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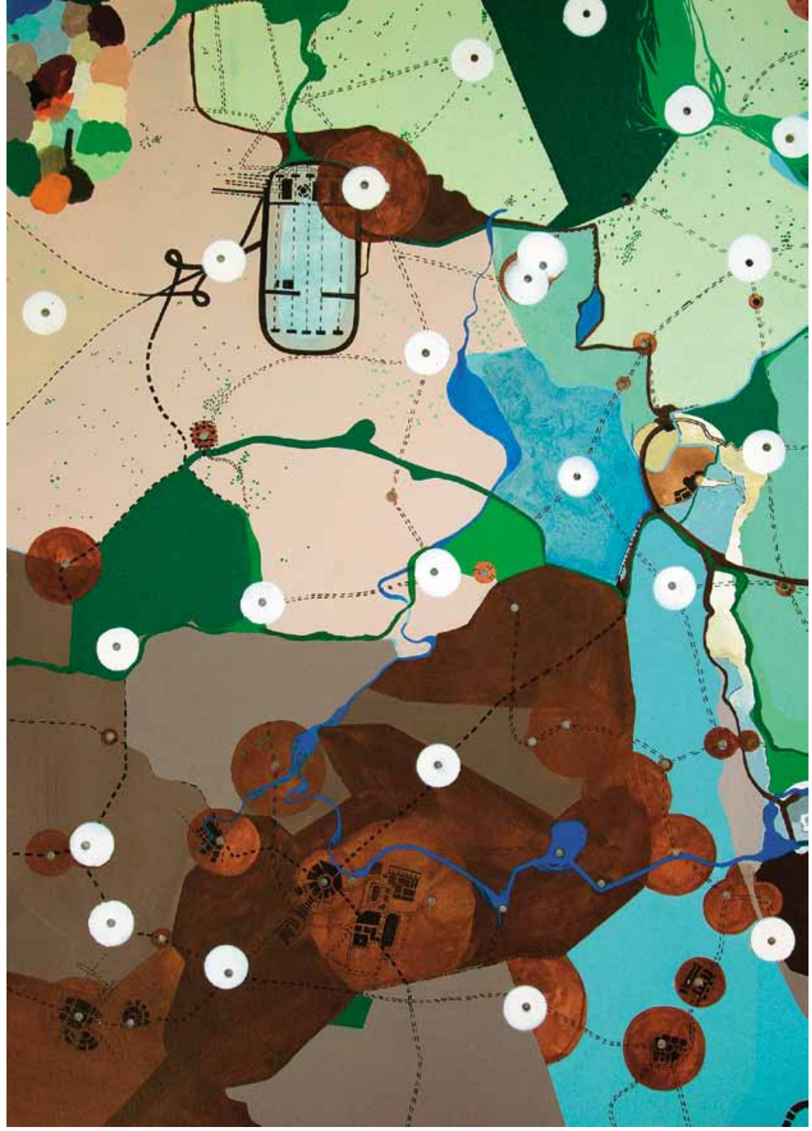

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Delta Stories: Blind folded history lesson, 2005–06
Acrylic on paper
32 cm x 24 cm

Delta Stories: Collapsed projects, 2005–06
Acrylic and ink on paper
32 cm x 24 cm

Delta Stories: Landscape I, 2005–06
Spray paint, ink, pen, and acrylic on paper
70 cm x 49.5 cm

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Extreme climate conditions: How Africa can adapt

Africa's climate already poses grave risks to the continent's people and economies, and global warming promises to intensify the problem. A factual risk-management solution can help.

Adrien de Chaisemartin, Marcel Normann, and Julien Pestiaux

Even before global warming became an issue, many African countries were unusually vulnerable to floods, droughts, and heat waves. Indeed, if there were to be no further change in Africa's climate, its current state already presents grave risks to the continent's people and economies. Global warming could trigger more frequent and severe weather disasters, shifts in rainfall patterns and climate zones, and rising sea levels.

For African nations, adapting to these possibilities is an urgent necessity. To do so, their leaders must answer some difficult questions. What climate-related losses could these economies sustain over the coming decades? How much can be averted and through what measures? Which investments will be required to finance them? Will the benefits outweigh the costs? We believe that such questions can be answered systematically through a factual risk-management approach that African leaders can use to assess climate's impact on their countries and to find ways of minimizing it at the lowest cost to society.

Knowledge about future climate trends—particularly their local impact—is incomplete, so policy and investment choices must be made under uncertainty. Yet enough is known to build plausible climate change scenarios as a basis for these decisions, even in developing countries. Such scenarios can help decision makers to identify adaptation measures useful against a range of climate change outcomes. Cost-effective responses can address much of the identified risk: depending on the country studied,[1] 40 to 70 percent of the losses expected by 2030 could be averted—even under severe climate change scenarios—through adaptation measures whose economic benefits outweigh their costs. In almost all cases, however, at least some risk cannot be averted through known measures.

Many adaptation measures would strengthen economic growth in developing countries; in Mali, for instance, climate-resilient agricultural development could generate millions of dollars annually in additional revenues. Measures with demonstrated net economic benefits could also attract investments and trigger valuable new innovations and partnerships. Indeed, well-targeted, early investments to improve climate resilience—through infrastructure development, technological advances, capacity improvements, new systems and behavior, and risk transfer measures—will probably be cheaper and more effective for the world community than complex disaster relief efforts after the event.

A fact-based approach can provide valuable input into the overall decision-making process. Among other things, it recognizes the importance of cost–benefit considerations, makes it possible to put "price tags" on current and future climate risks, and lets decision makers develop plans to help businesses adapt to them.

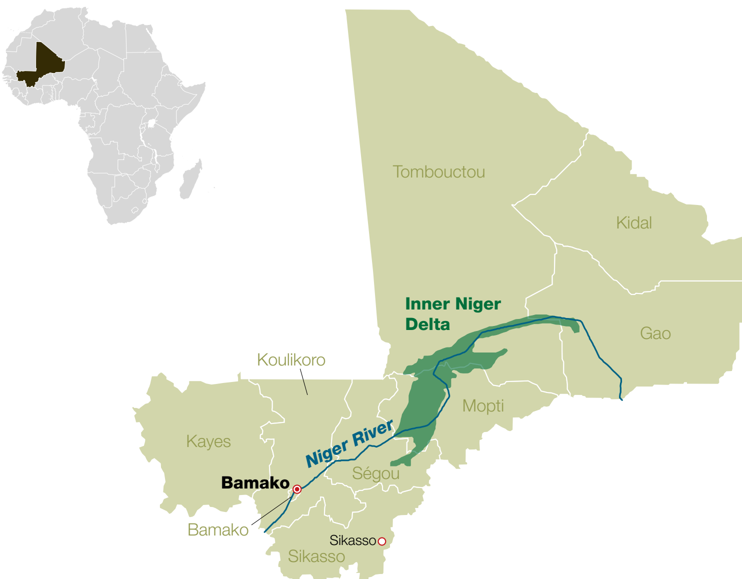
Mali: Climate zone shift

In northwestern Africa, stretching deep into the Sahara, Mali is a mostly dry nation, subject to frequent droughts. Increasing temperatures and decreasing rainfall tell of a shift in climate zones as the desert moves south over productive land. In these regions, farmers dependent on agriculture and livestock already face trying periods of drought and have few options to overcome them. Many

[1] The full report, *Shaping climate-resilient development*, is available at mckinsey.com and includes case studies of areas in China, Guyana, India, Mali, Samoa, Tanzania, the United Kingdom, and the United States. The report was conducted on behalf of the Economics of Climate Change Working Group, a partnership among ClimateWorks Foundation, the European Commission, the Global Environment Facility, McKinsey, the Rockefeller Foundation, Standard Chartered Bank, and Swiss Re.

Exhibit 1

Mali has a wide variety of natural environments, from the arid north to the more tropical south.



are moving to the cities, others to the country's less arid south. Our study focused on Mopti, an important agricultural area in the central region.

Mali has a wide variety of natural environments, ranging from a Saharan climate in the north to the more tropical south. From year to year, its rainfall levels are among the world's most variable. Annual floods during the rainy season in the Niger River's interior delta benefit agriculture but may harm local populations (Exhibit 1). Mali also faces additional hazards from climate change: drought is expected to increase in frequency and severity, weakening the country's agriculture and GDP. The climate zone shift—the combined effect of rising average temperatures and declining average rainfall—has already pushed the country's agroecological zones to the south over the past 50 years, with average rainfall down by about 200 millimeters and average temperatures up by 0.5°C over the same period.

Desertification and climate zone shift have multiple causes, with complex interactions. The impact from climate change is aggravated by farming and domestic practices, such as slash-and-burn agriculture (which erodes the soil) and deforestation, mostly to meet 90 percent of Mali's cooking and heating requirements. (Forest cover has decreased by almost 50 percent since the 1980s.) Nonetheless, local adaptations could eliminate a significant share of the loss due to climate change, and it is important to recognize that farmers have already developed the kinds of techniques that will help them cope. Diversity in crop cycles—already widely practiced by Malian farmers—will be essential. Genetic variation in plants helps to make agriculture in areas with higher climate risks more resilient to them. Also advantageous will be the farmers' tendency to spread out geographically for access to different types of soils and water sources.

In 2006, the value of Mali's crops and livestock was estimated at $840 million and $620 million, respectively. Projections to 2030 take into account the most valuable agricultural crops (cotton, maize, millet, rice, and sorghum) and livestock (for eggs, meat, and milk). Following historical expectations, the five main crops' value would increase by 46 percent, to $1,220 million (1.6 percent annual growth). In a more optimistic scenario, that level would more than double, to $2,470 million (4.6 percent annual growth).

Scenarios and responses

The significant uncertainty about climate change has spawned a range of climate projections for rainfall, while temperatures are consistently projected to increase significantly. Local climate models allowed us to consider three scenarios for a climate zone shift by 2030. Under the moderate-change one, temperatures would rise by 1.2°C and annual rainfall would decrease by 2.2 percent. The high-change positive scenario projects an increase in rainfall and temperatures of 8.1 percent and 0.9°C, respectively, while the high-change negative scenario anticipates a decrease in rainfall of 10.6 percent and an increase in temperatures of 1.4°C. Under all three, Mali would suffer economic losses by 2030. The pessimistic high-change scenario could involve losses of about $300 million annually (some 15 percent of the value of agriculture and livestock); the optimistic scenario, losses of $120 million annually (6 percent).

These losses will probably be offset, to some extent, even in the absence of specific adaptation measures. Agricultural production in Mali is likely to increase in value through the encouragement of farming in the regions best suited to it and the promotion of the right mix of crops. The human migrations required should happen naturally. Still, such measures would not cover the full expected climate-related economic decline.

Measures to increase productivity by encouraging the development of assets primarily in the most promising areas could compensate for losses elsewhere. Simulations show that by 2030, a migration of one million people could raise agricultural production by 6 percent more than population growth spread evenly across regions would. The migration of 1.5 million people by 2030 could raise production by an additional 8 percent—an overall 14 percent increase compared with the base case. But such controversial measures might promote conflict and increase competition for resources. Infrastructure and asset-based measures could make semi-arid areas substantially more resilient, however, so accelerated migration isn't essential.

Such measures depend on the specifics of each natural environment, so we assessed a few promising possibilities for the Mopti region (in the middle of the country), which well represents Mali's diverse agroecological zones. The southwest of Mopti, near the Niger River's internal delta, is suitable for rice cultivation, horticulture, fishing, and livestock. The east and north, with a hotter and drier climate typical of the Sahel (the region on the fringe of the Sahara), is more appropriate for dry crops such as millet and sorghum—and threatened by the desert's advance and the struggle to find water.

Asset-based adaptation measures, such as soil techniques, irrigation systems, and the provision of additional water for cattle, would help to "climate proof" yields. Of the measures reversing the losses, about three-quarters would have benefits higher than their costs. Other measures would generate additional agricultural revenues—for instance, by extending the land area suited to horticulture, providing for two harvests a year rather than one, or encouraging additional products and practices (for instance, by mixing agriculture and forestry in crop fields). The generation of new revenue, essentially another adaptation alternative, has massive potential but requires careful consideration of its secondary effects on society. For the Mopti region alone, revenue-generating cash crops could cover much if not all of the expected loss for the entire country. In other words, these measures are essentially economic-development activities.

Enablers and barriers

Many measures we identified are labor-intensive, so the availability and use of local workers can constrain both the potential and the speed of deployment. Labor is an additional cost, but nongovernmental organizations (NGOs) often finance measures in exchange for free work by farmers. Since machinery frequently produces better cost–benefit ratios, however, the desire to help the local workforce must be weighed against the advantages of using more efficient but expensive machines. Building local water holes for livestock close to villages during the dry season, for example, can take two months for a team; a bulldozer can dig one in a day. The workforce is usually idle during the dry season, though, so the choices are quite complex.

The many cost-effective measures—which were analyzed, through local experiences and suggestions, and which make sense from a purely developmental perspective—should be led by the players typically involved. Government engagement will be required for larger-scale infrastructure measures, such as irrigation in the delta. NGOs are likely best suited for smaller-scale measures. International institutes can provide important expertise on issues such as crop engineering and meteorology. Given the complexity and magnitude of the challenges, support from the international community will be critical.

An effective portfolio of climate resilience measures can be assembled at limited cost. The key is to create the right enabling environment to provide for effective adaptation to climate change as well as economic development.

Tanzania: The impact of drought

During the past 30 years, Tanzania has experienced six major droughts. The most recent, in 2006, is estimated to have cut GDP growth by 1 percent. Two specific effects of drought are of special concern. The first is the threat to human health posed by malnutrition and the spread of cholera and other water-borne diseases resulting from fresh-water shortages. Second, power generation in Tanzania depends predominantly on hydroelectric plants; during the 2006 drought, for example, the country faced severe power rationing because of a shortfall of water in reservoirs.

Our study focused on the drought-prone central regions (Dodoma, Singida, and Tabora)—where various local climate models allowed us to build realistic scenarios for climate evolution. Under the moderate-change scenario, these regions are projected to experience a 10 percent decrease in annual rainfall and a 25 percent increase in the variability of the amount of rainfall—changes that would lead to more severe and frequent droughts. Under the high-change negative scenario, rainfall would decline by 20 percent and variability increase by 50 percent.

The central regions are primarily rural, and a majority of their 4.4 million inhabitants are poor subsistence farmers. This population faces a range of serious drought-related health risks: for example, in 2003 a survey reported that 19 percent of children under five had suffered from diarrhea during the previous two weeks to the survey. Hydropower generation is also critically important in the central regions: the Kidatu and Mtera dams, located in or near them, contribute 50 percent of Tanzania's hydropower production capacity.

Health: Effects and adaptation measures

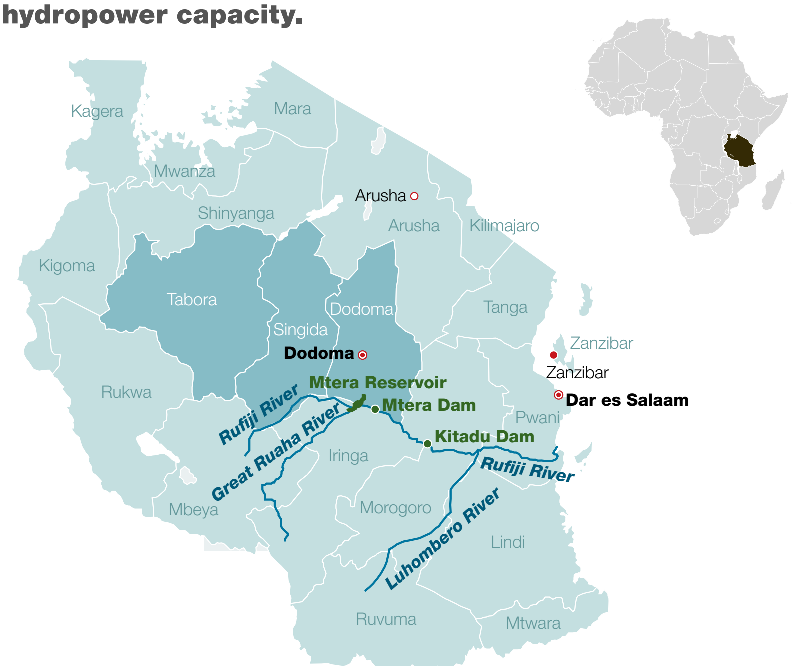
The most important drought-related diseases prevalent in the central regions are cholera, diarrhea, dysentery, malnutrition, and trachoma (which causes blindness). By 2030, even if the frequency or intensity of droughts doesn't change, 5 percent of the regions' population is projected to endure hunger from poor yields; the same percentage will suffer from trachoma. Cholera and dysentery will be common as well, and diarrhea will afflict almost 200,000 children under five.

In the moderate-climate-change scenario, by 2030 a 10 percent decrease in average rainfall levels could raise the proportion of the population under food stress by 60 percent, with a significant increase in the number of cases of cholera and dysentery. Trachoma cases could double. The high-climate-change scenario worsens the prognosis, particularly for trachoma.

Our study analyzed measures that could protect Tanzanians against drought-related health risks. Some are preventive: for instance educational programs for hygiene, sanitation, and breastfeeding; the building of covered wells with pipes and ventilated pit latrines; and the harvesting of

Exhibit 2

The Kidatu and Mtera dams, in or near Tanzania's drought-prone central regions, provide half the country's hydropower capacity.



rainwater. Others are treatments, such as oral rehydration therapy and the administration of antimicrobials and zinc supplements.

It will not always be easy to distinguish spending for adaptation to climate change from development spending on health. Water access measures, for instance, could prevent thousands of cases of cholera, diarrhea, dysentery, and trachoma but could be considered sound policy no matter how the region's climate evolves. Health spending should become more forward-looking rather than reactive.

Power generation: Impacts and adaptation

In 2030, Tanzania is predicted to rely on hydropower for more than half of its electricity. Ninety-five percent of this hydropower will come from the central regions, but drought will decrease the water flow in rivers and thus cut the amount of electricity generated. The Tanzania Electricity Supply Company will have to make greater use of more expensive natural gas and coal—thus also increasing greenhouse gas emissions—or cut the supply of electricity. In the latter case, companies with diesel generators will bear the extra cost of using them, and the production of other 40 percent will fall.

In the high-change negative scenario, the expected losses would cut the national GDP by 1.7 percent in 2030. Even in the moderate-climate-change scenario, GDP will fall by 0.7 percent, solely because of climate change–induced droughts. Tanzania could close most of the expected shortfall in power production if it were to implement energy efficiency measures, such as reducing demand by encouraging less (or more careful) usage in the residential and commercial sectors—moves that would save more money than they would cost. In addition, reducing spillage at hydro stations could significantly increase the power supply almost free of charge. No-regrets energy efficiency measures such as these could be implemented immediately.

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We do not know how much or how soon the global climate will change because of rising greenhouse gas emissions, but we do know that a country's ability to cope with climate change will depend on its socioeconomic position. The poorest developing economies face especially difficult challenges both in addressing their current climate risks and adapting to new ones. For them, linking climate responses with economic-development strategies will be vital. A fact-based approach that considers both costs and benefits can help.

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Adrien de Chaisemartin is a consultant in McKinsey's Johannesburg office, **Marcel Normann** is a principal in the Hamburg office, and **Julien Pestiaux** is a consultant in the Brussels office.