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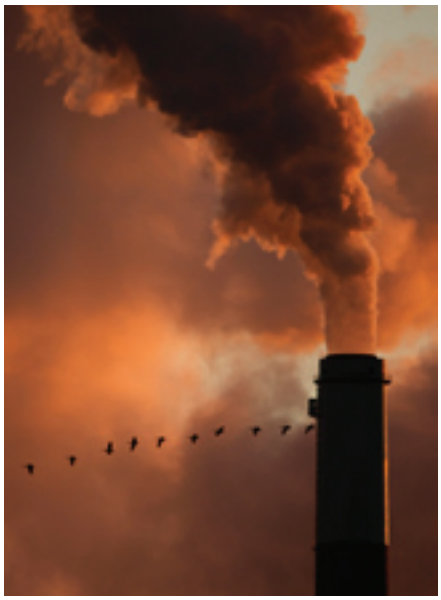

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Even as a new study, published by the journal *Science*, indicates that human activity-generated emissions have reversed an Arctic cooling trend, leading to global warming unmatched for 2,000 years, world leaders are negotiating an action framework to succeed the Kyoto Protocol. This international agreement, aimed at stabilizing the greenhouse gas emissions that accelerate global warming, will expire in 2012.

"We have reached a pivotal moment in the climate challenge, and what we decide to do now will have a profound and lasting impact on our nation and our planet," writes U.S. Special Envoy for Climate Change Todd Stern in his introductory article.

In this *eJournalUSA*, experts from key nations around the world ponder the conditions that climate change and global warming present in their regions. They discuss what is being done within their countries to address climate change mitigation and adaptation and how they envision mutually beneficial international partnerships. These issues will be considered in-depth at the December 2009 meeting in Copenhagen, Denmark, the United Nations Framework Convention on Climate Change (UNFCCC) 15th Conference of Parties (COP15). The goal is a viable agreement that satisfies the nearly 200 countries concerned.

All of the countries profiled in this publication — Brazil, Canada, China, Germany, India, Indonesia, Jamaica, Kenya, Russia, and the United States — already feel the impact of global warming. India is vulnerable to rising sea levels and extreme weather events, writes Intergovernmental Panel on Climate Change (IPCC) Chairman R. K. Pachauri, who discusses India's national action plan. IPCC adviser Jiahua Pan describes the ambitious measures China is taking to ameliorate the serious effects of climate change there.

Rainforest conservation is critical to the health of the planet, since forest degradation is a major source of damaging "greenhouse gas" emissions, as biologist Liana Anderson explains in her assessment of climate change impact in Brazil. IPCC Vice Chair Richard Odingo examines the situation in Kenya. Harry Surjadi is concerned with the plight of the Indonesian poor. Scientist A. Anthony Chen addresses problems specific to Caribbean island nations. Alexey Kokorin writes that the imminent danger of climate change has yet to be fully understood in Russia, yet the government has taken important steps to meet the challenge.

Young people will inherit a world that climate change increasingly compromises. Some of them have organized to demand more aggressive action. "Climate change is among the issues that galvanize young people simply because our government's actions don't make sense to us," writes Canadian environmental activist Zoë Caron. American Richard Graves says, "Young people in the United States have made clear that they want bold environmental leadership."

Will the United Nations be able to cope with climate change pressures? That is the question considered by Swedish diplomat Bo Kjellén.

One thing our contributors agree upon is summed up by Todd Stern: "The status quo is unsustainable."
We hope you enjoy this *eJournal USA*.

— *The Editors*

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A Pivotal Opportunity

Todd Stern

© AP Images/Gerald Herbert.

Vice Chair of China's National Development and Reform Commission Xie Zhenhua (left) shakes hands with U.S. Climate Change Special Envoy Todd Stern in Washington, D.C., July 2009.

Todd Stern, special envoy for climate change at the U.S. State Department, is instrumental in developing U.S. international policy on climate and is the administration's chief climate negotiator, representing the United States internationally at the ministerial level in all bilateral and multilateral negotiations. He has extensive experience in the public and private sectors, in environmental and other global issues.

Here Stern lays out the main challenges and important remedies relating to climate change from the perspective of the Obama administration.

We have reached a pivotal moment in the climate challenge, and what we decide to do now will have a profound and lasting impact on our nation and our planet.

The science is clear. Arctic sea ice is disappearing faster than expected. The Greenland Ice Sheet is steadily shrinking. The melting of permafrost in the tundra raises the risk of a huge methane release. Sea levels now threaten to rise much higher than previously anticipated. And water supplies are increasingly at risk with the melting of glaciers in Asia and the Western Hemisphere.

These are the facts. They send a simple and stark message: The status quo is unsustainable.

The health of our planet is in our hands and the time for action is now.

The upcoming United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen offers a chance to mobilize international

collective action to meet this global challenge. Under the leadership of President Obama and Secretary of State Clinton, the United States is working with our partners around the world to find common ground and stem the tide of future irreversible damages.

We recognize that the United States must be a leader in the global effort to combat climate change. We have a responsibility as the world's largest historic emitter of greenhouse gases. We know that without U.S. emissions reductions, no solution to climate change is possible. And we are confident that the United States can and will take the lead in building the 21st-century clean energy economy.

In just eight months, the Obama administration has dramatically shifted U.S. policy on climate change and is leading by example through robust action at home. The American Recovery and Reinvestment Act included more than $80 billion for clean energy investment. President Obama set a new policy to increase fuel economy and reduce greenhouse gas pollution for all new cars and trucks. And there is a bill making its way through Congress, the American Clean Energy and Security Act of 2009, that would cut U.S. carbon emissions from 2005 levels by 17 percent in 2020 and 83 percent in 2050.

Addressing climate change is an economic opportunity, not a burden.

But action by the United States and other developed nations is not enough. More than 80 percent of the future growth in emissions will be from developing nations. There is simply no way to preserve a safe and livable planet unless developing countries play a key role in the climate negotiations and join us in taking collective action to meet this common challenge. It is not a matter of politics or morality or right or wrong, but simply the unforgiving math of accumulating emissions.

Addressing climate change is an economic opportunity, not a burden. The link between clean, sustainable energy and robust economic growth is the hallmark of the 21st-century global economy. With the right support, developing countries can leapfrog the dirtier phases of development and seize the potential of new, clean energy sources. This is the future.

The United States is pursuing a multipronged strategy to engage the international community and encourage developing countries to take further action.

First, we are fully committed to the Framework Convention negotiating process. Our negotiating team recently returned from its third trip to Bonn, and we will continue to take part in the negotiating sessions leading up to Copenhagen in December 2009.

Second, we have established an invigorated dialogue among 17 of the largest economies — including China, India, Brazil, Mexico, South Korea, South Africa, and Indonesia — through our Major Economies Forum on Energy and Climate, which met in July at the leaders level in Italy immediately following the G8 meeting. The forum presents a unique opportunity to hold candid discussions among the world's major economies on a number of complex issues, including mitigation, adaptation, technology, and finance, which will be a central focus in Copenhagen.

Third, we are focusing on key bilateral relationships. The administration has expanded efforts to strengthen the U.S.-China relationship, and climate change is an essential component of that dialogue. I joined Secretary Clinton in February during her first trip to China, where she elevated the climate change challenge to a top priority. Secretary of Energy Steven Chu and Secretary of Commerce Gary Locke delivered similar messages during subsequent visits. Moreover, the State Department, in conjunction with the Treasury Department, recently hosted meetings of the Strategic and Economic Dialogue with China, where the two countries signed a memorandum of understanding on clean energy and climate. Simply put, no global solution will be possible if we don't find a way forward with China. In addition, I traveled with Secretary Clinton to India and later alone to Brazil to consult and deepen our dialogue with two important partners and explore opportunities for our countries to make progress toward a successful outcome at the UNFCCC negotiations in Copenhagen.

Rarely are we presented with as clear an opportunity to shape our future and enhance our way of life for generations to come. The United States is clear in its intent to secure a strong international agreement, and I am confident that together we can meet the global climate change challenge. ■

The 21st-Century Challenge

Michael Specter

Award-winning writer Michael Specter has been a staff writer at The New Yorker *magazine since 1998. His awards include the Global Health Council's Annual Excellence in Media Award (2002 and 2004) and the American Association for the Advancement of Science 2002 Science Journalism Award. His new book,* Denialism: How Irrational Thinking Hinders Scientific Progress, Harms the Planet, and Threatens Our Lives, *will be published in October 2009 (The Penguin Press).*

The reality of global warming must supersede debate about it, and urgent steps must be taken to reduce greenhouse gas emissions before it is too late, Specter writes in this overview of the issue.

Photo by Alex Remnick

Michael Specter

People who refuse to accept the truth — that AIDS is caused by a virus, for example, or that global warming is genuine and the result of human activity — will always be with us. But as the profoundly disturbing facts about the pace of warming become increasingly evident, the cries of climate change denialists seem finally to have been overcome by the mounting series of grim realities. Those realities are both obvious and subtle: Between 1961 and 1997, the world's glaciers lost nearly 4,000 cubic kilometers of ice; since the Arctic is warming at nearly three times the global average, Greenland's ice sheet may already have passed the point of saving.

Greenland is hardly the only place in acute danger of massive forced change. One projection, by no means the most alarmist, has estimated that the homes of 13 to 88 million people around the world would be flooded by the sea each year in the 2080s. As always, poorer countries will suffer the most. For the first time in memory, mosquitoes, carrying viruses as grave as malaria, now appear on Mt. Kilimanjaro and other African highlands — places that for centuries had served as cool reservoirs of safety from some of the developing world's most devastating diseases.

Although specific estimates vary, scientists and policy officials increasingly agree that allowing emissions to continue at the current rate would induce dramatic changes in the global climate system. Some scientists liken climate change to a tidal wave that can no longer be held at bay. These are not issues that can be easily solved — but it's not too late to prevent the worst effects of warming, despite what many people say. Still, to avoid the most catastrophic effects of those changes, we will have to hold emissions steady in the next decade, then reduce them by at least 60 to 80 percent by the middle of the century.

Is that possible? Absolutely. But it will require equal measures of sacrifice and science. (And the willingness of Americans and Europeans to stop expecting China and India to cut emissions as rapidly as we must in the West and to stop using their limited progress as an excuse to do nothing.)

Individuals can do a lot. According to one 2008 study

by researchers at Carnegie Mellon University, for instance, if we all simply skipped meat and dairy just one day each week, it would do more to lower our collective carbon footprint than if the entire population of the United States ate locally produced food every day of the year. In fact, producing just one kilogram of beef causes the same amount of greenhouse gas emissions as driving a small car more than 112 kilometers.

The most important way to rein in carbon emissions is to charge for them, either through taxes or with a cap and trade system. Obviously, when the cost of polluting is low there are few incentives to stop it, and the cost of pollution remains far too low. The Kyoto Protocol was never ratified in the United States because the Bush administration and the U.S. Congress feared it would result in large job losses; however, the Obama administration and an increasing number in Congress understand that the real costs of global warming will be, and in many cases are already, far higher than the costs of pretending the problem does not exist. Climate-induced crises pose the risk of destabilizing entire regions of the world.

Some scientists liken climate change to a tidal wave that can no longer be held at bay. These are not issues that can be easily solved — but it's not too late to prevent the worst effects of warming.

But how do we cut fossil fuel emissions? One way, of course, is to consume less. Another is to develop new types of fuel, fuel that will not tax our environment. Scientists throughout the world are trying to do just that. In the United States people like Craig Venter, who directed the team that won the race to sequence the human genome, are now working on engineering microbes that could help move the United States away from our addiction to oil — while drastically cutting greenhouse emissions. There are many similar efforts underway throughout the country. In California, for example, Amyris Biotechnology, which had already manufactured a synthetic malaria drug, has now engineered three microbes that can transform sugar into fuel, including one that turns yeast and sugar into a viable form of diesel. Amyris says that by 2011 it will be producing more than 750 million liters of diesel fuel a year — resounding proof of the principle that we can create new forms of energy without destroying the atmosphere. The Obama administration has signaled, with words and with money, that such endeavors will be supported, which, in a world dominated by the political might of entrenched interests, has not been easy.

Without international cooperation, none of these efforts will make enough of a difference. Many people are beginning to understand that — which is why, for example, conservationists are beginning to pay poor timber farmers in places like Indonesia not to allow their rainforests to be ripped apart by loggers. I can only hope it doesn't take a catastrophe to make the rest of us confront the serious challenges we face — or embrace the fact that we can and are capable of facing them successfully. ■

The opinions expressed in this article do not necessarily reflect the views or policies of the U.S. government.

The melting Greenland Ice Sheet is seen through an iceberg in Kulusuk, near the Arctic Circle. Polar melt, which may exacerbate effects of climate change, is more rapid than scientists anticipated.

© AP Images/John McConnico

Overview on a Range of Threats

Liana Anderson

Courtesy of Liana Anderson/Photo by Douglas Morton

Biologist Liana Anderson surveys a forest burn in the Mato Grosso, southern Brazilian Amazon.

Brazilian biologist Liana Anderson's primary research has been in the Amazon Basin, where she has seen the effects of climate change close up. She is completing her doctoral research at the Environmental Change Institute, Oxford University.

Anderson surveys the most critical areas of concern, including agriculture, public health, and the importance of containing deforestation, which accounts for Brazil's largest source of damaging greenhouse gas emissions.

Brazil is a vast country, taking up nearly half of South America and claiming much of its eastern coastline. Although renewable energy accounts for 47 percent of the energy produced in Brazil, much higher than the global average. Brazil still emits a large share of the total global greenhouse gas emissions. The chief reason is rapid slash-and-burn deforestation in the Amazon Basin. The Amazon, the world's largest tropical forest, spreads over nine countries, but most of it lies within Brazil. Rainforests are enormous carbon storage sinks. When they are cleared and burned, carbon dioxide and other greenhouse gases are released into the atmosphere. These have been found to contribute to climate change and global warming.

According to the United Nations Framework

© AP Images/Luis Vasconcelos, Interfoto, File

Anama Lake near Manaus, Brazil, after drought affected levels of the Amazon River, caused the water level to drop several feet, and harmed the fishing industry in 2005.

Convention on Climate Change (UNFCCC), when emissions from land-use change and forestry estimations (LUCF) are included, Brazil's emissions amount to 12.3 percent of the total of the 151 non-Annex I Parties to the UNFCCC, primarily developing countries, that have no emissions reduction targets according to the Kyoto Protocol.

It is estimated that Brazil releases about 1 billion tons of carbon dioxide (CO_2) into the atmosphere per year; about 75 percent of this is from deforestation, the Brazilian Ministry of Science and Technology reports. Recent estimates suggest that the Amazon Basin has a total biomass of 86 petagrams of carbon, equivalent to the last 11 years of CO_2 emissions. Deforestation is estimated to have reduced the Amazon forest by 15 percent in the past three decades, driven by infrastructure expansion in the forest frontier and increasing global demand for soya, beef, timber, etc. Climate change also is predicted to increase the probability of droughts in this region. The University of Oxford, in collaboration with NASA (U.S. National Aeronautics and Space Administration) and Brazilian scientists, demonstrated the close link between droughts and the increase in forest fires, potentially doubling the total amount of carbon emitted to the atmosphere. (Saatchi, Houghton, Dos Santos Alvala, Soares, and Yu, 2007.)

To tackle Brazil's largest source of greenhouse gas emissions, deforestation, the Brazilian government launched in 2008 the National Plan for Climate Change, which envisions diminishing the deforestation of the Amazon by 70 percent, in relation to the estimates from 1996-2005, by 2017. This initiative is a major strategy to mitigate global climate change by preserving the forest. It has also opened possibilities for funding and political cooperation. At the U.N. Climate Change Conference in Bali (December 2007), the nations agreed to include payments for Reduced Emissions from Deforestation and Degradation within the framework of the Kyoto Protocol.

However, the Amazon forest is not the only ecosystem facing the threats of climate change. The continental extension of Brazil demands a multidimensional approach to adaptation and mitigation. Brazilian and American scientists, testing different scenarios of global warming, estimate widespread species loss for the Cerrado biome (Brazilian savannah), with loss of more than 50 percent of potential distributional area for many species. Northeast Brazil, the poorest region in the country, is threatened. The Water Availability and Vulnerability of Ecosystems and Society program, a collaboration between Brazil and Germany, recommends careful planning in long-term resource-use plans, as river flow and crop production are specifically sensitive to climate change. They also predict water scarcity for Ceará State by 2025.

Climate change is likely to affect agriculture in southern Brazil, the most important region for crops such as potato, wheat, rice, maize, and soybean. Although simulations for increased atmospheric CO_2 concentration show beneficial effects for those crops, the effects of increased air temperature and uncertainties in rainfall pattern due to climate change are predicted to greatly reduce the agricultural productivity in this region. This will affect crop management and will require adaptation strategies from producers and the government. Investments in technologies will be decisive in mitigation of climate

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A boat transports people from flooded homes in Trizidela do Vale, Brazil, along the Mearim River. Although flooding is common here, waters now rise higher and stay longer.

change impacts on the food supply. In contrast, small farmers in the Amazon are more susceptible to the extended droughts, floods, and increased wildfires associated with changing climate patterns. An immediate improvement of infrastructure, information, and communication networks is essential to alleviate the effects of climatological changes in this remote region.

Public health is also a great concern. It is accepted that environmental changes will modify vector-borne disease transmission patterns and their area of occurrence. Recent studies in Brazil showed a significant increase in cases of leishmaniasis, a potentially fatal parasitic disease spread by sand flies, during El Niño years. With the expected increase of El Niño frequency and intensity in this century due to climate change, the number of leishmaniasis cases is likely to rise in many Brazilian regions. The cost of leishmaniasis medical care during the 1997/98 El Niño in Bahia State (Northeast region) was estimated at 62 million dollars.

The Amazon forest is not the only ecosystem facing the threats of climate change. The continental extension of Brazil demands a challenging multidimensional approach to tackle climate change effects and to develop adaptation and mitigation solutions.

In response to the extensive range of threats to Brazil that may result from climate change, many actions have already been taken by the government and the scientific community. Strengthened networks of multinational scientific collaboration have greatly advanced the knowledge of many ecosystems and their interactions with the environment and human populations. In 2008, State of São Paulo Research Foundation launched the Global Climate Change program, investing more than 7 million dollars in scientific projects.

Reaching Brazil's ultimate goal of greenhouse gas emissions reduction and mitigating the effects of climate change requires multinational, interdisciplinary research by the scientific community, political action, the involvement of the citizens, extensive dissemination of information, and an effective interface of regional and international policy for enforcement and consolidation. Immediate responses are essential to face the worldwide common threat, climate change. ■

References cited are listed in Additional Resources.

The opinions expressed in this article do not necessarily reflect the views or policies of the U.S. government.

O Canada: How Good It Could Be

Zoë Caron

Zoë Caron is co-author of Global Warming for Dummies *and editor of ItsGettingHotInHere.org. She is the climate policy and advocacy specialist at World Wildlife Fund-Canada and is involved in coordinating the Nova Scotia Renewable Energy Consultations, a joint project of the provincial government and Dalhousie University in Halifax. She is also a founding member of the Canadian Youth Climate Change Coalition.*

Caron sees the chief climate change opportunities for Canada in new efforts on sustainable renewable energy development and political will toward action to meet the challenges ahead.

Courtesy of Zoë Caron/Photo by Tracy Morris-Boyer

Activist and author Zoë Caron

I pulled my iPhone from my pocket to catch up on the news in a public park, just blocks from my office in downtown Halifax, Nova Scotia. The headlines contrasted starkly with the serene surroundings: "Oil lobby to fund phony campaign against U.S. climate change strategy" (*Guardian News*); "Kyoto Protocol working group [closes] with Chair … encouraging parties 'to work twice as hard in Bangkok'" (International Institute for Sustainable Development); "Yvo de Boer: 'At this rate, we're not going to make it. Recognize that serious climate change is equal to game over'" (Global Campaign for Climate Action).

Not particularly uplifting, but such is the state of climate change discourse in Canada. Canadians have ranked the environment as a top priority in the recent past. Surveys suggest that Canadians are saturated with climate change awareness, but messaging has opted for shame over solutions, and we have reacted with nationwide paralysis.

The most serious challenge presented by climate change in Canada is our long-standing reliance on an economy rich in natural — but often finite — resources. Despite growing sparks of leadership in solar and wind power, we continue to promote development in the Athabasca tar sands, an underground oil reserve larger than the state of Florida. The province of Nova Scotia still depends on coal, and Ontario continues to develop nonrenewable nuclear energy.

Yet we have a tremendous opportunity to enjoy an economy that can thrive from today forward. Waste from Canada's agricultural sector can provide for biomass-derived fuels. Wind across the prairies and off the east coast of Nova Scotia can generate electricity. Solar energy potential exists across many parts of the country. The possibilities for building the infrastructure for this could start in our own towns, creating new green jobs for our country.

What we crave as Canadians is a strong public mandate for sustainability at the federal level. Many young people who will live to see the results of today's action — or inaction — on climate change are frustrated that the federal government seems to focus on other priorities.

© AP Images/Rick Bowmer

Permafrost melt resulting from global warming is damaging infrastructure across the Arctic. This section of the Dempster Highway in Canada's Northwest Territories collapsed because of thawing permafrost.

But provincial governments have taken up the challenge: British Columbia and Ontario have developed Climate Change Secretariats; British Columbia and Quebec have implemented variants of hydrocarbon taxes; and Nova Scotia has legislated an ambitious renewable energy target.

The most serious challenge presented by climate change in Canada is our long-standing reliance on an economy rich in natural — but often finite — resources.

Our commitment to the Kyoto Protocol has been reduced, officially, to the lowest targets of all industrialized countries. Fortunately, Canadians are prepared to act, regardless of the federal response.

To date, Canada's primary partner on climate change has been the United States. Perhaps surprisingly, the United States appears to be far more committed than Canada is prepared to be. The United States is investing six times more per capita than Canada in green technology, for example. Transforming "comfortable" status-quo relationships into engagement with new strategic partners in sustainable technologies offers staggering potential for the Canadian economy to prosper in the long term.

Despite this response of policymakers and elected officials, or perhaps because of it, various communities — business, industrial, indigenous, and nonprofit — are growing sources of mobilization, awareness, and proposed solutions. The voice and political legitimacy of the youth movement, in particular, is building, largely as a response to political inertia. Climate change is among the issues that galvanize young people simply because our government's actions don't make sense to us. The youth reaction to political decisions that we do not and cannot support reflects our values and convictions on justice and equity, as well as the desire for accessible government plans and processes, meeting the transparency demanded by a generation weaned on the Internet.

The young leaders in climate change have become ever-mightier stakeholders in this field. The Canadian Youth Climate Coalition was founded in 2006 to address the political issues of climate change. The U.S.-Canada Energy Action Coalition brings together dozens of organizations on climate justice. A global network of youth is working together across continents to mobilize young people and influence global policy. The examples abound.

Climate change is defining the lives of this and future generations. How to address these issues most quickly and effectively here in Canada ultimately boils down to our government satisfying the needs of future generations. While politicians may raise eyebrows at such revolutionary reform, it is only this revolutionary reform that will bring about the changes necessary to act decisively on climate change.

A middle ground must be created to encourage continuous and mutual relationship-building between the government and the public, for it is only through creating a culture of proactive participation that policy truly will reflect the voice of the people, especially where the stakes are high and the clock is ticking. To be sure, this remains an ambitious objective, but we have yet to see a national response to climate change proportional to the risks. Supported by a vocal youth movement, a well-informed populace, and an abundance of renewable resources, it's time to stop being meek, modest, and polite, and rise to the challenge of creating an equitable and flourishing world. ■

The opinions expressed in this article do not necessarily reflect the views or policies of the U.S. government.

The View from an Island: Jamaica

A. Anthony Chen

A. Anthony Chen is currently the chairman of the National Steering Committee of the Global Environmental Facility Small Grants Program (GEF-SGP) in Jamaica. The GEF-SGP is a community action program implemented by the United Nations Development Program (UNDP).

Chen has headed the Climate Studies Group at the University of the West Indies, Mona, Jamaica. He is a member of the Intergovernmental Panel on Climate Change (IPCC), which shared the 2007 Nobel Peace Prize with former U.S. Vice President Al Gore.

He discusses the chief concerns of island nations, with the focus on the Caribbean, where islands are threatened by increasingly severe storms, rising sea levels, and drought.

Courtesy of A. Anthony Chen

A. Anthony Chen

Imagine yourself 10,000 years ago, when the earth started warming after the last ice age, on an island in higher tropical latitudes, such as Jamaica. Without the benefit of thermometers and tidal gauges, you would probably not have perceived the gradual rise in temperature or sea level. You would not have seen the need to take any adaptation measures. Compare that with yourself as a modern islander. Over a lifetime you will experience a generally warming climate. You will feel the need to install air-conditioning or cooling fans in your home. You will come to believe that periods of drought and flooding have become more frequent, storm surges more destructive. You probably will be forced to take temporary measures to react to some of these climate outcomes, such as storing water during droughts or securing your home during a hurricane, but nothing on a planned basis.

What is the difference between 10,000 years ago and now? The former warming took place over thousands of years and was due to natural variations, such as in solar radiation, volcanic eruptions, and vegetation. The present warming has taken place over only a century and a half, and it is due not only to natural variations but also to increased emission of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, since the time of the Industrial Revolution (IPCC, 2007). Both proxy data measurements and actual measurements have shown an exponential increase in these gases over the period (IPCC, 2007). With the benefit of measuring instruments, scientists have been able to detect a warming of the Caribbean region (Peterson and Taylor et al., 2002), drying conditions (Neelin et al., 2006), and rising sea level (Church et al., 2004).

Now, fast forward to 2100. While there are many scenarios that we can envisage, climate scientists are coming to a consensus that focuses on two: one in which temperature increases are kept below 2 degrees Celsius, and the other, above 2 degrees Celsius. Under these two scenarios, the effect of climate change will be of the same kind but more severe at higher temperatures, perhaps even

© AP Images/Collin Reid

A flooded road in Kingston, Jamaica, the result of 2008 tropical storm Gustav, which claimed nearly 100 lives. Extreme storms and dry periods are becoming more common in the Caribbean.

reaching a tipping point of no return. Two of the impacts of greatest concern, based on scientific studies, are in the water and health sectors.

Islanders in the high tropics can expect much drier conditions. This is because much of the moisture in high tropics will be transported to the equator, which will become wetter (IPCC, 2007). To see the consequences of this drying, we look at the results of a study done by ESL Management Solutions Limited (2008). Some watershed areas will become deficient. The watershed area serving the Kingston metropolitan area will be in surplus but will be severely strained. Communities supplied by a single spring or river will be increasingly vulnerable. Nonirrigated crops, which are important for the wider rural community in Jamaica and in the provision of locally grown crops and foodstuffs for the local Jamaican market, will be threatened. In contrast to drier conditions, rainfall associated with storms, even though less frequent, is expected to be more intense or heavier (Knutson and Tuleya, 2004; Knutson et al., 2008). Flooding, landslides, and soil erosion, especially in mountainous regions; sediment transport; and high turbidity in the water supply will produce devastating results. Given the coastal location of many of Jamaica's wells — for agriculture, public water supply, and industrial use — increases in sea level will make these wells vulnerable to salt water intrusion and reduced water quality.

Many health issues will arise as documented in, for example, the Second National Communication of Jamaica to the United Nations Framework Convention on Climate Change, a report required from all parties in the UNFCCC. Dengue fever is a case in point. Temperature rises over 2 degrees Celsius can lead to a three-fold increase in the transmission of dengue (Focks, 1995; Koopman et al., 1991). A direct link between temperature and dengue in the Caribbean has been reported (Chen et al., 2006; Chapter 2) in a study sponsored by the Assessments of Impacts and Adaptations to Climate Change (AIACC). Thus the transmission of dengue can be expected to increase in line with increased temperatures, along with increases in its more deadly form, dengue hemorrhagic fever.

Other effects include

- the probability of more intense hurricanes, the intensity of which is known to be naturally cyclical, but investigation shows that increased intensity can be caused by future rise in sea surface temperatures in the Atlantic;
- endangered human settlement due to sea level rise and storm surges;
- bleaching and possible death of coral reefs;
- depletion of coastal resources, including the death and migration of fishes to cooler waters;
- possible extinction of some plant species.

Compounded with concomitant conditions that could lead to a reduction in tourism, all the above, except the last, would lead to human suffering and pose serious challenges to social peace and economic progress.

Because of the severity of these challenges, reactive responses will no longer be possible. Planned adaptive strategies and actions must be put in place, either at the national or international level. On the national level, recommendations for the water sector, based on the 2008 ESL study, have been presented to the Ministry of Water for consideration. For adapting to increased dengue transmission, several strategies, including an early-warning system, have been suggested by the AIACC project (Chen et al., 2006) and presented to the Ministry of Health. A UNDP/GEF-sponsored Community Based Adaptation (CBA) program funds selected communities to adapt to climate change. A local funding agency, Environmental Foundation of Jamaica, also plays a significant role in funding nongovernmental organizations and other institutions for mitigation and adaptation projects.

Regionally, several initiatives are currently being undertaken to combat climate change. The Belize-based Caribbean Community Climate Change Centre (CCCCC) coordinates much of the Caribbean region's response to climate change. The center is a key node for information on climate change issues and on the region's response to managing and adapting to climate change in the Caribbean. The Caribbean Disaster Emergency Response Agency (CDERA), which is an interregional supportive network for countries within the Caribbean Community (CARICOM) based in Barbados, has made response to climate change part of its mandate. The respective national meteorological offices play important roles as well.

However, commitment of the region's policymakers in response to the threats posed by climate change has not been reflected generally at the national level. Guyana is the notable exception. Given the severity of the threats, it has been suggested (Hill, 2009) that the Jamaican goverment ensure that the global and all-encompassing nature of climate change is coordinated and integrated in all foreign and domestic policies and programs, at all levels of the political system. The important roles played by national meteorological agencies will need to be strengthened and their expertise be tapped in policy making.

On the international level, the most pressing issue is mitigation of climate change. Developed and developing countries must make deep cuts in the emission of greenhouse gases to prevent the dangerous consequences that would arise from a climate change driven by a rise of more than 2 degrees Celsius in temperature. The case is being argued on behalf of small islands by the Alliance of Small Island States (AOSIS), an intergovernmental organization of low-lying coastal and small island countries that consolidates the voices of 43 small island developing states, 37 of which are members of the United Nations. The alliance represents 28 percent of the developing countries, 20 percent of the U.N.'s total membership, and 5 percent of the world population. Besides pressing for emission cuts, AOSIS is seeking a commitment from developed countries to fund adaptation measures in small islands.

Because of the severity of [climate change] challenges, reactive responses will no longer be possible. Planned adaptive strategies and actions must be put in place, either at the national or international level.

Our scenarios of past, present, and future islanders, have taken us from a scene in which little impact of climate was noted and little needed to be done about climate change to one in which the effects of climate change will be severely felt. Small islanders have done the least to contribute to climate change but will be among those suffering the worst impacts. From the perspective of small islanders, it is imperative for all to act to mitigate and adapt to climate change. ■

References cited are listed in Additional Resources.

The opinions expressed in this article do not necessarily reflect the views or policies of the U.S. government.

Addressing Climate Change Through Sustainable Development

Jiahua Pan

Executive director of the Research Center for Sustainable Development (RCSD) at the Chinese Academy of Social Sciences (CASS), Jiahua Pan is also an economics professor at the CASS graduate school. He served as a senior program officer and adviser on the environment and development at the United Nations Development Program's Beijing office. He was a senior economist for the Intergovernmental Panel on Climate Change, Working Group III, and a lead author for the 3rd and 4th assessment reports on mitigation. He has authored numerous papers and articles on the economic and social dimensions of sustainable development and climate change policy. He discusses the urgency of implementing sustainable development programs in China, which is particularly vulnerable to the effects of global warming and climate change, and the measures already taken to protect the environment.

Courtesy of Jiahua Pan

Jiahua Pan

China has long suffered from climatic disasters throughout its history and will be more vulnerable to climate change. The key reason lies in the fact that the physical environment is highly fragile. Ever-increasing human population, physical resources, and infrastructure are exposed to climate risks, along with effects from China's development process. Sustainable development has been taken as the key approach to addressing climate change challenges, both adaptation and mitigation. China's experiences and challenges are of global significance, and international cooperation is needed for effective mitigation of and adaptation to climate change.

CLIMATE SECURITY

Extreme climatic events, such as drought, flooding, and typhoons in the coastal regions and snow storms in the northern inland region, often trigger social unrest and instability. In 1931, Yangtze River flooding killed 145,000 people, with tens of millions made homeless. The most economically dynamic and wealthy population is concentrated in the coastal areas, in particular the Yangtze River Delta, Pearl River Delta, and Bohai Rim. During the past 30 years, the sea level has been rising at 2.6 millimeters per year and this trend is to continue. In the Yangtze River Delta region, population density is at 890 per square kilometer. Fifteen large cities in the delta region occupy 1 percent of China's land area, but their share of China's gross domestic product (GDP) is as high as 17 percent in 2008. In the northwest, where human settlements are highly dependent on snowmelt in the Himalaya and Tianshan Mountains, temperature increase would mean disappearance of the oasis agriculture.

Along with population growth, a rising rate of urbanization, and overall development of the economy, climate change is no doubt a security issue. Water scarcity is another issue. Extreme events precipitated by climate

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Solar power water heaters grace rooftops in Yichang city, central China. China's Golden Sun Project, launched in 2009, aims to subsidize installation of 500 megawatts of solar generators across the country.

change make food production insecure. Sea level rises will put hundreds of millions of people and assets at trillions of Renminbi (Yuan/RMB) at high risk. Therefore, minimization of climate change impacts and adaptation to climate change constitute the foundation for sustainable development in China.

Fighting Climate Change Through Development

China is a victim of climate change. Doing nothing will certainly result in diminished sustainability. The experiences in China and the world show that climate change can be effectively addressed through development. In 1998, Yangtze River flooding occurred again, similar to the scale of 1931, and the losses were a negligible fraction as compared to 1931. The reason is very simple: The dikes are much stronger and more resources can be mobilized for flood control now. Before 2000, economic losses incurred by extreme climate events each year amounted to 3 to 6 percent of China's GDP. For the past decade or so, the losses are at 1 percent or less, although in absolute terms the monetary figure is larger. Before reform in 1978, each year typhoons would kill numerous people and destroy houses in the coastal region. Now the buildings are able to withstand the strongest typhoon. Pre-warning systems can effectively let people be well prepared. Water-saving technologies and irrigation are able to reduce demand for water.

As a developing economy, under the Kyoto Protocol, China is not required to reduce greenhouse gas (GHG) emissions in absolute terms. But this does not mean that China has not been taking actions to curb emissions. As a matter of fact, the pursuit for sustainable development in China is consistent with recommended emission reductions and has contributed substantially to GHG reductions. In China's 11th five-year plan (2006-2010), a compulsory target is to reduce energy consumption per unit of GDP by 20 percent in 2010 as compared to 2005.

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The Yellow River, China's second largest, is beset by pollution and water shortage from soaring demand and climate change.

Strong enforcement through administrative and incentive measures indicates that this target will be achievable. Reforestation and afforestation efforts, including sealing the mountains for natural regeneration and return of arable land to forest in the past three decades, has led to an increase in forest coverage from 12.7 percent in the late 1970s to 18.7 percent now. New buildings are to be 65 percent more energy efficient than old ones. According to the World Wide Energy Association, newly installed wind power capacity in China in 2008 ranks after Germany, accounting for 23.1 percent of the world total newly installed capacity in 2008. China has been investing in wind and solar power so aggressively that China might be the real leader in the development of renewable energy. Social policies and advocacy of sustainable consumption also help. China has already prepared national and provincial level climate change programs. Further planning and actions will make the development process more climate friendly. For instance, climate change mitigation and adaptation must be included in the planning of transriver basin water diversion, seawall construction, and urban development.

China is a victim of climate change. Doing nothing will certainly result in diminished sustainability. The experiences in China and the world show that climate change can be effectively addressed through development.

Despite China's aggressive mitigation efforts, China's GHG emissions have kept increasing. Since 2007, China was considered to emit more than the United States, and per capita emissions are already comparable to the world average level, although the number is still substantially lower than the Organization for Economic Cooperation and Development figure. As China is still in the process of urbanization and industrialization, increase in GHG emissions is likely to continue.

International Cooperation

Clearly, mitigation of climate change in China goes beyond national boundaries. International cooperation will effectively reduce the rate of emissions in China.

The Clean Development Mechanism (CDM) under the Kyoto Protocol has shown the potential of international cooperation. The amount of financial inflow into China is minimal, but it enables commercially unviable wind power and energy efficiency investments to become feasible. The rapid increase in wind power in the past several years is a good example for illustration. Carbon price of Certified Emissions Reductions (CER) from CDM projects signals the market that low-carbon technologies can be competitive. Technological cooperation is one of the keys. Mitigation of climate change is of global public benefit. Government must play a role in the development, transfer, and deployment of climate-friendly technologies. Technological cooperation between developing countries can also be of importance as appropriate technologies from developing countries can be workable and cost effective. In addition, demonstration of how low emissions can result in a high quality of living in developed nations will help shape climate-friendly consumption patterns in China. Climate change adaptation and mitigation require shaking hands to join forces, instead of finger-pointing at one another. ■

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Security Through Energy Policy: Germany at the Crossroads

R. Andreas Kraemer

R. Andreas Kraemer has been director of Ecologic Institute in Berlin, Germany, since its founding in 1995. Well-versed in sustainable development and environment policy after more than 20 years in the field, he is a professor in the Berlin Program of Duke University in Durham, North Carolina, and cochairman of the OekoWorld advisory board on "green" investments. Ecologic Institute Washington, D.C., of which he is chairman, opened in 2008.

Germany has been a leader in renewable energy development, setting ambitious climate protection policies at home that have fueled growth of new technologies and related jobs that are now being exported around the world.

Courtesy of Ecologic Institute

R. Andreas Kraemer

The greatest concern in Germany is not acute domestic effects of climate change, but that developments around the world might harm political stability in other countries, result in a loss of trade, induce migration, and ultimately cause conflict. Promoting good climate policies abroad is seen as being in Germany's best interest and as good global citizenship.

At the heart of Europe, with all neighbors being member states of the European Union (E.U.), Germany is in a favorable position, geographically and politically. Some E.U. countries like Belgium, the Netherlands, Britain, or Denmark will likely suffer more from rising sea levels, while others around the Mediterranean will feel stronger effects from changing rainfall patterns. Germany has comparatively strong, well-organized, and efficient government and can respond to emerging threats more effectively than countries with more limited statehood, especially developing countries outside the E.U.

Germany is most vulnerable to the effects of climate change along the North Sea and Baltic coasts, but these are not densely populated. However, we find many houses, businesses, and much transport infrastructure along the rivers. Seasonally low flow already forces the occasional shutdown of nuclear plants and other installations. Recent record floods in all large rivers are seen as a consequence of changing climate, with a warmer atmosphere carrying more water and triggering stronger rainfall or snowfall. In time, a partial retreat from vulnerable areas will become necessary, yet there is no sense of urgency now.

TRANSFORMATION

Promoting energy efficiency and renewable energies is the preferred way to a climate-safe future for Germany. Fossil energy carriers are on the way out, as may be nuclear power.

Domestic hard coal production from deep mines is expensive and in phase-out; surface-mined soft coal (lignite) will remain a fuel for power generation for some

time but is politically on the defensive. Very likely, no new coal-fired power plants will be built in Germany. Domestic oil and gas production is economically irrelevant, and reliance on imports is not only expensive but brings with it threats to security of supply. Disruptions in gas deliveries from Russia in recent winters have not affected Germany directly but still raised concerns about supply security, as well as the outlook for the new democracies in Russia's shadow.

German energy taxes raise the prices of fuel, gas, and power, inducing families and businesses to monitor their energy use. Manufacturers develop efficient industrial equipment, household appliances, and cars, while building regulations promote insulation and efficient heating (and cooling) systems. Public investment programs, tax breaks, and dedicated credit lines support retrofits of existing buildings, and the efficient co-generation of heat and power.

Net metering and attractive feed-in tariffs support renewable power producers and are gradually leading to more diversified structure of distributed power generation. The key Federal Renewable Energy Act provides for feed-in tariffs above grid price levels to support emerging renewable energy technologies during the early phase of market development, especially for solar and wind power. The tariffs, designed to provide a stable economic environment for otherwise very risky investments in renewable energies, go down over time and will end as the renewable energies reach grid parity and can survive on the market.

The greatest concern in Germany is … that developments around the world might harm political stability in other countries, result in a loss of trade, induce migration, and ultimately cause conflict.

Germany never focused on fermenting grain to make ethanol as a bio-fuel, which is inefficient and environmentally harmful, but approached bio-energies — including bio-diesel, biogas, and wood pellets — more broadly. The production of storable biomass and biogas, and their subsequent conversion to power and heat, is a particularly dynamic and promising field now, attracting innovators and investors alike.

As a consequence of these policies, renewable energies now make up 15.1 percent of total power consumption and 9.5 percent of total energy consumption (2008). Last year's turnover of the industry was 29 billion euros (more than $40 billion), and it employs about 280,000 at various levels of qualification.

In 2008, overall greenhouse gas emissions decreased by 12 million tons, or 1.2 percent, from 2007 levels. Total emissions are now 945 million tons CO_2e (CO_2 equivalent) and within Germany's target corridor of the Kyoto Protocol, which allows Germany emissions during the period 2008 to 2012 at 21 percent below those of 1990. Germany's 2008 emissions are 23.3 percent below 1990 levels, making it likely that Germany will meet the target.

When could Germany supply all power needs from renewable sources? A federally funded research and demonstration project links variable wind and solar power plants with biogas-to-power plants, hydropower, and pump storage to form a virtual "combined renewable power plant" (kombikraftwerk.de). Thirty-six plants linked throughout Germany proved able to follow the load curve on the grid and supply a fixed proportion of power demand through the year.

Assessments of the renewable power and industrial scale-up potentials indicate that a full conversion to renewable power could be attained by 2050. This transformation would be completed even earlier by using smart-grid technology, demand response, load-variable power use, feed-in tariffs, and battery storage in electric automobiles; the German government wants to see 1 million electric cars on its roads by 2020. The concomitant phase-out of coal and nuclear power makes the transformation attractive in view of climate change and the proliferation risks and security policy price of nuclear technologies.

Doing Well by Doing Good: Exporting Solutions

Germany did not wait for other nations to bear the brunt of climate change and copy solutions others had found. Instead, Germany has developed domestic policies and worked with its partners in the E.U. to formulate continentwide responses to the challenges of climate

change. Germany engages with energy exporters, such as Russia, and many others to diversify its sources of energy, improve energy security and understanding of the need to mitigate greenhouse gas emissions, prepare for the impact of unavoidable climate change, and move toward sustainable and equitable societies.

Examples of this approach include German leadership in setting up the International Renewable Energy Agency (IRENA) and the International Carbon Action Partnership (ICAP), promoting international cooperation for efficient carbon markets. The Transatlantic Climate Bridge establishes bilateral links with the United States and Canada. A significant share of German cooperation with developing countries and emerging economies is directed at climate solutions and access to sustainable energy supplies.

This proactive attitude is not new. It can be traced to the beginnings of the E.U. in the 1950s and, more specifically, to the oil crises in the 1970s and early 1980s. Since the establishment of a full-fledged federal ministry of environment in 1986, German policies on environment, climate, and energy were marked by continuity and consistency across party lines and through changes in government. In setting effective policies at home, developing new technologies and services, letting them mature in the domestic and European markets, and selling them to other nations, Germany has created and secured businesses and jobs and provided solutions for others to adapt and adopt. ■

For more information, see *www.ecologic-institute.eu; www.ecologic-institute.us.*

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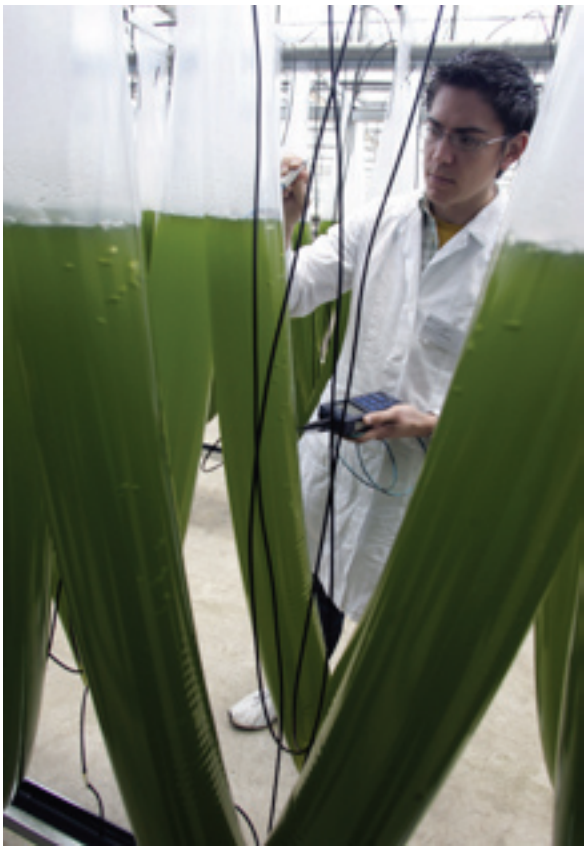

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Germany has invested heavily in renewable energy research and development. A scientist at RWE Energy Company in Bergheim, Germany, tests algae grown in a pilot project for carbon dioxide reduction for coal power plants.

India's Global Position on Climate Change

R. K. Pachauri

Rajendra K. Pachauri is chairman of the Intergovernmental Panel on Climate Change (IPCC) and director-general of the Energy & Resources Institute (TERI) in New Delhi, India. He accepted the 2007 Nobel Peace Prize, shared with former U.S. Vice President Al Gore, on behalf of the IPCC for raising awareness of and posing solutions for the problems of global warming.

India has serious concerns because it already experiences the impact of climate change in low-lying areas, which are more vulnerable to inundation by water from sea level rise and increasingly severe storms. There is evidence of melt in Himalayan glaciers, water resources for much of Asia. Pachauri outlines some of the problems and the measures taken to minimize the damage.

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Chairman Rajendra K. Pachauri and former U.S. Vice President Al Gore greet the public after accepting the Nobel Peace Prize jointly awarded to the IPCC and Gore for their work on climate change, December 2007.

The subject of climate change is receiving considerable attention and eliciting widespread interest in India, particularly since the visit of Secretary of State Hillary Clinton in July 2009. India has been quite active on multilateral issues related to climate change, going back, in fact, to the period when the United Nations Framework Convention on Climate Change (UNFCCC) was being negotiated prior to its completion in 1992. India has been reiterating the principle of "common but differentiated responsibility," and its position as a country is often misunderstood on this account.

Indians are concerned about climate change because ours is a country that is particularly vulnerable to its impacts. With a coastline of 7,600 kilometers, for instance, it has to be worried about sea level rise. Some parts of the country, such as the Sundarbans across the Hooghly delta and the low-lying coastal area of Kutch on the western side, are particularly vulnerable to sea level rise, because even with a small increase in sea level, large parts of these locations would be threatened with major damage and destruction and with complete inundation, resulting from storm surges and cyclonic activity. In the Sundarbans, in particular, some islands have already disappeared and others are under similar threat.

The impacts of climate change on India would be diverse and serious. There is already evidence in some parts of the country of changes in precipitation patterns. While some parts of India show a perceptible decline in rainfall and there is reduced snow in the Himalayas, a major concern also arises from projected increases in the frequency and intensity of extreme precipitation events. These are not only likely to pose a major danger to those who would be affected directly, but they could also affect the livelihoods of hundreds of millions of small farmers, who are entirely dependent on rain-fed agriculture. India is also vulnerable to the increase in frequency, intensity, and duration of floods, droughts, and heat waves. Human health will be affected by climate change, not only on account of these occurrences but also as a result of increased vector-borne diseases. Another area of deep

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Extreme weather events — severe storms, floods, and, drought — increasingly plague the Indian subcontinent. A villager crosses a parched landscape near Bhubaneswar during a widespread 2009 heat wave.

concern to Indian society stems from the impacts of climate change on agriculture. There is already growing evidence, on the basis of ongoing research, that some crop yields are declining on account of climate change. This trend will, of course, grow if global society is unable to mitigate the emissions of greenhouse gases adequately. India has a remarkably good record of agricultural progress, mainly as a result of the green revolution, but climate change poses a new challenge. The major objective of policy in the agricultural sector is to ensure adequate food and nutrition for 1.2 billion people today and a larger number in the next decade or two. Food security is, therefore, a major concern in this country.

India's response to the challenge of climate change can perhaps best be described by referring to the National Action Plan on Climate Change (NAPCC), which actually consists of eight separate missions involving both mitigation and adaptation measures. As far as mitigation is concerned, the Solar Energy Mission, which has set a goal of 20,000 megawatts of solar capacity being installed by 2020, is clearly the most ambitious and progressive plan that could have been drawn up in this field. The impacts of climate change would, of course, seriously affect agriculture and availability of water, and the NAPCC will target adequate adaptation measures in both these areas.

Indians are concerned about climate change because ours is a country that is particularly vulnerable to its serious and diverse impacts.

In terms of cooperative relationships that India is trying to establish, the most promising would be in the field of joint technology development. However, India's position is that in keeping with the provisions and intent of the UNFCCC, finances should be provided for facilitating transfer of clean technologies, which in several cases would be far more expensive than conventional systems but would have lower levels of emissions and energy intensity. But the particular activity that would have great interest, not only for the Indian government but also for business as well as academic and research organizations in India, would be the possibility of collaborative research projects between organizations in the United States and India. It is envisaged that with the substantially lower cost of scientific and technical manpower in India, even American business will find such an approach beneficial. Of course, intellectual property issues would need to be clearly resolved in such activities, but since both countries are signatories to the World Trade Organization, this should not present a serious problem.

Overall, a strategic relationship between the United States and India to deal with the challenge of climate change would have benefits not only for the two countries themselves but for the world as well by providing a model for similar arrangements between other developed and developing countries. India is also trying to promote collaborative ventures with the member nations of the South Asian Association for Regional Cooperation, since they face similar challenges, as well as with the European Union (E.U.), which has a major program for funding technological developments involving organizations based in the E.U. and those in "third countries," such as India. ■

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Reducing Poverty While Cutting Carbon Emissions

Harry Surjadi

Harry Surjadi, founder and executive director of the Society of Indonesian Environmental Journalists, has reported on environmental issues for two decades. A graduate of Bogor Agricultural University, he has written for magazines and newspapers, and he now maintains an environment blog on the Internet. He was a Knight International Journalism Fellow and has given workshops to journalists and nongovernmental organizations in Indonesia.

In Indonesia, the impacts of climate change will be most keenly felt by the poor, as extreme weather upsets agriculture and drives up food prices. Staving off poverty is a critical component of climate change policies, Surjadi writes.

Courtesy of Harry Surjadi

Harry Surjadi

How many Indonesians have ever read or heard about the issue of global warming and climate change? Studies have shown that climate change awareness is increasing, but this is largely among the educated.

According to an ACNielsen Omnibus survey in six Indonesian cities in February 2007, 70 percent of the 1,700 people surveyed said they had not read or heard anything about the issue of global warming. Only 28 percent said they had. The same study found that 50 percent of people surveyed attributed rapid global warming to human activities like driving cars and other uses of fossil fuels. Only 24 percent said the causes are natural changes in the climate, while 25 percent said both nature and human activity were factors. About 76 percent considered climate change "fairly serious" or "very serious."

One year later, in March 2008, people surveyed who were aware of climate change had increased 3 percent, and significantly more of them considered climate change very serious. Mass media successfully educated these people that climate change is a serious threat to Indonesia.

But have 43 million farmers, fishers, and local people who depend on forests read or heard about climate change? Have many of the 32.5 million Indonesians under the poverty line ever read or heard about global warming and climate change? Probably not.

If they had, and were asked, "What are the most serious threats climate change presents to Indonesia?" their answers would be scarcity of basic necessities. Their greatest concern is greater poverty and the lack of food and water, whether this comes from climate change or other causes.

Studies have shown global warming will likely increase the frequency and intensity of drought and floods in many areas. Three major El Niños, in 1973, 1983, and 1997, caused severe drought in Indonesia. Hundreds of rice paddy fields have failed harvests due to drought. Hundreds of thousands of people living in more than 50

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Trees smolder after a clearing fire in a Sumatran forest in Indonesia. Such clearings release massive amounts of carbon dioxide into the atmosphere, a major contributor to global warming.

villages across Central Java Regency now face a shortage of clean water as an ongoing drought worsens.

Extreme weather affects agriculture and can raise prices for staple foods, such as rice, important to poor households. Indonesians who earn less than $2 a day will suffer first, and the number of poor people will increase. Poverty is Indonesia's greatest concern, and climate change will increase the number of poor people and worsen their poverty.

If [the poor] were asked, "What are the most serious threats climate change presents to Indonesia?" their answers would be scarcity of basic necessities, water and food.

Meanwhile, Indonesia will continue to emit carbon dioxide (CO_2). In 2005 Indonesia was already the world's third-largest CO_2 emitter, after the United States and China, with emissions around 2.2 gigatons, or billion tons, CO_2 per annum. A study conducted by McKinsley and Company, a consultant company for the Indonesian government's Climate Change National Council (CCNC), predicted that Indonesia's greenhouse gas emissions would increase by 2 percent annually.

According to CCNC Secretary General Agus Purnomo, in 2020 emissions were expected to jump to 2.8 gigatons CO_2 and then to 3.6 gigatons by 2030, if Indonesia takes no action. The main sources of emissions — responsible for 80 percent of the total projected 2030 emissions — are deforestation and peat land clearing, transportation, and power plants. The forestry sector contributes about 850 million tons CO_2 equivalent per year. The deforestation rate is around 1 million hectares per year, which emitted 562 million tons CO_2e. Degraded forest is responsible for 211 million tons CO_2e per year. And forest fires are responsible for 77 million tons CO_2e.

According to the McKinsley study, Indonesia could potentially reduce emissions 64 percent, or as much as 2.3 gigatons of CO_2, by 2030 through the adoption of 150 different programs focused on forestry, peat land, and agriculture sectors.

It is clear that developed countries can help Indonesia to mitigate climate change. The CCNC, based on the McKinsley study, recommended bilateral cooperation with developed countries on programs to halt or reduce deforestation and encourage reforestation. The study estimated the cost to reduce emissions from the forestry sector is about 7 euros (approximately $10 U.S.) for every one ton of CO_2 equivalent. To implement programs to reduce emissions about 1.1 billion tons of CO_2 equivalent per year, Indonesia would need $10.8 billion of funding.

But the government must take responsibility and move more quickly. "It takes five years [for the government] to change. In five years we need help from outside world. The outside world should show the money. Money is the easiest policy tool to get real and fast results," said Purnomo in a recent interview.

The developed countries should make sure every dollar or euro they invest addresses not only climate change mitigation but also safeguards Indonesians against poverty. Reducing poverty is a main goal of all emissions reduction programs.

"At the end of the day," says Purnomo, "the government of Indonesia can only create an enabling environment." ■

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Strategies to Counter Climate-Related Threats to Kenya's Economy

Richard Odingo

Vice chair of the Nobel Prize-winning United Nations Intergovernmental Panel on Climate Change (IPCC), Richard Odingo is a Kenyan expert on climate science. He is a professor in the Department of Geography at the University of Nairobi.

In Kenya, as in many other African countries, economic survival depends on vigorous action to address climate-linked environmental conditions, which range from severe drought to flooding. Odingo examines some of the problems and suggests remedies.

Courtesy of IISD Reporting Services

Richard Odingo at a November 2007 IPCC plenary session.

Like many small African countries, Kenya is vulnerable to the impacts of climate variability in the short term and to climate change in the long term. Virtually all sectors of the Kenyan economy are vulnerable to climate change. The energy sector is over-reliant on hydropower for the modern sector and biomass for the rural sector. Agriculture and food production are plagued by frequent, climate-linked food insecurity crises, and the water sector faces serious shortages in rural and urban areas. Early-warning systems are in place, but the lack of timely response has led to frequent problems: crises in energy supply, marked by power rationing; famines leading to international appeals for food aid; and rural insecurity because of inadequate water and grazing for nomadic pastoralist populations. Consequently, the government has always resorted to crisis management to respond to climatic threats in these critical sectors. A bad drought and food shortage associated with El Niño-linked high rainfall accompanied by flooding, such as occurred in 1997-1998, often leads to a fall in the gross domestic product by up to 20 percent in affected years. Such obvious vulnerability calls for serious planning efforts to forestall drought and flood-induced disasters, but this has not happened.

The greatest concern is that over the years, despite the availability of climate information, including early warning provided by USAID's (U.S. Agency for International Development's) FEWSNET, the economic planners have been slow to recognize the dangers posed and the need to shift gears away from traditional crisis management. The most telling evidence of this reluctance to plan with climate change in mind can be seen from the economic development planning paper Vision 2030, wherein climate change has been given short shrift and virtually ignored. Similarly, agricultural planners are yet to advance beyond responding to information about annual rainfall variability and start thinking of the impacts of slowly advancing climate change. Climate change and global warming are mentioned as future challenges to the economy but not factored in the 2030 scenarios.

Yet according to the Fourth Assessment Report issued by the IPCC in 2007, by 2030 the first strains of global warming will already be felt in most sub-Saharan African countries. Kenya and most countries in the Great Horn of Africa are highly sensitive to climate change. Under the ravages of climate variability and climate change, it will be well-nigh impossible to maintain a sustained economic growth of 10 percent per annum over 25 years,

© AP Images/Khalil Senosi

Children collect dirty water from this drying river in Nyariginu village, Kenya. A prolonged dry spell wiped out 2009 harvests throughout the country, severely compromising food security.

as projected in Kenya's Vision 2030. Kenya depends on hydropower for electricity, yet hydropower is extremely vulnerable to climate fluctuations. As rivers dry up because of drought and glaciers disappear on Mt. Kenya, water for hydropower production will no longer be guaranteed. Another major worry is the drop in agricultural yields attributable to droughts. As warming accelerates, crisis conditions will arise. Water stress will increase geometrically in most arid and semi-arid areas.

The greatest concern is that over the years, despite the availability of climate information…the economic planners have been slow to recognize the dangers posed and the need to shift gears away from traditional crisis management.

Government is not serious enough in addressing the consequences of climate change — or, indeed, factoring climate change impacts in the development process. Hence, food security is threatened, as are the prospects for self-sufficient food production. The economy is always buffeted by climatic considerations, and the nation has yet to graduate to carefully calculated fallback adaptation action plans. Kenya is considered a leader among the developing economies of sub-Saharan Africa, but extensive production of tea and coffee for export has come at the expense of food production; self-sufficiency in food-related crops and livestock production have been neglected.

The current drought in Kenya, the second in two years, is a small symptom of what is clearly one of the worst on record. More than 4 million persons at risk from food shortage is an indication of the vulnerability of the food production system. The drought has been compounded by acute water shortages for agricultural and urban populations and for livestock, which in addition have no grazing. Livestock mortality is at its highest in the last 20 years, and economic growth is bound to be depressed down to 2 percent or less.

Kenya needs the developed world to help with improved agricultural planning and energy development that relies less on hydropower and more on renewable sources. More sober economic planning and adequate funding to help agricultural and pastoral communities weather bad droughts are necessary. Safety nets for food, agriculture, and livestock should be promoted. Looking to food imports as a way out is unwise. The economic importance of climate change must be factored into all development and financial planning.

Water requires urgent attention. Investment in water harvesting at all levels can provide better environmental management to stop deforestation and devegetation, which will slow down the progress of climate change. In the international arena, Kenya can benefit by working with other nations. Technology transfer and adequate funding at national and international levels to help reduce vulnerability to climate change can make adaptation a working reality. Making pastoral areas more productive and integrating pastoral populations more fully into the national economy will strengthen self-sufficiency. In good years Kenya has the capacity to produce enough food for its population, now over 35 million. As time passes, the challenges posed by climate change will be harder to bear. There is no shortcut to finding solutions to all these problems other than sound economic planning that gives governments alternative ways of responding to the climate crisis. ■

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Good Domestic Efforts, Underestimated Threat

Alexey Kokorin

Russian climate expert Alexey Kokorin heads the Climate and Energy Program of the World Wide Fund for Nature (WWF-Russia). He guides and implements climate change-related educational projects for communities and other groups to promote energy efficiency. He has worked on development of a domestic and international greenhouse gas inventory system and economic mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol. He has participated in key domestic studies, including Coalitions for Future (Strategies of Russian Development in 2008-2016), and in the development of long-term Russian Energy Strategy for 2020 and 2030.

Here Kokorin evaluates the climate change impact sustained by Russia, the likely future, and the steps the government is taking to adapt and mitigate the effects of climate change domestically and in cooperation with international partners.

Courtesy of Alexey Kokorin

Alexey Kokorin

As a northern country, Russia has experienced, so far, a very modest climate change impact. Local but temporary positive climate change impacts have occurred in agriculture and the opening up of northern shipping routes. Negative impacts are melting permafrost and flooding in susceptible areas, public health threats from the spread of diseases, winter transportation in the north, and the impact on wildlife, particularly the polar bear. Currently there seems to be sort of a balance, and people still think that an overwhelming negative impact may become a reality only in the second half of the 21st century, not in the near future. The minister of Natural Resources and Ecology announced, in April 2009, that current Russian losses from emergencies created by weather events cost the country 1 to 2 billion dollars per year.

Top Russian officials still do not recognize greenhouse gas (GHG) reduction as a great value itself, although the level of recognition is gradually growing. They do recognize now the anthropogenic causes and *global threat* of climate change, but they do not yet see that danger is here now in Russia. It is rather critical already and will be more so after 2010.

On the other hand, officials recognize the concerns and the climate change-related losses suffered by other countries. As an important international power, Russian leadership wants to share in shouldering the responsibilities in dealing with the global climate situation along with other nations. Evidently, the Russian government is looking at the competitiveness of the Russian economy in the context of new carbon emissions rules, taxes, and measures that may be adopted internationally in negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) to replace the Kyoto Protocol.

Russia has set some important climate-friendly goals:

- Reduce energy intensity of GDP by 40 percent by 2020
- Achieve associated gas utilization by 95 percent by 2014-2016
- Increase share of renewable sources from 0.9 to 4.5 percent (excluding large hydro) by 2020

Growth of GHG emissions by 1 to 2 percent per year is expected, but these measures can slow down GHG growth and provide a stable level of emissions by about 2020. The level could be 25 to 30 percent below 1990 levels or only 5 to 10 percent above 2007 levels.

Other climate-friendly steps include studies and reporting, education, and preparations for adaptation measures in the most vulnerable regions, for example, in permafrost and flood-risk areas.

- Russian Assessment Report, similar to Volumes 1 and 2 of the IPCC 4AR, has been prepared and provides a basis for recognition of the threat. But economic Volume 3 has not been started, and the question about scale of losses in comparison with cost of adaptation and GHG reduction is still open.
- Russian Climate Doctrine is ready to be signed by the president, proclaiming mitigation, adaptation, and contribution to global efforts as key tasks. It is not yet supported by plans and implementation but has great value to increase public awareness by rolling out educational efforts.

In international fora of the UNFCCC, G8, and Major Economies Forum, Russia displays its goodwill to work together toward a new climate change agreement at the United Nations Climate Change Conference (COP15) in Copenhagen in December 2009. At the recent G8 meeting in Italy, Russia agreed to a 2-degree C global goal, as defined by the G8, meaning that global temperature increase should be limited to 2 degrees Celsius (3.6 degrees Fahrenheit) in comparison with the preindustrial era, and to a very ambitious goal of 80 percent emissions reduction by 2050 for developed countries as a whole, but only a 50 percent reduction for Russia itself.

Negative impacts are melting permafrost and flooding in susceptible areas, public health threats from the spread of diseases, winter transportation in the north, and the impact on wildlife, particularly the polar bear.

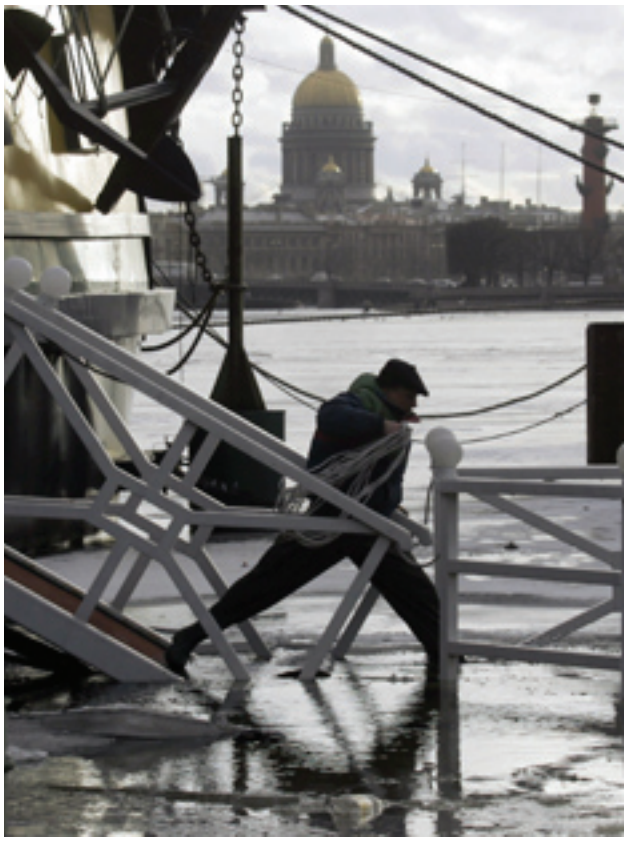
© GORDON WILTSIE/National Geographic Society

A polar bear rests on a small ice flow in the Arctic Ocean north of Franz Josef Land, Russia.

Burden Sharing

Russia emphasizes the *equity of burden sharing*, with special attention to the largest GHG emitters. The general view of Russian officials and the public is the same: Even countries with relatively smaller GDP per capita should determine equal levels of commitments, which has to be fixed in an international agreement together with Russian commitments.

Without a positive reply from all of the largest global emitters, Russia announced only very weak



© AP Images/Dmitry Lovetsky

Flooding of the Neva River in downtown St. Petersburg, Russia, is an unusual occurrence in mid-winter. Flooding and permafrost melt have increased in recent years.

mid-term goals by 2020: 10 to 15 percent below 1990 levels or 20 to 25 percent above the current levels (in percentage points of 1990). It is a very disappointing decision, which I hope may be corrected if the largest GHG emitters adopt more ambitious goals.

Burden sharing includes *financial contributions*, and after the recent Major Economies Forum, President Medvedev stated that Russia is ready to support the Multilateral Fund proposed by Mexico. In the Russian case, the source of funding will be mainly the state budget, which allocates funding for foreign aid.

Russia is still out of the *global carbon market* and does not take part in joint implementation or emissions trading mechanisms of the Kyoto Protocol. But there are many projects and ideas that have the support of potential foreign carbon investors. Russian business would like to see carbon trading more seriously pursued. The law on joint implementation participation was signed two years ago, but no project has been implemented to date. Although in June 2009 the prime minister issued an order to accelerate and simplify procedures, there is not yet clear progress. The main reason is that the government does not consider joint implementation or emissions trading important because the potential scale of these mechanisms is negligible for the state budget.

In a new climate agreement, Russia would like to keep joint implementation in balance with the Clean Development Mechanism outlined by the UNFCCC. Officials appear open to domestic emissions trading systems in a sector or sectors of the economy, but this is considered a national concern, which should not be under international agreement.

Domestically, Russia is going to implement climate-friendly steps even though the full implications and value of climate protection measures may not be fully acknowledged or understood. Internationally, Russia certainly would like to be a "good guy" in global climate efforts and take a leadership role, but the realization of the given goodwill requires more effort in developing and applying effective remedies to meet the very real challenge of climate change. ■

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International Youth: Fired Up About Climate Change

Richard Graves

Richard Graves, a young activist focused on climate change issues, is the blogger and online campaigner with the Global Campaign for Climate Action, project director and founder of Fired Up Media, an associate producer for LinkTV's EarthFocus, and a contributing editor for It's Getting Hot in Here.

Graves says the generations who will inherit the burden of global warming want bold environmental leadership, responsible climate policies, and green jobs — and they are telling the world about it, person-to-person and on the Internet.

Courtesy of Richard Graves/Photo by Christine Irvine

Richard Graves

The most important meeting of the 21st century is happening this December in Copenhagen, yet those who have the most to gain, or lose, are left on the sidelines. Global warming will define this century, just as the struggle between totalitarianism and democracy defined the last one. The decisions that senior officials make today will shape the kind of world that young people, representing nearly half the world's population, will inherit. In a strange intersection of physics and politics, politicians elected today have the most say over the conditions that future governments and societies will have to live with. The world leaders gathering in Copenhagen would do well to look to young people for a timely example in leadership.

Young people in the United States have made clear that they want bold environmental leadership, with 64 percent of young voters saying the environment is very important to their vote. And we haven't just been demanding change from our political leaders: We fought to change the political landscape when we weren't being heard. Every presidential candidate in 2008 faced hard questions about global warming and the environment when they visited college campuses, held town hall meetings, or had any other event where you didn't have to pay hundreds of dollars to get in.

We demanded fair climate policies, including green jobs for those excluded from the dirty-energy economy, and responsibility on a global scale for the United States' historical emissions. In the end, 24 million voters under the age of 30 showed up last November, supporting the candidate who promised change and action on global warming.

However, it is past time for demanding change; we have to work for it. Twelve thousand young people gathered in Washington, D.C., in spring 2009 to meet with every member of Congress and demand bold action on global warming at the Power Shift conference, which continues as a campaign on campuses and as an online advocacy network. More than 100 youth leaders from

Courtesy of Indian Youth Climate Network

Indian environmental activists bring the climate change message to rural areas in solar-powered caravans.

other countries, including the United Kingdom, China, Australia, India, and other major emitting countries, were there to strategize about how to make our governments work together to solve this global problem.

Two years ago, I represented the international youth delegation to the U.N. climate negotiations in Bali, Indonesia. We had all scraped together the resources to travel to this event, as we were desperate to be heard. Youth leaders from countries all around the world met for the first time. Whether we came from Kiribati, India, Australia, or the United States, we were unified in what we wanted from our leadership. We partnered with UNICEF to tell our stories, and every speaker was united in calling for a fair, ambitious, and binding climate treaty to protect our future.

If you have ever talked to young people from Kiribati or Bangladesh, who have their whole future in front of them and understand what the scientific community has predicted from global warming, it changes you forever.

Once again, world leaders are gathering to finally forge a climate treaty. However, things will be different this time around. Youth from the United States who organized the Power Shift conference are working with young people in the United Kingdom to hold their own conference, while the Australian Youth Climate Coalition had 3,000 participants at their Power Shift conference, in Sydney, last fall. Indian youth who were in Bali launched the Indian Youth Climate Network and worked with colleges, Nobel Prize-winning scientists, and civil society groups to bring messages of change and renewable energy to the countryside in solar-powered caravans.

If you have ever talked to young people from Kiribati or Bangladesh, who have their whole future in front of them and understand what the scientific community has predicted from global warming, it changes you forever. We are working to gather these stories and tell them to the world. Tech-savvy youth from the developing world are working with youth leaders in developing countries to use Web sites, blogs, and new media to tell their stories. We have helped launch sites like What's with the Climate? Voices of a Subcontinent Grappling with Climate Change [*http://www.whatswiththeclimate.org*] and Youth Climate.org [*http://youthclimate.org*]. Young people from the developed world are moved by how similar young people are from the developing world and how we face a common challenge.

The overwhelming election margin provided to President Obama by young people fired up about global warming has inspired a worldwide explosion of youth climate activism. Youth leaders in the United States and abroad are expecting great things from new leadership in the United States, but they are also working to change political reality at home.

When world leaders gather in Copenhagen, let's hope that the representatives of the United States are inspired by the bold leadership of young Americans on global warming. I ask that those world leaders look around them, as young people will be there, watching, on the sidelines. However, don't expect them to stay there for long. If this political reality will not assure us a livable world, be advised that nearly half the world's population will not allow an inconvenient political situation to stand between us and our very survival. ■

For more information, see the Global Campaign for Climate Action [*http://tcktcktck.org*]; Fired Up Media [*http://firedupmedia.com*]; LinkTV: Earth Focus [*http://www.linktv.org/earthfocus%5d"*]; It's Getting Hot in Here [*http://itsgettinghotinhere.org*].

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Is the United Nations Up to the Challenge?

Bo Kjellén

Seasoned diplomat Bo Kjellén brings his depth of experience in environmental policy to this analysis of the role of the United Nations in formulating and implementing climate change policy. He joined Sweden's Ministry of Environment as chief negotiator in 1990, heading Swedish delegations in the Rio process and climate negotiations until 2001. He has been chairman of the Swedish Research Council on Environment, Agricultural Sciences, and Spatial Planning (Formas) and a visiting fellow at the Tyndall Centre for Climate Change Research, UEA, Norwich. He has received prestigious awards for his diplomatic service, including the Elizabeth Haub Prize for Environmental Diplomacy (1998) and the GEF Global Environment Leadership Award (1999).

Courtesy of IISD/Markus Staas

Bo Kjellén

Almost 20 years ago, in February 1991, the negotiations for the United Nations Framework Convention on Climate Change started in Chantilly, Virginia, outside Washington, D.C. This was the beginning of a long series of climate negotiations within the U.N. framework, based on the scientific findings of the Intergovernmental Panel on Climate Change (IPCC). The importance of this scientific contribution was recognized in 2007, when IPCC was awarded the Nobel Peace Prize.

From the beginning, the United States and member states of the European Union had provided a cooperative leadership, both scientifically and politically. However, when the United States decided not to ratify the Kyoto Protocol in 2001, European Union leadership became decisive in finally putting into force the protocol in 2005. And now the Obama administration has returned the United States to an active role in the negotiations, giving new energy to the process.

We have learned a lot during the decades of negotiation within the United Nations. Climate has moved from being an issue for scientists, experts, and nongovernmental organizations into the permanent agenda of summit meetings of world leaders. And now, in the face of scientific evidence that indicates overwhelming proof of the dangers of human impact on the global climate system, the urgency of reducing the emissions of greenhouse gases is generally recognized.

However, we also realize that such global action is difficult. Fossil fuels paved the way for the energy and transport revolution that gave a decisive contribution to living standards in the industrialized world. But a large part of the planet's population has not yet benefited from these developments. It is not surprising that the developing countries in the climate negotiations insist on transfer of technology and increased financing for adaptation and continued combat of poverty as a necessary part of a climate deal.

The United Nations is the place where all these different elements of international cooperation come

UN photo/Mark Garten

U.N. Secretary General Ban Ki-moon visits the polar ice rim to see the impact of climate change first hand in June 2009, as part of his campaign for a fair, effective agreement at the COP15 in December.

together. It is the U.N. General Assembly that adopted the Millennium Development Goals in 2000; it is the United Nations that held the major conferences on the environment in 1972, 1992, and 2002; and it is the United Nations that has hosted all negotiating processes on global change: climate, ozone, air pollution, biological diversity, desertification, drought, and regulation of toxic chemicals.

Climate has moved from being an issue for scientists, experts, and nongovernmental organizations into the permanent agenda of summit meetings of world leaders. The United Nations is the place where all these different elements of international cooperation come together.

But the question has been raised if the cumbersome U.N. procedures are good enough for translating normative principles into effective action on issues like climate change, with its need for concrete measures and difficult societal effects directly influencing lifestyles and economic structures. Can the U.N. system really deliver?

The question needs to be raised. And it is quite clear that other processes and institutions, such as the G8/G20, the Major Economies Forum (MEF), the Organization for Economic Cooperation and Development (OECD), or the various regional organizations, all have a role in translating political will to action in their own nations, and, jointly, with other nations around the world, into common action. The climate negotiations have benefitted greatly from the active presence of NGOs. Their advocacy and expertise have certainly impressed many of the delegates.

But there is no substitute for the United Nations when it comes to really global issues. And nothing is more global than climate change: Emissions of greenhouse gases from all countries accumulate in the common atmosphere. At the same time, climate change is only part of a broader process of accelerating change in natural systems caused by human activities. The human species has now become so numerous and our technological capacity so overwhelming that common action is needed to counter the threats of collapse of life-supporting natural systems. There is no other planet to go to.

So the problem is really not to build another United Nations. Instead we have to ask: How can the United Nations be reformed to meet the requirements of today and tomorrow? Some people would say that this is unrealistic. So far U.N. reform has always stumbled on political difficulties, such as those that met the proposals of former Secretary-General Kofi Annan. Despite all the difficulties, I trust that the ongoing climate negotiations will demonstrate the capacity of the United Nations to provide an efficient framework for cooperative action on global threats. And I firmly believe that there is scope for more general reforms aimed at linking global political issues with economic and environmental problems of a new character. I hope that the clearly stated ambitions of President Obama with regard to multilateral cooperation would also be instrumental in moving to U.N. reform, perhaps in the direction of providing the existing Trusteeship Council with a new agenda on global survival issues, as proposed by the Commission on Global Governance. We will also need more efficient U.N. processes for facing climate-related and other natural disasters. There is no time to lose. ■

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Additional Resources

Articles, books, and Web sites on climate change issues

Articles

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Academic

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http://www.ncar.ucar.edu/research/climate/

The World Bank World Development Indicators Database, 1 July 2009. Gross domestic product (2008).
http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf

Yale University: School of Forestry and Environmental Studies: Project on Climate Change
http://research.yale.edu/environment/climate/

Government

U.S. Department of Commerce: National Oceanic and Atmospheric Administration: Climate
http://www.noaa.gov/climate.html

U.S. Department of Energy: Climate Change
http://www.energy.gov/environment/climatechange.htm

U.S. Department of State: Bureau of Oceans and International Environmental and Scientific Affairs: Climate Change
http://www.state.gov/g/oes/climate/

U.S. Environmental Protection Agency: Climate Change
http://www.epa.gov/climatechange/

International

Intergovernmental Panel on Climate Change
http://www.ipcc.ch/

Kombikraftwerk
http://www.kombikraftwerk.de/index.php?id=27

U.S.-E.U. Strategy Dialogue on Energy Transformation
http://www.energy-transformation.org

United Nations Framework Convention on Climate Change
http://unfccc.int/

Organizations

Pew Center on Global Climate Change
http://www.pewclimate.org/

Resources for the Future: Climate Change
http://www.rff.org/research_topics/pages/climate_change.aspx

Sixth Compilation and Synthesis of Initial National Communications From Parties not Included in Annex I to the Convention
http://unfccc.int/resource/docs/2005/sbi/eng/18a02.pdf

For Students

Climate Change: The Threat to Life and a New Energy Future
http://www.amnh.org/exhibitions/climatechange/

Climate Classroom — From the National Wildlife Federation
http://www.nwf.org/climateclassroom/

Fired Up Media
http://firedupmedia.com/

Global Campaign for Climate Action
http://gc-ca.org/

Hot Politics
http://www.pbs.org/wgbh/pages/frontline/hotpolitics/

It's Getting Hot in Here Blog
http://itsgettinghotinhere.org/

LinkTV: Earth Focus
http://www.linktv.org/earthfocus

Real Climate: Climate Science From Climate Scientists
http://www.realclimate.org/

U.N. Environmental Programme: Seal the Deal! — Youth Action on Climate Change
http://www.sealthedeal2009.org/

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