An Uncertain Harvest

Increasingly volatile weather patterns around the world are already causing supermarket prices to rise. But when it comes to global warming and the food supply, the real losers will be those in developing countries. A look at how one corner of Africa is coping.

T he night the dykes blew, Calimentina Anyango and her family grabbed what they could and ran for higher ground. For the next three days, the rain pounded down. There was nowhere to hide, nothing to eat. The babies cried till exhaustion gave way to sleep. And when the clouds finally cleared, what was left of the family’s ravaged mud home sat in plain view across a decimated field of cassava—a lonely reminder of what little they’d once called their own.

Six weeks later, Anyango and her three sons, three daughters-in-law, and five grandchildren are still sleeping on the skinny ridge in western Kenya that they fled to on that night. Among some 10,000 people who were driven from their homes by the unprecedented downpours that began here in the Busia District, on the border of Uganda, in late November and continued into the New Year, they now take shelter in tents donated by Doctors Without Borders. And every week, one of them makes the three-mile trek to a health-care center where World Vision and the Red Cross distribute...
WHY IS AFRICA SO VULNERABLE TO CLIMATE CHANGE?

As former secretary-general Kofi Annan explained at the U.N. Climate Change Conference in Nairobi last November, the African continent is in a particularly weak position when it comes to global warming. Here’s why:

**WATER SUPPLY**
One-third of Africans live in drought-prone areas, and a lack of rain and rivers dry up, competition for water will mean mass migrations. Africa’s heavy dependence on rain-fed crops makes it particularly vulnerable in regions where water is scarcest. The lack of water also cripples local economies. The challenge is to increase water efficiency and conservation.

**AGRICULTURE**
Most of Africa relies on rain-fed crops. As a result, it is highly vulnerable to seasonal shifts and changes in temperature patterns. Declines in agricultural production threaten the food security of entire populations.

**BIODIVERSITY**
Given Africa’s heavy dependence on natural resources from food and fuel to shelter, medicine, and tourism, communities will be directly affected by the loss of biodiversity. Climate change is expected to cause.

**DISEASE**
Changes in rainfall will affect the presence of vector and waterborne diseases. Higher temperatures and flooding, for example, will result in larger populations of mosquitoes and other vector-borne disease carriers. These are particularly problematic in areas with inadequate healthcare resources.

**RISING SEA LEVELS**
Coastal zones around the continent—many of which already lack reliable infrastructure such as bridges, buildings, and paved roads—could be completely wiped out by flooding. Declining numbers of people in coastal areas could cripple local economies.

**DESERIZATION**
Two-thirds of the African continent is comprised of desert or near-desert land. Climbing temperatures in Kericho, Kenya, for example, will cause many trees to die. Without trees, crops will fail, and the land will become barren and uninhabitable.

**OCEANS**
Rising sea levels will affect coastal areas and the wildlife that depend on them. The acidification of ocean water will have major effects on marine ecosystems and the fish stocks upon which coastal populations rely.

**FAUNA**
The extinction of major coral species, with associated losses of local fish stocks.

**FAUNA**
Some African countries have already experienced significant changes in their wildlife. In Gambia, where groundnuts (or peanuts) account for 85 percent of exports, heavy rains in 2004 and 2005 by droughts that drove up the cost of grain and took a heavy toll on livestock. Where are adversely affecting nontropical species that migrate in response to rainfall variations; as a result, both people and livestock are dying. In Gambia, where groundnuts (or peanuts) account for 85 percent of exports, changes in rainfall patterns could cripple the national economy.

**COASTAL POPULATIONS**
Rising sea-surface temperatures off the coast of Namibia may already be contributing to declining fish stocks. On land, scientists expect that warming trends could cause more than 30 percent of threatened plant species to become endangered or extinct by 2080.

**PEOPLE AND THE ENVIRONMENT**
By late January of this year, floods that had blazed northeastern Kenya sparked an epidemic of the mosquito-borne Rift Valley Fever, killing nearly 150 people and hundreds of animals.

**WARMING CLIMATE, SHRINKING FOOD SUPPLY**
Researchers are predicting—and, in some places, already observing—how warmer temperatures, rising sea levels, and other effects of climate change will impact Africa’s food and water supply.

1. Oceans are becoming more acidic as a direct result of rising carbon-dioxide levels in the atmosphere. This acidification will have major effects on marine ecosystems and the fish stocks upon which coastal populations rely.
2. The bleaching of coral reefs due to rising temperatures and lower sea levels could result in the extinction of major coral species, with associated losses of local fish stocks.
3. Scientists estimate that rising temperatures could result in a 33 percent reduction in maize growth in Tanzania.
4. By late January of this year, floods that had blazed northeastern Kenya sparked an epidemic of the mosquito-borne Rift Valley Fever, killing nearly 150 people and hundreds of animals.
5. Climbing temperatures in Kericho, Kenya, are threatening the region’s vital tea industry.
6. In Uganda, a temperature increase of 2°C would drastically reduce the area suitable for growing robusta coffee, one of the country’s major exports.
7. Studies suggest that Sudan’s sorghum yield could drop by a staggering 82 percent with even a slight rise in local temperatures.
8. The level of Kenya’s Lake Nakuru has dropped dramatically in recent years, and by November 2006, more than 800,000 flamingos had deserted its shores, robbing a tourist attraction of its main attraction.
9. Prolonged drying trends in Botswana and elsewhere are adversely affecting nontropical species that migrate in response to rainfall variations; as a result, both people and livestock are dying.
10. In Gambia, where groundnuts (or peanuts) account for 85 percent of exports, changes in rainfall patterns could cripple the national economy.
get drier and wet areas get wetter, he explained, Africans “are going to be caught between the devil of drought and the deep blue seas of flood.”

For Amanyanga and her family, the abstraction that is global warming has already manifested itself in the form of an empty stomach. And they are not alone. This past November, 3.8 million people were driven from their homes by heavy flooding in northeastern Kenya, Ethiopia, and central and southern Somalia. Coming on the heels of an extended dry period that left the ground unable to soak up the rainfall, the downpours—which were the worst the region has experienced in half a century—proved the death knell to crops already on their last legs. And just a year earlier, severe drought in the same region had left eight million people without food; so many animals were lost that herdsmen aren’t expected to recover their livelihoods for several years.

While it’s true that a warmer earth will mean longer growing seasons for agricultural zones in the northern hemisphere and other regions, the overall results of a world heaping up is a food supply downwardly sloping. A series of experiments conducted by the London-based Royal Society in 2005 showed devastating impacts from warming on internationally staple crops as maize, rice, soybeans, and wheat. Estimates suggest that climate change will likely reduce crop yields by 10 percent over the whole of Africa, and even more in specific regions.

Because so much of the global economy is rooted in agriculture, it too is set to suffer crushing blows. Worldwide, the reported losses from climaterelated disasters rose from $131 billion in the 1970s to $629 billion in the 1990s, and it’s estimated that the figure could reach $150 billion per year in the coming decade. In Africa, where agriculture accounts for half of total exports and represents 40 percent of gross domestic product (GDP), economic viability is inextricably linked with patterns of precipitation. The 1997–1998 El Niño floods and the 1999–2000 drought, for example, are estimated to have cost Kenya alone 40 to 49 percent of GDP. This past January, Kenya’s Standard newspaper reported that the seasonal export of raw cashews had dropped by 95 percent due to low production caused by heavy rains.

Storms like these have already trickled down to supermarkets in Europe, where most of Africa’s food exports land. And here in the U.S., we’ve felt the effects of similar upheavals in Central and South America. That’s on top of whatever havoc climate change is wreaking closer to home. This past January, for instance, back-to-back hurricanes in the Rocky Mountains threatened the cattle industry to the tune of tens of millions of dollars. (Look for the fallout on your bill the next time you enjoy a steakhouse dinner.)

To counter a half mile or so out on the lake, are forced to head farther and farther from the shore in pursuit of their catch—often spears, today’s raiders brandish the AK-47s that are available so cheaply and readily across the border in Somalia.

Instead I head back east, stopping in the town of Kisumu, on the shores of Lake Victoria, where Francis Otieno Faraji, helping me into his craky fishing boat, has his own stories to tell of an ecosystem in distress. “You see those mango trees?” he asks, pointing to a dense grove 150 feet off in the distance.

Of course, heavy, monsoon-like rains are the ultimate breeding ground for disease-carrying mosquitoes, and rising temperatures provide more suitable habitats for them. According to Stern, a 2°C rise would expose up to 60 million additional people in Africa to malaria every year. Out in western Kenya, where the disease has long been a way of life, more sick people and fewer farmers in the fields—not to mention fewer students in the classrooms and fewer traders in the markets—are a constant threat not just to daily meals at home on the ridge: Calimentina Anyango with her three-year-old grandson, Clinton.
pull in are no bigger than six or seven inches long.

Anyone who’s seen the 2004 film Darwin’s Nightmare knows that the problems surrounding Lake Victoria are by no means limited to climate change. (Invasive species, overfishing, pollution, and AIDS all have their place.) But rising temperatures aren’t doing anything to help matters. The level of the lake—which is the main feed for the Nile River as well as a vital source of food, water, transportation, and electric power for some 50 million people—has dropped six feet in the past three years alone. A December 2006 report by the U.S.-based Water Resources and Energy Management International concluded that higher temperatures could cause the evaporation of up to half of Victoria’s inflow from rain and rivers, threatening both the immediate community and more than 100 million Egyptians, Sudanese, and others living on the Nile. “People talk about the snows of Kilimanjaro,” says Aris P. Georgakakos, the chief author of the report. “We have something much bigger to worry about, and that’s Lake Victoria.”

The truth is that every one of Africa’s major lakes is today in a state of crisis. Lake Chad, once the world’s sixth largest, has shrunk to an unimaginable 2 percent of its 1960s size, and the level of central Africa’s Lake Tanganyika dropped five feet from the late 1990s to the early 2000s, according to a 2003 article in Nature. Its sardine harvest, a major source of dietary protein for the local community, has contracted by half since the 1970s.

In the face of rising temperatures and increasingly dramatic (and destructive) weather patterns, many local communities have begun taking matters into their own hands. Pulling into the Masasi village of Kinamere, in the drought-stricken Kajiado District about 20 miles south of Nairobi, I hook up with Jane Minissa, a 34-year-old mother of four, who proudly leads me across a rocky path to the 1,000-liter water tank that dominates her neighborhood’s backyard. Backed by UNEP and implemented by a local non-governmental organization, the water-harvesting project that resulted in the tank, which Minissa built with the help of her co-members in the Tobula Women’s Group, represents a much bigger vision. In order to receive instruction and funding for it, the women were required to carry out other tasks—digging holes for new trees, preparing a vegetable garden, and fashioning a dam for rainwater harvesting—aimed at sustaining their community.

You’ve often heard about some ancient African traditions—like the ones you grew up with—are actually “green.” Can you give us an example?

There were some trees that were considered sacred. They were never cut, just left to grow and fall on their own. One such tree is the wild fig tree. Because it wasn’t cut, it sent a lot of roots very deep, and it fixed itself very firmly into the ground, and it therefore helped to stabilize the soil in those highlands where we lived. Also, because the roots went so deep, it fixed itself very firmly into the ground, and it therefore helped to stabilize the soil in those highlands where we lived. Also, because the roots went so deep, they connected with the groundwater system and helped bring water from underground reserves to the upper levels. Quite often, whenever you would find these trees, you would find a stream.

Do you think that modern Africans—and people in general—have lost sight of those traditions?

As people move into the cities, we tend to forget our connection to the earth. When we congregate in the cities, we build houses, we create concrete, and we literally cut ourselves off from nature and the way nature operates.

How can we begin to remember and implement those traditions?

We can start with something understandable and something that all of us participate in: the creation of greenhouses. And on a personal level, you can make a decision that you want to understand how nature operates, and work with it in your own backyard. The Billion Trees Campaign is partly to raise awareness about these issues among ordinary people.

In your opinion, has global warming already begun to affect some parts of the African continent?

Yes, very seriously. We have seen that the glaciers on Mount Kenya and Mount Kilimanjaro have melted. And scientists tell us that they have melted faster the time than they have in the past 10 years. We have seen our raked eyes many rivers that used to be big rivers; they are now small, and many streams have dried up. Although this can be attributed to interference with the forest, especially deforestation, it’s also attributed to climate change.

What challenges do you think Africa will face as climate change intensifies?

For one, we know that it will likely interfere with the availability of freshwater. This will probably create conflict and war among people. Many of the wars we fight in Africa are actually over resources, whether it’s between communities, or between Africans and people from outside Africa who are interested in its resources and find it necessary to access them. People will fight over water, land, farms, and grazing ground. We know that in Darfur, one issue that causes conflict is grazing. This situation can only get worse if the environmental crisis continues.

And it’s important to think about this now so we can begin to find solutions.

What’s the best thing you’ve done to keep the past in your thoughts?

I’m a tree planter, and I’ve been doing that work for many years. I believe that the pastoral communities, for example, need to cut down on their animals. You cannot have so many animals that you completely degrade your land, and then when drought comes you lose everything you have, including your own life. It’s also very important to protect forests, and this is one of the reasons I’m advocating for the protection of the Congo’s ecosystem. It’s one of the major ecosystems that we need in Africa, but also in the world. It’s very highly threatened by both legal and illegal logging.

Even after seeing widespread environmental degradation in Africa, you’ve remained optimistic. How have you managed to maintain that optimism?

It’s important to maintain your optimism because the alternative is to give up. And that would be terrible. So we have to continue telling people that if they don’t do something, the result will be much worse. I always believe that people can change. I just hope we will have even more change before it is too late.
The ice cap on Mount Kilimanjaro has shrunk by an astonishing 82 percent since it was first surveyed in 1912, and several of the rivers that it feeds have begun disappearing during the summer months. If warming continues at its current rate, scientists predict that the cap could disappear completely in as few as 15 years. Melting snow and ice at high altitudes results in less snowmelt to feed the rivers during dry periods, when farmers need it most, and creates more runoff during rainy seasons, making flooding more likely to occur.

Satellite photos of Lake Chad, which straddles the borders of Nigeria, Cameroon, Niger, and Chad, show it changing shape. Once the world’s seventh-largest lake, it has shrunk to a mere 2 percent of its 1960s size—the victim of an increasingly dry climate that forces farmers to use the lake’s water for irrigation. In these photos, areas of the lake that have been taken over by vegetation appear in red, and the ripples at the lake’s edges represent encroaching sand dunes.

And they’re not the only ones. At the Nairobi conference, Agnes Mosoni Loirket, the woman responsible for spearheading the initiative, told the delegates that in the past two years alone, women’s groups in the region have constructed more than 80 of the tanks. “Before the project,” she explained, “women used to leave early and sleep close to the river, leaving children going to school unattended.”

Minisa herself knows that story all too well. But these days she has the time to craft beaded jewelry and run a small shop, earning enough extra cash to send all four of her children to school. She also takes solace in the knowledge that, whatever shocks may result from climatic changes (which she attributes to “the lack of trees and the use of factories”), she and her family have a steady supply of drinking water and an acre and a half planted with beans, maize, and other crops.

Similar water-harvesting initiatives are proliferating across the developing world, and experts say they have the potential to make a big difference in the face of rising temperatures. Kenya, for example, currently gets enough rainfall to supply the needs of six to seven times its population of 40 million. And the beauty of small-scale efforts like Minisa’s tank (which required just four days of labor and cost just $60) is that, unlike big, exposed dams, they lose little water to evaporation. At the close of the November conference, Kenya’s water minister announced plans to require all new buildings to include similar structures.

Back in my old stomping grounds out west, I come across other signs of a growing dedication to mitigating the effects—and the causes—of climate change. One afternoon I stop by the Mumias Sugar Factory, a huge compound near my former home that’s perhaps most significantly, to be making the connection between global warming and a threatened supply of food. This past December, the consortium of scientists known as the Consultative Group on International Agricultural Research announced a climate-change initiative whose goal is to breed crops capable of withstanding heat, flooding, and drought. And India’s Navadnya, the organic farming program led by environmental activist Vandana Shiva, also recently launched a plan to establish seed banks for drought-, saline-, and flood-resistant crops.

Increasingly, governments and aid organizations are supporting forward-thinking strategies like agro-forestry, in which trees are planted together with food crops, which helps prevent erosion; increases the soil’s fertility, and provides shade for the crops (while also sequestering carbon); and conservation farming, a minimum-tillage strategy that traps moisture, improves the quality of the soil, and minimizes erosion, thereby fostering more drought-tolerant growing conditions. Researchers are also aiming to improve climate-change monitoring capacities across the developing world and to implement early warning systems that will give farmers the information they need to protect their harvests. Columbia University, for example, has paired farmers in India and Zimbabwe with climate and agricultural scientists for just this purpose.

At the November conference, Annan announced the Nairobi Framework, a U.N. initiative intended to help developing nations get funding to promote clean energy technology and manage the climate threat in general. Included in the Framework is a program that will facilitate carbon finance agreements under the Kyoto Protocol between developing and industrialized countries. The World Bank has estimated that by selling carbon credits, developing nations could earn as much as $100 billion a year by 2050.

Some have suggested that small-scale farmers themselves ought to be allowed to participate in emissions trading schemes. Given the logistics involved, such an arrangement might prove a little tricky to pull off, but the idea of it alone points up the fact that there’s something drastically wrong with this picture. “My people do not drive four-by-fours,” a Maasai woman named Sharon Looremeta told the delegates at the Nairobi conference. “We don’t go on weekends, on holidays by flight. We are feeling the first and worst of climate change. We had hardly little rains for the last three years. Animals are dying, children are not going to school, women are spending all their time in search of water.”

And, of course, people are going hungry. Unless industrialized nations do more to curb their own emissions, factoring climate change into new development and agricultural initiatives can only go so far.

As Kofi Annan put it in his address to the delegates, those who would drag their feet on the former “should be seen for what they are: out of step, out of arguments, and out of time.” In an increasingly globalized world, after all, it won’t be long before the hunger pangs of Calentina Anyango beginsmart right here at home.

THE MELTING SNOWS OF KILIMANJARO

NOW YOU SEE IT...

WATER-HARVESTING INITIATIVES ARE PROLIFICATING ACROSS THE DEVELOPING WORLD, AND EXPERTS SAY THEY HAVE THE POTENTIAL TO MAKE A BIG DIFFERENCE IN THE FACE OF RISING TEMPERATURES.

The company recently launched a $50 million cogeneration project, which involves installing a new environmentally friendly boiler and upgrading the power system to better utilize bagasse, the fiber that remains after the juice has been extracted from sugarcane. By the end of 2008, says Luchacha, the factory will produce enough power to meet its own demands. They’re not the only ones. At the Nairobi conference, experts say they have the potential to make a big difference in the face of rising temperatures.