domestic waste water from showers and dishwashing, which would be cheaper and more effective, he says.

But John Thwaites, the water minister of Victoria until mid-2007, says that Melbourne has taken a multi-pronged approach that includes conservation and harvesting storm water. The government originally preferred measures other than desalination, but decided to build the plant in response to the unprecedented water shortage.

The United Kingdom has taken a different approach to planning for water problems. In autumn 2000, rainfall was at its highest since records began in 1766, causing devastating floods that left the village of Hambleton under water for six weeks at a cost of more than £1 billion (US\$1.6 billion). Early this year, a long drought led to water restrictions in parts of Britain, but the spring and summer that followed were the wettest in a century. Climate projections indicate that the country will face more frequent droughts and floods, but the models do not agree on the extent and timing of the changes.

Given the uncertain predictions, UK water companies are adopting a more flexible approach for making decisions about building reservoirs, extracting groundwater and other water-related plans. Rather than developing one strategy and sticking with it, they plan incrementally and frequently re-evaluate on the basis of new information, says Nigel Arnell, director of the climate research-focused Walker Institute at the University of Reading, UK.

Communities living on tiny islands, however, don’t have the luxury of considering many different options and reevaluating plans. For people in the Maldives, Kiribati and Carteret, there is simply nowhere to retreat when rising sea levels infiltrate their drinking-water supplies and flood their homes, so they will have to flee.

Small island nations can learn valuable lessons from the Alaskan village of Newtok, which is already in the process of moving. Located on the Ninglick River next to the Bering Sea, Newtok is below sea level and losing ground at a rate of roughly 22 metres per year to erosion. The villagers selected a site for their new home on Nelson Island, which is 15 kilometres away.

Turning a hardship into an opportunity, the residents are learning building skills to construct sustainable homes in their new village, and that will give them more job options in the future, says Robin Bronen, head of the Alaska Immigration Justice Project in Anchorage, which works with communities being relocated as a result of climate change in Alaska.

The experience in Newtok serves as a model for how ‘climigration’ should work in practice, says Bronen. “That’s because of the process — the community has made all of the decisions.”

Heat is often considered less dangerous than floods, but some of the most serious consequences of climate change will arise from hot weather. During the 2003 heatwave in Europe, temperatures reached their highest since 1500, topping 40°C for seven days in some parts of France. Almost 15,000 people died in that country alone. One climate modelling study of the Mediterranean region found that by the end of the current century, the frequency of heatwaves will increase from one every 3–5 summers to 2–3 heatwaves each summer; and they will last 2–5 times longer³.

In the aftermath of the 2003 disaster, France established a heatwave warning system, one of 12 now in operation throughout Europe⁶. In France, alerts are triggered when the five-day weather forecast predicts that temperatures will exceed thresholds for three days. In addition, scientists analyse mortality data, hospital patient loads and drinking-water



The costly Wonthaggi Desalination Plant in Australia has been criticized for consuming adaptation resources.

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supplies. The system can issue public warnings, mobilize personnel to visit vulnerable populations and call hospital and nursing-home staff back from their holidays. In 2006, a heatwave similar to the 2003 event put the system to the test; although it did reduce mortality and morbidity, thousands still died, in part because a significant fraction did not receive the warning and many did not heed the advice.

Ebi says that cities can do much better. “Heat-related deaths are completely preventable,” she says, if people are warned and told how to protect themselves. Yet the most vulnerable — the elderly, ill and poor, for example — often don’t see themselves as being at risk, says Graham Bickler, regional director at the Health Protection Agency in Brighton, UK. So one challenge is identifying and communicating to those groups. During a heatwave in Chicago, Illinois, in 1995, Ebi says, many of those who died were adults over 65 who lived in poor areas, where it was common practice to board up windows to protect against break-ins. The fans they used to try to keep cool had the reverse effect and turned their homes into convection ovens. They could have reduced their risk by consuming cold liquids and foods, taking cool showers and going to air-conditioned public spaces, says Ebi.

EARLY WARNING

Like Bangladesh, the nations of sub-Saharan Africa are particularly vulnerable to climate change, but they have received relatively little adaptation funding from international donors. Mozambique stands out as one of the most threatened, with 2,700 kilometres of coastline and more than half its 24 million inhabitants living in poverty.

Between 1965 and 1998 the country experienced 12 major floods, 9 major droughts, and 4 major cyclone events. Located at the end of river systems that stretch more than 1,000 kilometres into other countries, Mozambique can be struck floods without warning. “Mozambique is a country where every year there is a weather-related problem,” says Filipe Lúcio, a Mozambican meteorologist who now heads the Global Framework for Climate Services Office at the World Meteorological Organization in Geneva, Switzerland.

In 2000, Mozambique was hit by a flood worse than any in its history; it left 700 dead and caused damages totalling nearly US\$300 million, a significant fraction of its budget at the time. The event “wasn’t at all anticipated,” says Lúcio. Warnings of above-average rainfall came too late and failed to convey the magnitude of the coming flood. Since then, the country has switched to a colour-coded system that indicates the lead time for a predicted event and has recruited locals to record and monitor

precipitation and water levels — information they can use to raise alarms.

The system has succeeded in reducing risks. In 2007, a flood of similar magnitude to the 2000 event killed just 29 people. Looking to the future, the government has commissioned a study on national climate impacts and is working on a long-term strategic adaptation plan. But efforts to implement these plans will probably be hindered by lack of funding and sluggish bureaucracy⁷. The state has a budget of just \$5 billion, and half of Mozambique’s funds come from overseas aid, so resources are scarce even for crucial areas such as education and health. As of November 2011, Mozambique had received \$30 million in overseas climate finance and a further \$86 million has been pledged by the Pilot Program on Climate Resilience for a range of issues from upgrading roads to improving its meteorological service⁸. But experts say that this is far from enough.

It is a picture repeated across the globe. In 2011, developing nations received only about \$960 million in money dedicated for adaptation-related activities, but a 2007 report by the United Nations Development Programme estimated that developing countries would need \$86 billion a year by 2015 in funding to adapt to climate change⁹.

The issue is pushing the world’s rich and poor farther apart, says Desmond Tutu, the former archbishop of Cape Town in South Africa. In the UN report, he warned that “we are drifting into a world of ‘adaptation apartheid’”.

For both wealthy and poor nations, the challenge is to convince people to act before it is too late. “Adaptation is largely a matter of changing social processes so that fewer people are at risk,” says Barnett. “This of course won’t be easy — but it does mean the solutions are determined by people, not by nature” ■

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