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DEVELOPMENT Outreach

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CLIMATE CHANGE

LOW CARBON ECONOMIES

57665

RESILIENT SOCIETIES

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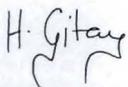
Promoting knowledge and learning for a better world

ABOUT THIS ISSUE

Human activities, particularly fossil fuel based energy production and use, as well as land use, have led to increases in the atmospheric concentration of greenhouse gases (mainly carbon dioxide, methane and nitrous oxides). These greenhouse gases emitted by one country affect countries all over the world, over decades to centuries. The impacts of such emissions include increases in the Earth's surface temperature, altered rainfall patterns, sea level rise, and increased frequency and severity of storm surges, floods, droughts and heat waves. These changes in turn have broader impacts, e.g. adversely affecting many developing countries and societies through agricultural related economic losses, access to clean water, loss of livelihoods and increased incidences of vector and water-borne diseases.

This special report of *Development Outreach* examines how climate change has affected development and what actions are needed to reduce our greenhouse gas emissions (referred to as mitigation), and what can be done to adjust to ongoing and potential effects of climate change (referred to as adaptation). Some initial articles articulate the global nature of the problem and the need for equitable and ethical action through the use of existing and emerging technologies combined with regulatory and behavioral changes to help reduce greenhouse emissions in both developing and developed countries. The next set of articles focus on how various parts of the world and people have already been affected by climate change and how they are struggling with and adapting to these changes. Specific roles of insurance, microfinance, knowledge and capacity development are discussed as tools and approaches to help move towards low carbon growth and build resilient societies in the last set of articles. This report also includes a summary of the major outcomes of the United Nations Climate Change Conference held in Bali in December 2007, including the Bali Action Plan, which provides hope for future collective action and a global response on mitigation and adaptation.

It is clear that climate change has become a development issue for many countries. We hope that the articles inform you on the links between climate change and development, what actions are being taken and what is needed from all of us in the future.



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RECOGNIZING THE POTENTIALLY DEVASTATING socioeconomic implications of climate change, the World Bank and other development partners have drawn up an agenda to address this complex, multidisciplinary challenge. The Bank is helping countries identify strategies, policies and actions to address and ameliorate the harmful effects of climate change. Approaches include developing innovative and concessional methods of financing for low carbon projects, creating new market mechanisms that provide incentives for reducing carbon emissions, and working with the business community and citizens' groups to support the development and adoption of appropriate technologies.

The United Nations Framework Convention on Climate Change has long recognized the need for raising awareness and building capacity as part of a holistic response to the problem. Challenges of this magnitude require a broad-based collaborative effort on the part of a wide range of development organizations, governments, NGOs, businesses and civil society groups, working together to identify and implement equitable and sustainable solutions. The World Bank Institute (WBI) is playing an active role in building this capacity, sharing knowledge across borders and among agencies, incorporating lessons learned locally about "what works and what doesn't work."

This *Development Outreach* report brings together expert contributors from key stakeholder groups mentioned above in an effort to identify and explain the links between climate change and development. It outlines a number of promising strategies to promote low carbon growth that will reduce greenhouse gas emissions without unduly constraining vital economic progress. The authors also provide examples of how some countries have modified their policies and already taken action to reduce the negative effects of climate change.

I hope that this special report will help raise awareness of climate change and the urgent need to provide support to those populations who are most at risk.



Rakesh Nangia
Acting Vice President
World Bank Institute

ACHIEVING LOW CARBON GROWTH FOR THE WORLD

GUEST EDITORIAL

BY LORD NICHOLAS STERN AND IAN NOBLE

THERE IS NOW A STRONG CONSENSUS EXPRESSED through the conclusions of the Intergovernmental Panel on Climate Change and other reports and the recent negotiations at the UN Climate Change Convention in Bali that the risks of inaction or delayed action on climate change are overwhelming; we possibly risk damages on a scale larger than the two world wars of the 20th century. The threat is particularly alarming for the world's poor people as inadequate responses to climate change would threaten progress on all the dimensions of the Millennium Development Goals.



Solar energy water heaters are installed on the roof of apartment buildings in Ningbo, Zhejiang province, China.



General view of the conference room during the meeting of the G8's Gleneagles Process on climate change and sustainable development held in September 2007 in Berlin.

KEY ELEMENTS FOR A GLOBAL DEAL ON CLIMATE CHANGE



River bank protection activities along the Brahmaputra River, Bangladesh, that completely dries up during the dry season and floods over during the rainy season.

The problem of climate change involves a fundamental failure of markets, namely that those who cause damage by emitting greenhouse gases generally do not pay. This global problem requires a collaborative, global response. Leadership, acceptance of differentiated responsibilities, emission targets and trading must be at the heart of any future global agreement to reduce greenhouse gas emissions.

Developed countries must lead the way in taking action by: adopting ambitious emission reduction targets of their own; promoting rapid technological progress to mitigate the effects of climate change; supporting programs to combat deforestation; encouraging effective market mechanisms; and honoring their aid commitments to the developing countries—all elements of the Bali Action Plan agreed to in December 2007 and summarized at the end of this report.



Solar-powered TV keeps these street children entertained in Northern Tanzania.

Criteria for fighting climate change

GLOBAL ACTION TO FIGHT CLIMATE CHANGE must invoke three basic criteria:

The first is **effectiveness**. The scale of the response must be commensurate with the challenge, which means setting a stability target for emission reductions that keeps risks at acceptable levels. The overall targets of 50 percent reductions in global emissions by 2050 (relative to 1990) agreed to at the G8/G5 summit in Heiligendamm in June 2007 are essential if we are to have a reasonable chance of keeping temperature increases below 2 or 3°C. While these targets involve strong action, they are not overly ambitious relative to the risks of failing to achieve them.

Second, **efficient** means of keeping down costs of emission reductions must be implemented, using prices or taxes wherever possible. Each of the taxation and market mechanisms based on quotas or permits has its advantages and difficulties. Emission trading between countries, including rich and poor countries, will promote international efficiency, and helping poor countries cover their costs of emission reductions will give them an incentive to play a role in this global challenge.

Third, **equity** is a concern we need to take to heart, as the starting point for taking action is deeply inequitable. Wealthy countries are responsible for the bulk of past emissions, while it is the poor countries that will be hit earliest and hardest by climate change. Fixed targets are crucial for managing risk and even a minimal view of equity demands that the rich countries' reductions should make up at least 80 percent of these global targets. Currently, the US emits more than 20 tonnes of carbon dioxide (CO₂) per capita per year, while Europe and Japan, with similar living standards, emit around 10 tonnes. China emits about five tonnes per capita, India around one and most of Africa much less than one. To reach a 50 percent reduction in global emissions by 2050, the world average per capita must drop from seven tonnes to two-three tonnes.

Resources for three key elements

DEVELOPED COUNTRIES MUST ALSO PROVIDE resources, including funding, technology transfer and capacity building, for three key elements of a global agreement:

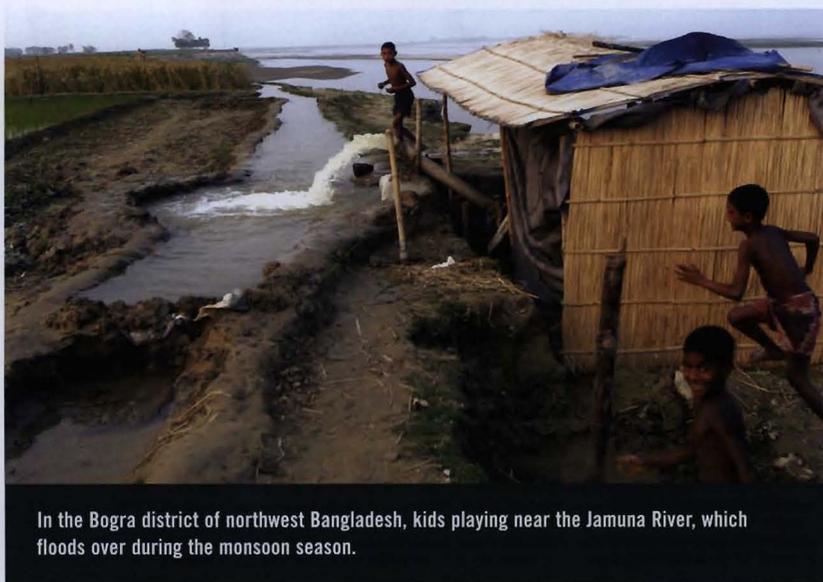
First, a coherent, integrated international program to combat deforestation, which contributes 15-20 percent of greenhouse gas emissions, should be established. For US\$10-15 billion per year, half of the deforestation could be prevented.

Second, technology development must be accelerated and methods to promote technology transfer found. Addressing carbon capture and storage (CCS) technology for coal is particularly urgent since coal-fired electric power will remain the dominant technology for some decades to come. However, industrialized countries must demonstrate that CCS works before developing countries can be expected to commit to this technology. For price support (ideally soon taken over by the carbon markets) of US\$5 billion a year, it should be possible to create 30 commercial scale coal-fired CCS stations within seven to eight years.

Finally, it is vital that extra resources be made available for new initiatives to help integrate adaptation into development as the extra costs developing countries face as a result of climate change are likely to be upwards of \$80 billion per year as soon as 2015. Developed countries should move quickly to honor their commitments of 0.7 percent of GDP in aid by 2015, which would yield flow increases of \$150-200 billion per year. All parties must also engage in discussions of how to implement their agreements in the UNFCCC that developed countries should "assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects."

The World Bank Group (WBG) has sought to provide leadership in each of these areas always within the context of the primacy of poverty reduction as the Group's *raison d'être*. At the climate conference in Bali, the Forest Carbon Partnership Facility was launched and it seeks to raise at least \$200 million

to build capacity and conduct demonstration activities to combat deforestation. In relation to technology transfer, the WBG is engaged in discussions with major donors to manage multi-billion dollar funds that will promote transformational change in low carbon technologies in the developing world. In the recent replenishment of IDA15—the WBG's highly concessional lending and granting program for the world's poorest countries—funding was increased by 42 percent to \$14 billion per year. This was partly in response to the Bank's submission that climate change will increase the resources needed to maintain levels of benefits from IDA by \$0.6 billion to \$1.9 billion per year. Comprehensive climate risk management in IDA projects will likely be the single largest source of funding for adaptation in least developed countries in the immediate future.



In the Bogra district of northwest Bangladesh, kids playing near the Jamuna River, which floods over during the monsoon season.

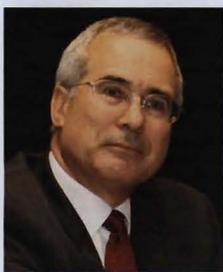
Action is vital and urgent

ACTION IS URGENT if we are to avoid the stocks of greenhouse gases building to levels that involve unacceptable risks. We can control the flows of greenhouse gases, but any delay will build up more stocks, which are very difficult to remove, making actions to stabilize at acceptable levels much more costly.

Different countries will choose different instruments—such as taxes, trading and standards—and different technological mixes, but in all countries, energy efficiency is possible. Price mechanisms for greenhouse gases will be central to correcting the market failure, but the urgency and risk of the problem and inertia in behavior imply that policy must go further. This means bringing forward technologies, deepening an understanding of what responsible behavior means, overcoming other market failures that inhibit energy efficiency and innovation, and combating deforestation. With leadership and the right incentives on carbon finance and technologies, developing countries will engage in future global action, as already shown in Bali.

The building of a global deal and its enforcement will come from the willing participation of countries driven by the understanding that action is vital. Commitments are increasingly being demonstrated by political action and elections around the world, and this understanding is being reflected in the public demand for responsible action. It is this public demand that will promote and sustain action at the individual, community, national and international levels.

Demonstration of effectiveness, efficiency and equity in a global agreement will encourage all countries to pursue their development aspirations via low carbon growth. New technologies can create great opportunities and provide impetus for new growth. Low carbon growth is the growth strategy; weak action will eventually stifle growth. The costs of action are a small price to pay for the grave risks they would avert. ♣



Nicholas Stern, Lord Stern of Brentford, Kt, FBA. Also IG Patel Professor of Economics & Government, London School of Economics.

Ian Noble is Climate Change specialist in the World Bank.



Note: Much of the material in this article was presented in 'Climate Change, Ethics and the Economics of the Global Deal' by Lord Nicholas Stern, the 2007 Royal Economic Society (RES) Public Lecture delivered at the University of Manchester 29 November and at Logan Hall, Institute of Education in London 30 November. See also his Richard Ely Lecture at the American Economic Association Meetings, 4 January 2008.

A "GREEN" SUCCESS STORY IN BANGLADESH



Shidhulai Swanirvar Sangstha won first prize in the 2007 Ashden Awards for Education and Welfare. It was founded in 1998 to help poor, marginalized communities living in the remote Chalanbeel region of Bangladesh to develop sustainable livelihoods. Shidhulai has achieved this by building up a fleet of flat-bottomed boats, all made with locally available materials, that make their way through the shallow rivers and canals of the Chalanbeel to bring a range of educational services and renewable energy supplies to water-side families.

These boats use solar PV modules to generate all the electricity they need to provide daily classes in primary education for children, libraries, training in sustainable agriculture, health advice, mobile phone and internet access, and battery-charging facilities. Shidhulai has also provided villagers with 13,500 solar-home-systems, 2,500 lanterns and 15,000 bicycle pumps that deliver between 60 and 100 litres of water per minute—enough to irrigate half a hectare of land during the dry season.

By putting into practice the agricultural techniques they have learned on the boats and using the renewable energy devices, farmers have been able to significantly increase their income and reduce the use of synthetic pesticides, with about one third of farmers eliminating their use altogether.

Low Carbon, High Hopes

Making climate action work for development

BY MOHAMMED VALLI MOOSA

CLIMATE ACTION IS COMPLEX, multi-faceted and, to a large extent, still evolving. It is complex, and yet we run the risk of simple "reductionism," measuring the earth's carbon-cycling capacity as a commodity that can be bought or sold on the global market. It is multi-faceted, and yet we constantly champion one or two elements of climate change to the detriment of other equally important aspects and impacts.

The good news is that climate action is still evolving, which means that we still have a window of opportunity to build consensus around an international carbon policy framework that provides for fair and equitable outcomes for all people and nations while providing a solid and credible basis for mitigation and adaptation action. The Bali Roadmap, which was agreed to at the Bali Climate Change Conference in December 2007, is a start to this process.



A woman demonstrates solar utility stoves, "Cookit," as a pollution-free alternative to combustible fuel stoves in Kajiado in Kenya's Rift Valley province.

In this article, I confine my contribution to discussing what I see as the unanswered questions around the tensions in political leadership and policy goals of global climate action and in the pursuit of a low carbon future.

Tensions in political leadership

THE TENSIONS IN POLITICAL LEADERSHIP on climate change emerge from a considerable diversity of views and needs that reflect the very different carbon agendas of the rich, the emerging and the poor nations of the world. Tensions exist between national growth aspirations on the one hand and individual rights on the other. Tensions are emerging from incentives for more technological innovation and investment and a growing civic responsibility to actually change lifestyle and consumption patterns.

If we view the atmospheric concentration of greenhouse gases as an "open access resource," then it follows that efforts to manage—or more accurately, stabilize—this public good at an acceptable level will produce suboptimal outcomes in the absence of a fair and equitable regulatory mechanism that penalizes the wayward and rewards the virtuous.

The problem, which we in the conservation movement know all too well from the management of other common resources, is that it is the powerful and rich who tend to benefit during periods of resource mismanagement and who are least affected by subsequent regulation, while the poor and disenfranchised too often lose out on both counts.

Neither the Kyoto Protocol nor the negotiations under the United Nations Framework Convention on Climate Change have resolved this problem. The question remains: how do we differentiate between roles and responsibilities of the historic big emitters, the recent big emitters and the truly poorer countries?

It is still the latter who may miss out and risk becoming a pawn in the "jump first—jump together" bargaining scenario. Thus, when considering low carbon growth, it is critical to develop different approaches that take into account the particular characteristics of these groups of countries. More specifically, low carbon growth is quite a different matter when it comes to countries like China, Brazil and India than when addressing the issue in most of sub-Saharan Africa and parts of Latin America and Central and South East Asia. Many of these countries have major energy deficits for the most basic needs—to lump their roles and responsibilities in with those of emerging economies is not only unjust, but a non-starter.

Market mechanisms

THE SECOND SET OF TENSIONS arise from the global repercussions of decisions taken by the wealthy and powerful, and by those who can afford to speculate on the price of carbon. While this may be stating the obvious, the fact is that the financing, investment, trade, technology and policy issues around climate action are increasingly complex today in their interdependency and global dimensions. With big emitters able to export part of their obligation to reduce emissions to developing countries, one is inclined to contemplate whether

the purported "sustainable development" benefits have been thoroughly analyzed and assessed or have simply been tacked on as an afterthought.

Market-based decisions in London, Tokyo or New York can have, and have had, tremendous negative and alien impacts on peoples' livelihoods and nations' development trajectories. For example, the rich world's demand for oil and gas has blithely ignored, and in some cases reinforced, poor governance and human rights abuses in resource-rich but economically poor countries.

We in the conservation movement have learned bitter lessons of how a "fences and fines" approach to securing another global public good—biodiversity—can inadvertently alienate poor people from their traditional lands and thus derail their future development prospects.

We must be mindful of history. We need to be very clear where "low carbon growth" and other associated climate actions are coming from, namely the developed world's historic emissions and its inability to deal with the resulting climate change. Low carbon growth must be part of a comprehensive framework that includes greater commitments by developed countries to reduce their emissions and increase financial support to address the costs of adapting to the impacts of climate change.

That said, while market mechanisms will never, on their own, be the sole solution, we ought not to shy away from the potential they hold. Market mechanisms present a real opportunity to transfer wealth to those who are already performing useful ecosystem management functions from those who benefit from it, but currently do not pay for it.

Markets can create additional incentives for poor people to manage the environment, maintain its productive capacity and keep ecosystems intact. For example, experience from Brazil's Ecológica Institute over the last 10 years has shown that market-friendly, socio-environmental and poverty reduction interventions can be designed and implemented by local communities that contribute both to emission reductions and sustainable development.

Technology transfer

A THIRD SET OF TENSIONS revolve around how open wealthier countries will be to share and codevelop cutting edge technologies with poorer nations. Much of the industrialized countries' prosperity is due to their ability to invent and incorporate technologies effectively into existing production and distribution cycles.

Technology and its transfer are, however, not just a matter of "know-how," but also of politics. Today's innovation drives tomorrow's competitiveness and the natural instinct in a globalized world is to safeguard, not to share, technological advances.

Meanwhile, in poor countries—those very countries that the rich world wishes would pursue "low carbon growth"—investments are currently being made in energy-generating technologies that are out of date when built and are destined to become an economic and environmental millstone for those



ing local knowledge of the rural poor's priorities and of how they deal with catastrophic events, and by assessing what this means in terms of future climate scenarios, the initiative aims to provide both local and national decision makers with clear options for policy and program interventions aimed at reducing the vulnerability of communities to climate change.

Rapid climate change has been seen for too long as simply an environmental issue and, hence, not of central concern to governments and societies. With the recognition that climate change is fundamental to the welfare, indeed to the survival, of the global economy, a comprehensive, fair and equitable framework for action that balances these two dimensions, namely climate change and sustainable development, is urgently needed. Nature and the people that depend on it deserve no less. 

Mohammed Valli Moosa is President, The World Conservation Union (IUCN).

nations throughout their operational life. This not only predicated against our ambitions of low carbon growth but also misdirects scarce resources in our battle to reduce poverty and support economic growth.

Managing the unavoidable

MOST OF THIS ARTICLE has explored the global tensions around "avoiding the unmanageable"—in other words, the framework for reducing emissions and promoting low carbon growth to avoid runaway climate change. However, there is one final set of tensions on the other side of the equation that need to be touched upon—and that is how do we globally, and poor countries in particular, manage the unavoidable?

In other words, when thinking of investing in low carbon growth, we cannot afford to ignore the likely impact of more frequent catastrophic natural disasters on poor countries' economies. As changing climate conditions threaten food and water supplies, developing countries will be forced to divert their already limited investment capital away from productive efforts towards disaster management. Too little consideration given to the economics of climate action goes towards appreciating how the costs of climate inaction by the developed world are transferred to the developing world.

IUCN is making its own modest contribution to address this shortfall, particularly in East and Southern Africa. Together with the International Institute for Sustainable Development and the Stockholm Environment Institute, we have developed and deployed a climate risk assessment tool for rural communities, called CRiSTAL (Community-based Risk Screening Tool—Adaptation and Livelihoods). By collat-

Business and Poverty Alleviation

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Low Carbon Growth

Our ethical responsibility

BY JAMES L. SWEENEY

WE, AS HUMANS, must face the implications of growing pressures on our natural resource base. Income per person is growing sharply in the most populous nations, particularly China, and India may not be far behind. More income implies more consumption; more consumption implies more production; and more production leads to increased use of natural resources.

The supply of some natural-resource-intensive products has increased sustainably, especially through technological advances such as the use of fertilizers and irrigation for agricultural crops. However, for others, the increase in supply needed to meet

increased use is not sustainable, such as with deep sea fish, because we exploit the resource faster than it is being renewed.

Other resources, such as oil and gas, are depletable and finite. Technological advances have allowed us to tap progressively lower qualities of such resources and to find resources that were previously undetectable. Advances have also allowed us to use the resources we extract more efficiently. However, since technological advances do not actually increase the resource base, these supply increases are unsustainable over the long term.

Fortunately, most of the key natural resources are governed by market forces, so rising prices can be expected to keep supply and demand roughly in balance. Consumers may not like



A green Santa Claus distributes 2008 free Greenlite energy efficient light bulbs in December 2007, in New York's Times Square.

the rising prices, but markets can effectively allocate these scarce resources to maintain balance. However, if no market exists for a specific resource, market forces cannot work effectively to create supply and demand balances. For these resources, systematic overuse will occur unless appropriate interventions are implemented. Most of these resources are what are called the global commons.

The combination of two issues—a) technological advances that have allowed us to use a resource more rapidly, but have not increased the natural system's ability to renew the resource stocks and b) lack of normal markets to balance supply and demand—can lead to intractable problems when the appropriate interventions are absent. If we add a third issue—a global resource stock—then the problems become even more intractable.

Growing pressures on the atmosphere

PERHAPS THE MOST IMPORTANT natural resource that suffers from this trio of issues is the capacity of the upper atmosphere to absorb greenhouse gases without destroying ecosystem services essential for human health and welfare. Technology has allowed us to “harvest” this resource very rapidly, through our greenhouse gas emissions into the atmosphere. But technology has not altered the rate at which these gases are cleaned out of the atmosphere. Thus, use of this atmospheric resource is also unsustainable, and because no one has property rights on the upper atmosphere, no natural market exists to efficiently allocate this scarce resource. Finally, use of this scarce natural resource is a global problem, with all nations drawing upon this global resource. The increasing concentration of greenhouse gases has already adversely impacted many ecosystems and endangers human health and welfare. The problem is both long-term and severe. Fortunately, public attention and understanding of the problem have increased and we now realize that urgent action within a global framework and agreement is needed.

Energy production, use and transportation account for 85 percent of greenhouse gas releases measured on a carbon equivalent basis, and 98 percent of the US carbon dioxide net releases. While figures vary by country, these three are the most fundamental underlying sources of greenhouse gases. Thus, changes to these sectors are essential for reducing greenhouse gas emissions.

Much attention has been paid to the creation of “clean energy,” energy that can be produced with minimal carbon dioxide releases. Wind, solar, hydro, nuclear and biomass are all potential clean energy sources. But the cleanest energy is that which is not used in the first place. There is now a growing realization that efficient energy use must be a fundamental component of any solution to the problem of global climate change. Hence, an important goal is to use less energy per capita while continuing to strive for economically, socially and environmentally sustainable and equitable growth.

Some options for reducing greenhouse gas emissions, focusing on low carbon growth, are explored in this article. However, without the appropriate international agreements, implementation will be inadequate.

Major options for reducing greenhouse gas emissions

A NUMBER OF LOW CARBON growth options exist for reducing our net greenhouse gas emissions, particularly carbon dioxide, which could be implemented over different time horizons. These include: 1) improved efficiency in energy use, especially over the short to medium term, through technological and behavioral changes; 2) producing energy which minimizes carbon dioxide emitted, especially for new power plants, and realistically over the medium to long term; and 3) reducing carbon dioxide produced in non-energy sectors, such as agriculture and forestry, and industries, such as cement production. In addition to these, technologies are being developed to capture and permanently store greenhouse gases, especially carbon dioxide.

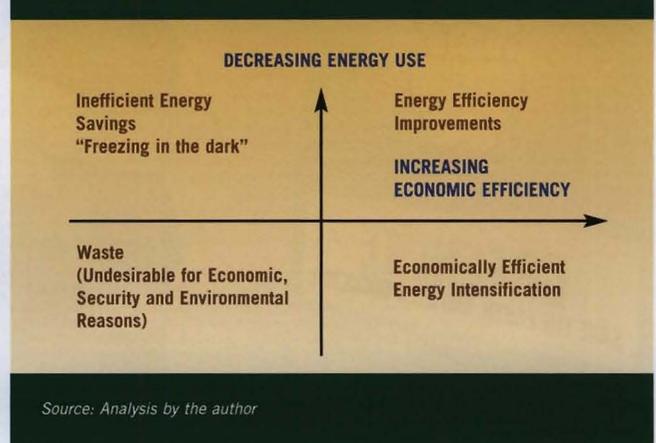
Improved energy efficiency

THE DESIRE TO REDUCE greenhouse gas emissions and fossil fuel economics—prices and price volatility—provide incentives for developed countries to reduce energy intensity, the amount of energy used to produce a unit of GDP or to perform some desirable service. In the US, a 10 percent reduction in overall energy intensity would lead to a reduction in fossil fuel use by 8.6 quadrillion Btu. This would have the same impact on carbon dioxide emissions as would doubling the entire US nuclear power output or by increasing, 25-fold, wind and solar-based energy production, with these increased energy outputs replacing equivalent amounts of fossil fuels.

However, reducing energy intensity is a very different concept than increasing energy efficiency. “Energy efficiency” means economically efficient reductions in energy intensity. We can explore this relationship by representing energy use on one axis and economic efficiency on another (Figure 1).

In a perfect market, economic efficiency increases—the right side of the diagram—would not be possible, since perfect markets would be economically efficient. Any increases or decreases in energy intensity would decrease economic effi-

FIGURE 1: CONCEPTUAL RELATIONSHIP BETWEEN ENERGY USE AND ECONOMIC EFFICIENCY



ciency. However, markets are imperfect and energy markets riddled with failures. Thus opportunities exist for increases in economic efficiency along with opportunities for decreases in energy intensity.

Many possibilities exist for energy efficiency improvements and economically efficient energy intensification through a mixture of technological, regulatory and behavioral/institutional changes. Thus, market mechanisms, regulatory frameworks and information availability could play critical roles. Figure 2 shows some of these possible changes. Some would increase energy efficiency, some would economically efficiently increase energy intensity, and some would reduce economic efficiency. For policy purposes, it is essential to determine which is which.

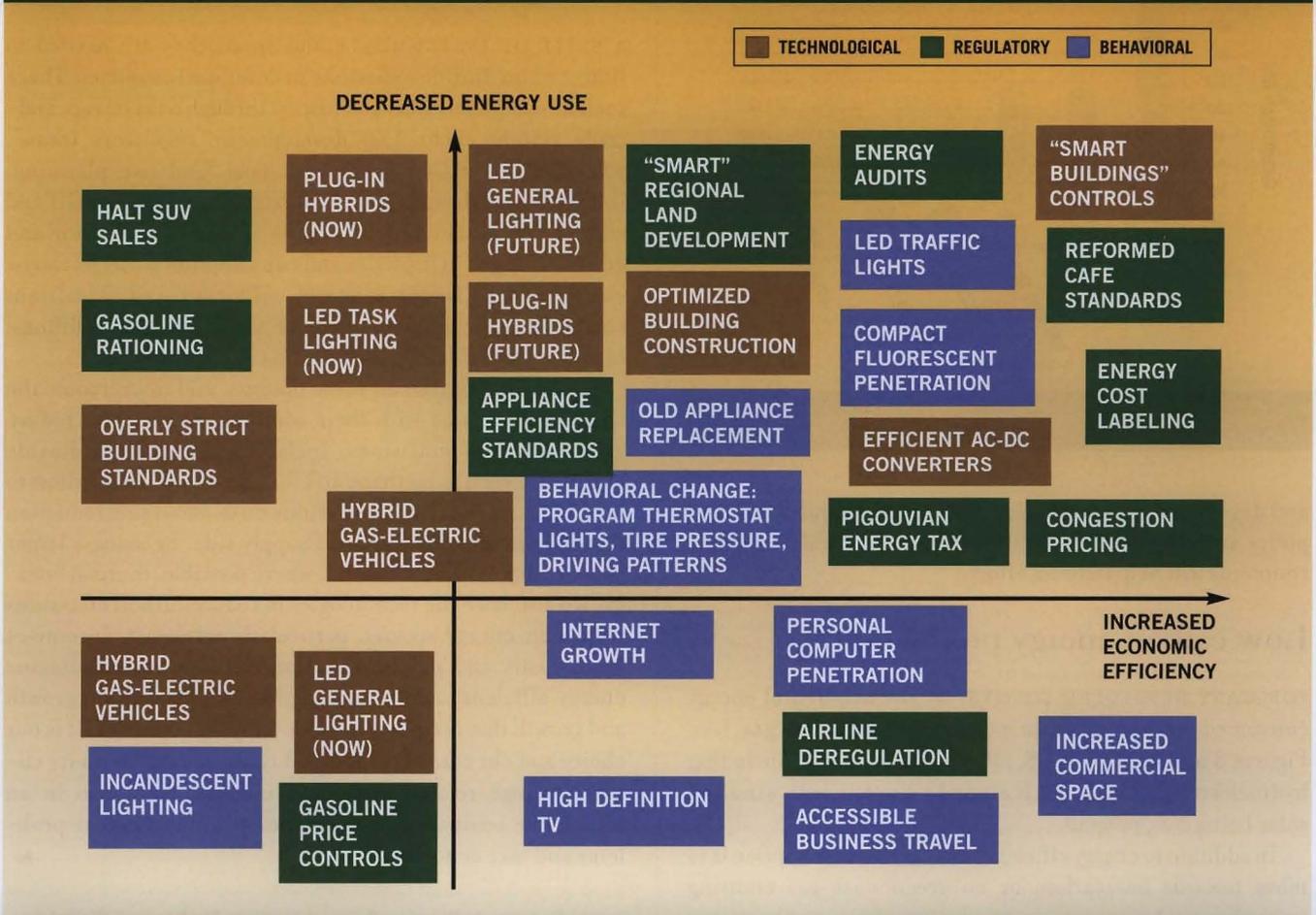
Regulatory mechanisms include halting sales of sport utility vehicles (SUVs), deregulating airlines, congestion charges and increased energy taxes. The first would be economically inefficient, the second is economically efficient, but has probably increased energy intensity, and the last two would economically efficiently decrease energy intensity.

Many technological changes, such as LED lighting, optimized building design and construction, improved gasoline mileage, and efficient AC-DC converters, would improve energy efficiency.

Provision of information and incentives to encourage changes in consumer behavior, such as using compact fluorescent lights and replacing old energy inefficient appliances, are possible and options are being pursued in many developed and developing countries. Regional or local land planning can be a short- to long-term option and can help with energy efficiency in multiple sectors.

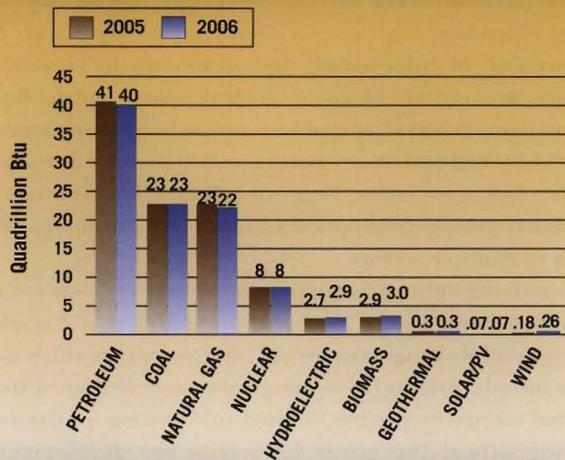
Identifying options for improving energy efficiency does not imply changes come easily. Various barriers and market failures inhibit changes that would increase energy efficiency. These include: pricing below marginal cost; non-time-differentiated electricity pricing; limited information availability; and suboptimal incentives for technology development. Efforts to recognize and overcome these barriers could lead to quicker adoption of energy efficiency measures. Accelerating market development, increasing funding of energy research

FIGURE 2: TECHNOLOGICAL, REGULATORY AND BEHAVIORAL OPTIONS THAT ARE AVAILABLE NOW OR IN THE NEAR FUTURE



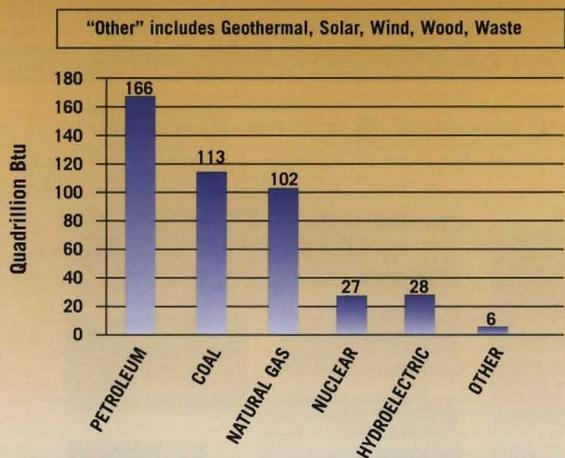
Source: Analysis by the author

FIGURE 3: U.S. ENERGY CONSUMPTION IN 2005 AND 2006



Source: Energy Information Administration, US Department of Energy

FIGURE 4: WORLD ENERGY CONSUMPTION IN 2005



Source: Energy Information Administration, US Department of Energy

and development, risk-sharing to encourage innovation, and policy analysis to improve the enabling and regulatory environments will help in these efforts.

Low carbon energy production

FOR MANY DEVELOPED COUNTRIES, the majority of energy consumed originates from petroleum, coal and gas (see Figures 3 and 4). In the US, all renewable energy, including hydroelectric and biomass, is around 7 percent, with wind and solar being 0.35 percent.

In addition to energy efficiency changes, another option is to move towards low carbon or no-greenhouse-gas-emitting technologies. An increasing proportion of renewable energy along with improved energy efficient and electricity production technologies are options currently available. However, some of

these electricity production technologies are characterized by significant economies of scale, so that household or community level solutions are not currently viable in all countries.

The World Bank, in its clean energy investment framework paper in 2004, recognized that meeting energy needs of developing countries is both an urgent need and a challenge. It will require national policies that provide incentives for energy efficiency and incentives for mobilizing public and private investment, nationally, regionally and globally. As many developing countries accelerate their development and thus increase their energy demand, access to affordable, reliable, clean and modern energy services will help decrease poverty, provide other cobenefits—such as decreased exposure to air pollution—and provide many benefits due to energy access that developed countries take for granted, such as lighting, cooking, space heating and cooling, and improved communications. In helping developing countries—especially through technology transfer and investment opportunities—to “leapfrog” to clean and modern energy production, distribution and use solutions will not only help their populations and development goals, but will also help the global atmosphere.

Ethical responsibility for ensuring a healthy future for our grandchildren

A SUITE OF INSTRUMENTS and approaches are needed to limit carbon dioxide emissions in developed countries. These include establishing carbon prices, through a tax or cap-and-trade system, technology development, regulatory frameworks, utility-based programs, local land-use planning, infrastructure design, and corporate, government, NGO and civil society leadership, as well as changes in behavior and ethics. Changes in lifestyles and consumption patterns can be encouraged to increase energy efficiency and significant changes can be implemented for transport and buildings, especially space heating and cooling and lighting.

We need to pursue all these options, and to overcome the barriers associated with their adoption, in order to reduce greenhouse gas emissions, including non-carbon dioxide emissions, such as methane and fluorocarbons. In the short to medium term, we must concentrate on demand side reduction through energy efficiency and supply side, by using a larger proportion of solar, wind and, where possible, thermal energy. We also have the technologies to reduce carbon emissions from non-energy sectors, particularly transport. Incentives for industry and public education can help in encouraging energy efficiency and in moving towards low carbon growth and growth that is equitable for developing countries. It is our choice and our ethical responsibility: we can let the future climate change related crises put our grandchildren in an impossible position or we can anticipate the growing problems and take action now.

James Sweeney is Director, Precourt Institute for Energy Efficiency and Professor in the Department of Management Science and Engineering, Stanford University.

China's Move Toward a Low Carbon Economy

BY LU XUEDU, ZHUAN GUIYANG
AND PAN JIAHUA

GLOBAL CLIMATE CHANGE has increasingly been causing widespread international concern. In May 2007, the Intergovernmental Panel on Climate Change (IPCC) concluded that future greenhouse gas (GHG) emissions depend on development patterns, and that it is economically feasible to stabilize GHG concentrations at a lower level of the 445-710 CO₂ equivalent range. Climate change mitigation involves costs and policy options, and if the social costs are considered, mitigation costs can be substantially reduced from an economic perspective. The key is to develop appropriate emission reduction policies and measures. Moreover, climate

change mitigation can ensure sustainable socioeconomic development.

China is currently at the stage of capital-intensive industrialization and rapid urbanization. As a result of globalization and the international division of labor, China is now a "world factory" where a significant proportion of energy embodied in products is exported for consumption outside its physical borders. Over the past few years, in the power sector alone, the average annual new power generating capacity reached 50 Gigawatts. The IPCC Fourth Assessment Report, released in 2007, indicates that by 2030 the global energy infrastructure investment will exceed US\$20 trillion. According to the International Energy Agency (IEA), China's energy sector needs an investment of US\$2.3 trillion dollars from 2001-2030, of which 80



Polluting steel factories are being ripped down in China in a bid to step up the war against climate change. Damaging to the environment and more eyesore than landmark, hundreds of these old-fashioned companies face explosive action.



Local residents ride motorbikes on the streets in Chengdu in southwest China's Sichuan province on World Car Free Day, September 2007. More than 100 Chinese cities took part in the country's first official Car Free Day, barring automobiles from selected areas and ordering officials to take public transport due to growing concerns about congestion, pollution and climate change.

percent should be used for electricity. Energy infrastructure investment has greater implications for long-term GHG emissions. In 2005, China's coal consumption per unit of power supply was about 353g per kWh, while the most advanced at the international level was only 287g per kWh. This means that there is a potential of 23 percent for energy saving in China in the thermal power sector. In the accelerating phase of industrialization, if such a large-scale energy infrastructure in China is only a simple duplication of conventional technology, there would be a locked-in effect for technology and capital during its lifetime, and a high level of carbon dioxide emissions would be inevitable. Therefore, China's future development path has important implications for global energy use and climate protection. Evidently, these constitute a strong case for China to explore low carbon economic development.

Low carbon and developing countries

IN A STUDY ON DEVELOPMENT need and GHG emissions undertaken in the year 2002-2003 by researchers at the Chinese Academy of Social Sciences, the concept of low carbon development was employed and an analysis made (Pan 2004). The intention was to break the deadlock of international climate negotiations and build a bridge of mutual understanding between developed and developing countries. The developing countries would pursue a path of low carbon development instead of accepting an emissions cap or emis-

sion reduction target. This path would require a rapid transition to a low carbon economy.

In the long term, the process by which a country moves toward a low carbon economy requires that GHG emissions be gradually decoupled from economic growth. Global GHG emissions have shown an upward trend and developing countries are the main contributors (IPCC 2000). The IPCC also shows a convergence trend of carbon emissions per capita between the developed and developing countries over time. Carbon emissions in developing countries will inevitably increase in order to meet the needs of human development, while the trend in developed countries is projected to stabilize or even decline due to demographic changes, behavioral adjustments and technological improvements.

Challenges for China's transition to a low carbon economy

CLIMATE CHANGE IS NOT JUST an environmental concern but also a development problem, and, in the end, a development issue. For developing countries, mitigation of GHG emissions through sound policies and measures may also contribute to development goals, and can be a win-win solution to address climate change, incorporate low carbon economy paths and promote development. Transfer of technology can be more effective than unrealistic legal obligations to reduce GHG emissions by developing countries.



China's sustained high growth rate and its pursuit of building a moderately well-off society have been the primary drivers for the large increase in energy demand and GHG emissions. China needs larger GHG emission space, and at the same time, China has an obligation to protect the global climate. To achieve these dual goals, China, as a responsible developing country, has taken a series of policies and measures in response to climate change, and achieved impressive success. In fact, China has clearly stated that it will adopt a low carbon economy approach in its *National Assessment Report on Climate Change* issued at the end of 2006.

The essence of a low carbon economy is energy efficiency and a clean energy structure. The key to achieving these goals is innovation in both energy technology and institutions. China is now developing its low carbon economy and including the implementation of initiatives such as a scientific approach to development, building a resource-saving and environmentally-friendly society, and changing the mode of economic growth.

China and other developing countries are facing many technological, market and institutional barriers when implementing sustainable development measures in pursuit of a low carbon economy. Many choices of low carbon technologies in all sectors are available in the market but economic barriers prevent their wide application (IPCC 2007). The potential of many new technologies, such as renewable energy, energy efficiency technologies in industrial sectors, electricity production technologies and hydrogen energy can be substantially expanded in the future (IPCC 2007). Indeed, if such advanced technologies can be widely applied in developing countries, through appropriate international agreements, a low carbon economy would be achievable in developing countries much sooner.

The main driving forces of China's CO₂ emissions growth include large population size, a coal-based energy mix, rapid industrialization and urbanization, and international trade. Energy consumption per unit of product continues to drop, but the increase in the number of consumer products leads to an increase in total energy consumption. China has made a significant contribution to climate change mitigation through economic and energy structural adjustment, energy efficiency

improvements, population control, afforestation and other measures. All these have been fully reflected in *China's National Climate Change Program* (CNCCP) released in June 2007, which also sets a 20 percent energy intensity reduction target by 2010 compared to 2005 levels. This is an important step toward low carbon development. China further issued an *Integrated Action Plan on Energy-saving and Emission Reductions in 2007* to ensure the achievement of the goals as set out in the Program, demonstrating China's determination and courage to deal with the challenges.

Moving to a low carbon economy

CHINA IS SHIFTING TOWARD a low carbon economy, not only through mitigating GHG emissions, but also by means of rising domestic exploitation of the nation's natural resources. By employing a low carbon economy, especially cleaner use of fossil energy, China will be able to change its current energy-intensive, high-emitting and low-output model of economic growth, and ease the conflicts between economic development, natural resource management and social costs.

The degree to which China and other developing countries can realize low carbon development and take advantage of being a latecomer in industrialization depends on capital and technological capability. Constrained by their own economic strength, developing countries lag behind when it comes to science and technology, as their capabilities of technological research and development are rather limited. The UN Framework Convention on Climate Change (UNFCCC) stipulates that developed countries have obligations to transfer technology to developing countries, but actual progress is far below the expected rate. Therefore, it is necessary to build instruments and mechanisms in the future international climate regime to solve the issue of technology transfer. China will work together with international partners within and outside the UNFCCC framework in a proactive way to promote technology transfer to China so as to accelerate the pace towards a low carbon economy.

Dr. Lu Xuedu, Chinese Ministry of Science & Technology.

Dr. Zhuan Guiyang and Dr. Pan Jiahua, Chinese Academy of Social Sciences.

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Adaptation Activities In India

BY RAJASREE RAY

INDIA IS NO STRANGER TO CLIMATE and weather induced vulnerability. Given her extreme climate sub-zones and volatile weather, these objectives have been embedded into the policy matrix for decades. Drought, flood and income proofing have been part of the objectives of many infrastructure projects and social programs through the successive five year plans. The *Indira Gandhi Canal* that carries water to the heart of the Rajasthan desert, the recent initiative to revitalize the 100,000 plus natural water bodies, and the proposal to link the major rivers in the country through major engineering, are just a few examples. However, climate change induced

adaptation, as it is now understood, was not the underlying perception behind many of these activities. In any case, anthropogenic climate change concerns are more recent, relative to development planning which commenced more than 50 years ago.

Smith et. al (2000) define adaptation as adjustments, whether passive, reactive or anticipatory, that are proposed as a means for ameliorating the anticipated adverse consequences associated with climate change. These adjustments can happen in the ecological, social or economic systems (IPCC 2001). To be effective, adaptation measures should ideally address both short-term and long-term concerns. Short-term adaptation measures generally relate to immediate relief



Domestic and municipal waste producing biogas for cooking and electricity generation.

and rehabilitation programs in the aftermath of a calamity or natural disaster management. Short-term measures may also involve proactive measures like evacuation/relocation of the population facing adverse climate conditions. Long-term adaptation strategies, on the other hand, should aim to empower the vulnerable sections of the people—those living in the drought prone, flood prone, low lying and coastal areas—to help them develop robust coping mechanisms against possible effects of climate change.

India, with its fragile ecosystems, diverse terrain, rich biodiversity and long coastline, is also vulnerable to climatic variations. Studies have projected that India is likely to suffer from long-term adverse impacts of climate change, such as (a) rise in the mean winter temperature (b) decline in the summer rainfall leading to unfavorable consequences for agriculture, drinking water supply and hydropower generation (c) melting of glacial ice that can drastically reduce water flows in the rivers of the northern plains (d) reduction in the duration of crop cycles, and shortening of the grain fill period that could substantially reduce agricultural productivity and output (e) sea level rise that could inundate low lying areas, coastal marshes and wetlands, and erode beaches (f) increased flooding, erosion and salt intrusion in the deltas that could result in loss of coastal mangroves and fisheries (g) migration from the coastal areas and (h) increase in vector borne diseases due to the rise in temperature and humidity levels.

India's huge mass of poor people, residing predominantly in areas with little means to weather possible climate change impacts, exacerbates India's vulnerabilities and puts additional stress on its socioeconomic system, which is already facing pressure due to rapid urbanization and industrialization. For this reason, adaptation is critical for a country like India, which has no choice but to develop effective strategies for adapting to probable climate change impacts.

India's adaptation activities

INDIA HAS YET TO DRAW UP PROGRAMS aimed exclusively at addressing critical vulnerabilities to climate change. In other words, India does not implement any adaptation schemes, *per se*, but has made substantial efforts to integrate adaptation into development schemes. Currently, several social sector development schemes that emphasize livelihood security, well-being of the weaker sections of society, and rural infrastructure are under implementation. In many ways, these programs reflect the short-term and long-term goals of adap-



Girl working a treadle pump in Mirzapur village, Bahraich, Uttar Pradesh. The treadle pump is a simple device, which uses human power to lift water from shallow aquifers or surface water, such as lakes or streams, up onto the fields, and is light enough for children to work with comfort and safety.

tation. The major activities promoted by the Government that could substantially assist communities to cope with climatic variability principally relate to (a) rural employment and poverty alleviation schemes (b) watershed development and rain-fed farming systems (c) developing drought proofing measures (d) promoting crop diversification and research (e) promoting farmer credit and insurance and (f) rural health and education.

Some of the major schemes/policies significantly addressing adaptation objectives are as follows:

- **Swarnajayanti Gram Swarozgar Yojana (rural self-employment program)**—This is a major program covering all aspects of self-employment like organizing the rural poor into self-help groups, as well as capacity building, planning of activity clusters, infrastructure development, financial assistance through bank credits and subsidies, and marketing support.
- **Sampoorna Gramin Rozgar Yojana (comprehensive rural employment scheme)**—This program was launched in 2001 with the objective of providing additional non-agriculture based wage employment in rural areas and food security and creating durable community assets. The scheme also includes special safeguards for the weaker sections of society and women.
- **Pradhan Mantri Gram Sadak Yojana (Prime Minister's rural roads program)**—This program was launched in December 2000, with the objective of providing connectivity to all unconnected habitations in rural areas with a



A man walking on the dried up lake-bed in Hyderabad, India

population of more than 500 people through good, all-weather roads.

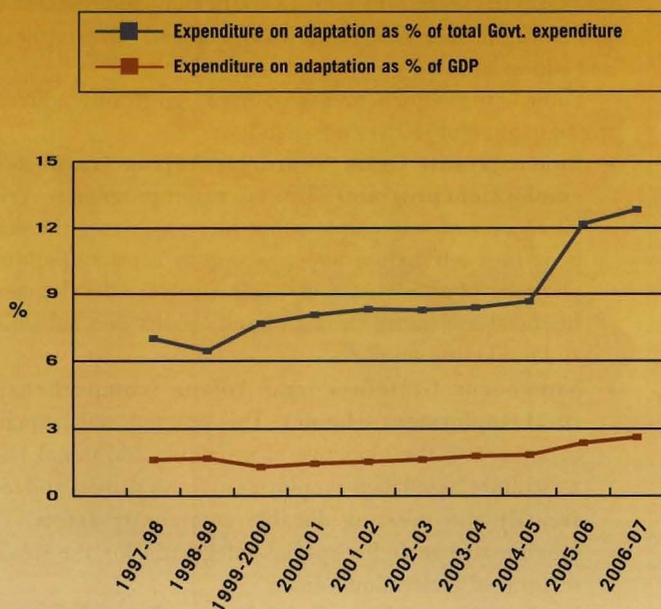
- **National Rural Health Mission**—The National Rural Health Mission (2005-12) seeks to provide effective healthcare to the rural population throughout the country with special focus on 18 states, which have weak public health indicators and/or weak infrastructure.
- **Accelerated Rural Water Supply Programme**—This is a scheme for providing drinking water for all rural habitations in the country. Rural drinking water is one of the components of Bharat Nirman, which was conceived to build rural infrastructure over four years from 2005-2006 to 2008-2009. The issues of sustainability and quality are being addressed through efforts to promote sustainability and monitor the water quality.
- **Desert Development Programme**—This program aims to control desertification and to conserve, develop and harness land, water and other natural resources for restoration of ecological balance in the long run and also to raise the level of production, income and employment through irrigation, afforestation and dryland farming.
- **Major and Medium Irrigation**—This project is aimed at: development of a water resources information system; hydrology projects; investigation of water resources development schemes; research and development for the water sector; information, education and communication; river basin organizations/authorities; infrastructure development; and dam safety studies and planning.
- **Sustainability of Dryland/Rainfed Farming System**—This system aims to develop dryland farming to increase production and productivity of rainfed areas in the country.

Under the scheme, rainwater harvesting, water conservation, efficient use of water, and especially life saving irrigation are emphasized.

- **Disaster Management**—The National Disaster Management policy aims to bring disaster mitigation into the development process. Within this policy, the Disaster Management Act, 2005, was enacted, which provides for the establishment of a National Disaster Management Authority and a National Disaster Response Force for coordinating emergency responses to natural calamities.

In order to get a measure of the adaptation related activities during the last ten years, the Indian Ministry of Environment and Forests of the Indian government has carried out an exercise to compile the yearly expenditure on sectoral schemes identified on the basis of their adaptation relevance (see Figure 1). The adaptation relevance of the schemes, in turn, are determined by a baseline categorization of critical adaptation objectives/components, namely (a) crop improvement and research (b) poverty alleviation and livelihood preser-

FIGURE 1: TOTAL EXPENDITURE ON ADAPTATION SCHEMES



Source: Ministry of Environment & Forests, Government of India

vation (c) drought proofing and flood control (d) risk financing (e) forest conservation (f) health and (g) rural education and infrastructure.

India spent 2.6 percent of its GDP, or 12.8 percent of the total central government expenditure (including transfers), on adaptation relevant schemes in the year 2006-07. India's expenditure on adaptation related programs as a percentage of GDP has increased consistently since 1999-2000 (Figure 1). This can be directly attributed to consistently increased outlays for rural development and crop improvement programs, as well as the launching of new social sector schemes, over the past five years.

Social sector schemes in India are primarily driven by the objective of poverty alleviation and preserving the livelihoods of farmers and other marginalized sections. Many of these schemes have been in operation for nearly 40 years. However, there is scope for including more measures to cover the entire range of impacts of climate variability, and to mainstream adaptation awareness and action in the policy making process. It is essential to screen the relevant policies for reducing risks and enhancing the adaptive capacity of the most vulnerable sections by promoting sustainable development. There is also a clear need to develop strategies ranging from changes in land use and cropping patterns to water conservation, flood warning systems and crop insurance.

However, funding for adaptation initiatives is a major issue, and a consensus is emerging that developed countries should share a fair burden of the adaptation costs that developing countries must bear. Like other developing countries, India has to deal with competing claims on resources; hence, deploying massive fiscal resources purely for adaptation related activities may not be possible in the short term. Already, India spends a reasonable amount on schemes that are directly adaptation oriented. The thrust, henceforth, must be in refocusing/redirecting these programs with new and additional resources so that the adaptation needs of the country are better served. 

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Endnote: The views expressed by the author are personal and do not belong to the organization in which she is working.



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We are currently judging applications for the 2008 Awards and the next round of applications will begin in September 2008.



Old Livelihoods in New Weather

*Arctic indigenous reindeer herders face
the challenges of climate change*

BY ANDERS OSKAL

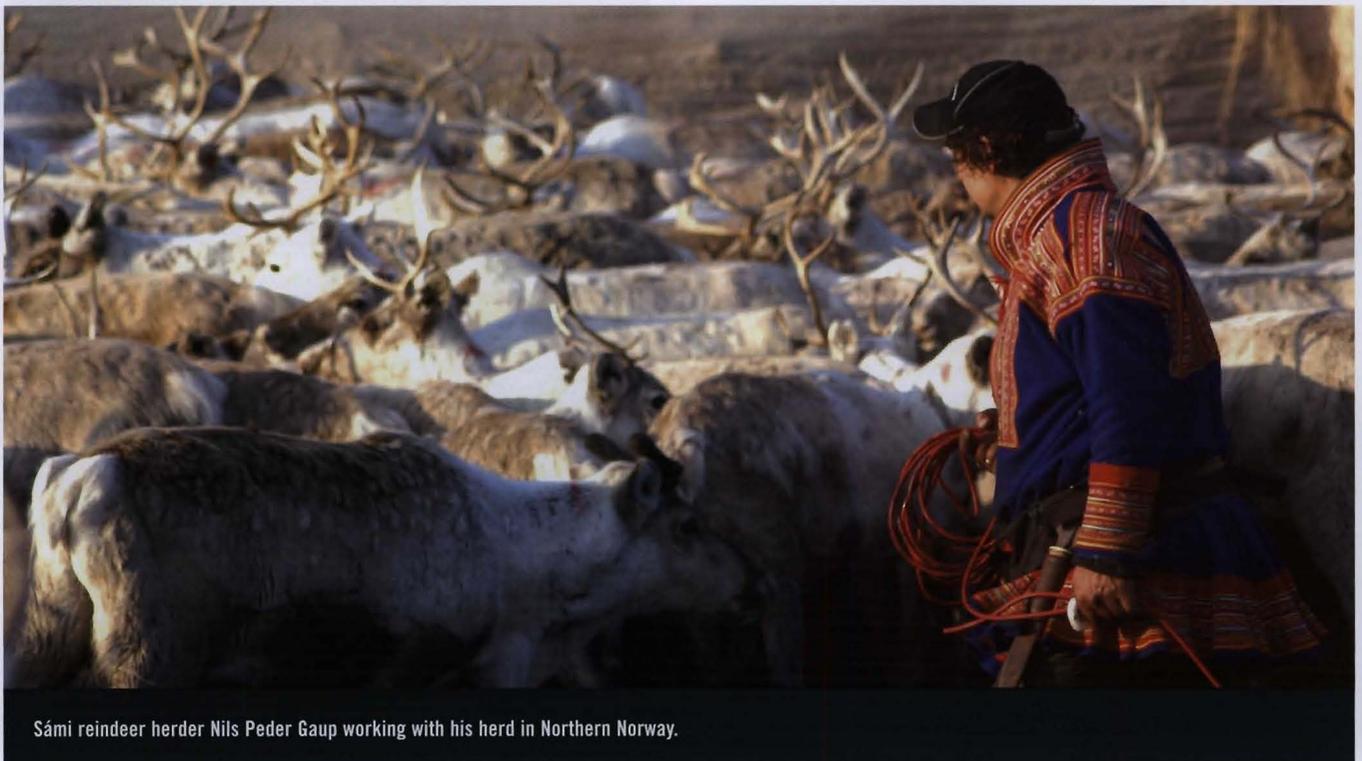
THE ARCTIC IS HOME to many indigenous peoples, including those who depend on reindeer herding for their livelihood in one of the harshest environments in the world. For the largely nomadic indigenous peoples, reindeer not only form a substantial part of the Arctic food base, but they are culturally important, shaping their way of life, mythologies, festivals and ceremonies.

Climate change is occurring faster in the Arctic than in other areas of the world. Independent of international discussions on the causes of climate change, reindeer herders them-

selves have chosen to focus on developing *local adaptation strategies based on their traditional knowledge of land use*. This article addresses the impacts of climate change on reindeer husbandry and local adaptation techniques developed and/or shared through international cooperation, and a multi-stakeholder and interdisciplinary Vulnerability Network Study aimed at supporting circumpolar reindeer herding peoples.

Circumpolar reindeer husbandry

REINDEER HUSBANDRY has a long history in the Arctic, and is practiced by more than 20 different indigenous peoples in



Sámi reindeer herder Nils Peder Gaup working with his herd in Northern Norway.



FIGURE 1: The main part of World reindeer husbandry and reindeer herding peoples of Eurasia.

Norway, Sweden, Finland, Russia, Mongolia, China, Alaska, Canada and Greenland. This livelihood involves some 100,000 herders and around 2.5 million semi-domesticated reindeer, which graze on approximately four million square kilometers of land in Eurasia.

While reindeer husbandry is spread across the Arctic and across many cultures, its organization is remarkably similar everywhere, consisting of a nomadic livelihood with family-based working communities and a typical indigenous way of life.

For hundreds of years, reindeer herders have managed vast barren circumpolar areas of land that hold little value for others. Herding represents a model for sustainable management of these areas that has developed through generations. Today, Arctic reindeer herders face major challenges, such as climate change, loss of grazing land due to development by humans, and effects of global change in their local societies. The Association of World Reindeer Herders, established in 1990, created a unique circumpolar international cooperation that represents 97 percent of the world's reindeer herders, with local representation in all reindeer herding countries, to help meet some of these challenges.

Impacts of climate change on reindeer husbandry

THE ARCTIC CLIMATE IMPACT ASSESSMENT (ACIA), a large climate study initiated by the Arctic Council, concluded that the rate of climate change in the Arctic is faster than in other regions of the world. For example, the study concluded that 10 years of climate change in the Arctic is equivalent to 25 years of climate change elsewhere in the world (ACIA 2004). Reasons for this include reduction of Arctic snow and ice-covers and diminishing reflection of sunlight. Ice covered with snow reflects 85-90 percent of the sunlight, while seawater only reflects about 10 percent, and the earth's surface about 20 percent (ACIA 2004). Therefore, ice melting reduces solar energy reflection and increases Arctic temperatures, which will, in turn, lead to the ice melting even faster. The changes in ice cover and increases in temperature have already impacted reindeer

husbandry and will continue to do so both directly, for example through changes in food availability, and indirectly such as through changes in human land use.

Changes in biodiversity: Some species replacing others have already been documented by reindeer herders (ACIA 2004). One example is the spreading of shrubs into the barren tundra areas. Shrubs can contribute to a hard packing of snow during the tough winter months, thus making access to food a challenge for reindeer. In addition, important food resources for the reindeer, such as lichens and reindeer-preferred species of grasses, may disappear partially, if not fully. Changes in insect populations could also change reindeer behavior during the summer by not allowing them to feed long enough or in summer pastures.

Changes in temperature, precipitation and climate variability: Changes in temperatures have already been observed (See Figure 2 on next page). These changes could cause rivers to freeze later in the autumn and melt earlier in the spring, causing challenges for the annual migration of reindeer between different seasonal pastures. Yet another change already observed is *increasing climate variability*. This is especially challenging during the critical wintertime, where increasing periods of mild weather with rain followed by cold frost periods form ice layers in the snow and block the reindeers' access to food on the ground. As reindeer live only on natural pastures, this often represents a "worst-case scenario" from the reindeer herders' perspective. Increasing precipitation in the form of snow can add to these challenges, while warming would shorten the period of snow cover in any particular year.

Indirect effects of climate change: Due to the sea ice melting and longer summers, there are other changes that can impact reindeer husbandry, especially increased accessibility of the Arctic regions for human activities. Human development and activities represent disturbances with negative effects for the semi-domesticated reindeer herds (UNEP



2001) and irreversible loss of marginal pasture resources—a serious challenge for reindeer husbandry. In the last 50 years, for example, around 25 percent of the reindeer pastures of the Euro-Arctic Barents Region have in effect been lost due to human development (Tyler et. al 2007). Of particular relevance today, the Arctic is estimated to contain approximately 25 percent of the world’s remaining undeveloped petroleum resources. For instance, Yamal in Western Siberia holds about 90 percent of Russia’s gas reserves, while also representing the largest reindeer herding area in the world. Activities to access these resources would contribute to reducing the grazing lands, which can also be viewed as “available room for adaptation” for reindeer husbandry.

Adaptation and use of best available knowledge

THE CHALLENGES reindeer herding communities are facing because of the effects of climate change are of such magnitude that the best available knowledge has to be used to minimize the impacts of these changes. To some extent, this knowledge is scientific, but in many cases, the best knowledge is the experience-based knowledge of the herders themselves.

Reindeer herders and their reindeer live for eight to nine months a year in extreme environments with continuously changing climatic conditions. Temperatures can vary, for example, from 25° C down to -65° C. As both reindeer and

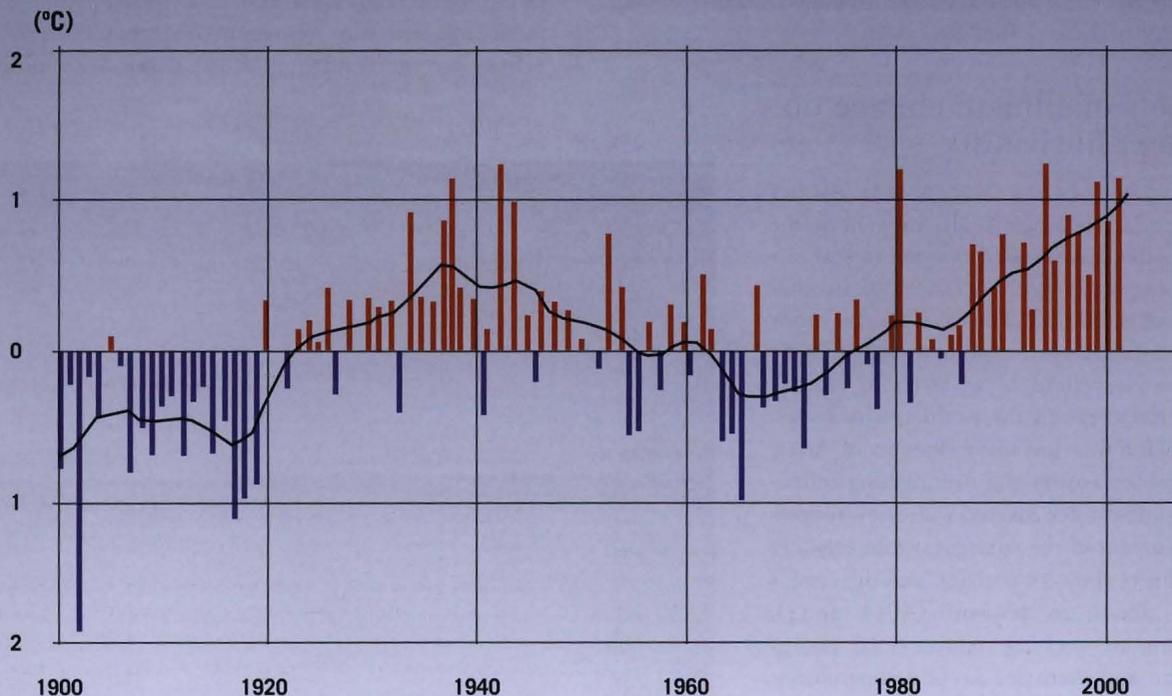
herders have adapted to living in these conditions, reindeer herding cultures themselves represent an adaptation to extreme climate variability. Senior Sámi reindeer herder and Secretary General of the Association of World Reindeer Herders, Johan Mathis Turi put it this way:

“...We have some knowledge about how to live in a changing environment. The term ‘stability’ is a foreign word in our language. Our search for adaptation strategies is therefore not connected to ‘stability’ in any form, but is instead focused on constant adaptation to changing conditions.”

Sámi reindeer herders have over 200 analytical expressions for snow and snow change in their language, and over 400 for reindeer, which represent an integral part of reindeer herders’ traditional knowledge. When referring to “traditional knowledge,” we are not talking about outdated knowledge, but rather critical knowledge used by reindeer herders in their everyday lives. Such traditional knowledge could and should be tested and integrated with scientific knowledge to provide the best possible knowledge foundation for the future. Constraints on use of reindeer herders’ traditional knowledge resulting from national legislation, for example, is an important challenge when discussing adaptation to climate change.

The Arctic has experienced a rapid temperature increase similar to the one which occurred in the 1920s-30s, but with more variation. There are still reindeer herders alive who have knowledge about how reindeer husbandry adapted during that time and that knowledge is relevant for the 21st century.

FIGURE 2: CLIMATE VARIABILITY IN THE ARCTIC, ANNUAL AVERAGE CHANGE IN NEAR SURFACE AIR TEMPERATURE FROM STATIONS ON LAND RELATIVE TO THE AVERAGE FOR 1961-1990 FOR THE REGION FROM 60 TO 90°N.



Source: ACIA, 2004.

Adaptation to climate change does not happen in the corridors of national ministries or international agencies, but rather at the local level where people are actually facing the changes in their everyday lives. Furthermore, adaptation must be discussed with a societal perspective, as it is about the human dimension. Hence, a network study was set up to help prepare the reindeer herders for the changes they are likely to face and the options they have. It was named "Ealát—the Sámi term "Ealát" means "good pasture," and is connected to "Eallu," meaning "herd," both of which come from the word "Eallin," which means "life." In other words: Pastures are the foundation for the reindeer herd, and the reindeer herd is the foundation for the lives of reindeer herding peoples of the Arctic.

The EALÁT-Network Study aims to prepare reindeer herding communities and local authorities for climate change, in order to reduce the impact of climate change on these societies. EALÁT focuses on adaptive capacity of reindeer pastoralism to climate variability and change and, in particular, on the integration of reindeer herders' knowledge in the study and analysis of their ability to adapt to environmental variability and change.

Launched in February 2007 and to be concluded by the end of 2010, EALÁT is an interdisciplinary study that actively involves reindeer herders, and indigenous institutions and organizations. EALÁT (see Figure 3) attempts to understand the wide spectrum of issues related to climate change and adaptation of reindeer husbandry, and address the knowledge challenges of circumpolar reindeer herders in a holistic manner. Local competence and capacity building in indigenous societies are major objectives of EALÁT, through community-based workshops in local reindeer herding societies, education and development of new communication tools (www.reindeerportal.org, www.reindeerblog.org and www.ealat.org). EALÁT is anchored in the University of the Arctic (www.uarctic.org).

EALÁT seeks to integrate scientific and traditional knowledge to better understand and prepare for climate change. For example, air and surface temperatures combined with precipitation data are used to model snow conditions and the formation of compressed snow near the ground. Such conditions occurred from December 2006 and continued through much

of the remaining winter. The compressed snow and ice layers constitute a serious challenge for reindeer in accessing food. Reindeer herders have extensive knowledge about such phenomena, explaining and understanding snow conditions with a completely different set of analytical expressions and concepts founded on experience and of great importance for adaptation.

One adaptation strategy EALÁT is studying is reindeer castration, a technique commonly used in reindeer husbandry as a tool for herd structure management. Castrates generally calm down female reindeer and calves, making herds easier to control. Due to their larger size, castrates are also more able to easily break through ice layers in the snow, facilitating access to food for females and calves. Adjusting herd composition through castration could represent a possible strategy for adaptation to future climate change.

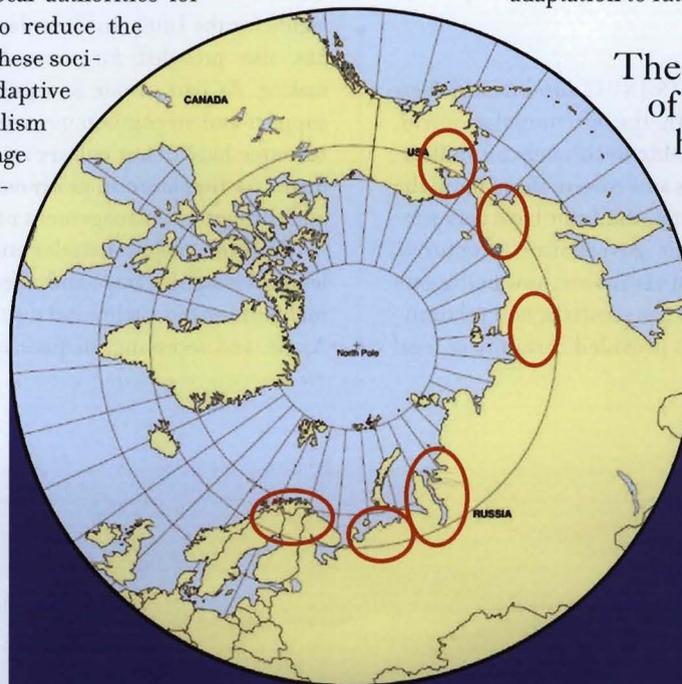


FIGURE 3: FOCUS AREAS OF EALÁT: REINDEER HERDING REGIONS OF FENNOSCANDIA (NORWAY, SWEDEN AND FINLAND), RUSSIA (NENETS, YAMALO-NENETS, SAKHA AND CHUKOTKA) AND THE AMERICAN CONTINENT (ALASKA). THE MAIN RESEARCH AREAS ARE NORWAY AND YAMALO-NENETS.

SOURCE: WWW.EALAT.ORG

The knowledge challenges of circumpolar reindeer herders

IN CONCLUSION, both knowledge and leadership are necessary to increase adaptive capacity to climate change in local communities. Local capacity building—building local knowledge and local organizations—is needed to reduce the risk climate change poses to local herding societies. Using a holistic approach, integrating social and natural sciences and reindeer herders' understanding in the co-production of knowledge, can contribute to local competence building in indigenous peoples' societies and help face the future challenges of climate change.

Anders Oskal is Director of the International Centre for Reindeer Husbandry.

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Climate Change Challenges Faced by the Inuit

BY VIOLET FORD

OUR ANCESTRY AND HERITAGE AS INUIT bind us together, transcending national borders in the circumpolar world, where we have carried out sustainable livelihoods for millennia, and maintained our traditions and culture throughout the countries we inhabit. More recently, the Inuit have also successfully established autonomous governance structures. Since the end of colonialism, land claims are now being settled for the Inuit of Canada, which has created a new relationship with the government and has provided certainty of legal

rights for the Inuit. In Greenland, the home rule government has also provided for more Inuit involvement in decision making. As part of our new political position, we are able to support and strengthen our connection to the territorial and resource base of our culture in a sustainable manner through direct participation in newly established management boards and through co-management programs.

However, major obstacles still exist for the Inuit. The challenges facing the Inuit and affecting their livelihoods include maintaining the quality and nutrition of traditional foods in the Arctic, and accessing adequate health care services. For exam-



Climate Change Forces Greenland Fishermen To Diversify—An Inuit fisherman looks for seals near his home town of Ilimanaq, Greenland. This fisherman has largely given up summer fishing forays for the more lucrative choice of hosting eco-tourists in his home, but he still remembers the last time the sea around his village froze over some 10 years ago, and says that in recent years the soil under the houses has defrosted, flowers bloom earlier in the year and the sea has more chunks of ice than before.

ple, chemical contaminants can build up in the food chain to levels that can be harmful to humans. In addition, climate change is impacting Inuit livelihoods, as witnessed by: the thinning of sea-ice; a rapid melting of permafrost; the increasing number of days without snow; and longer summers. Our plight is relatively unknown in the international arena, and we have no preferential access to funds to assist us in meeting the additional pressures that climate change is placing on our communities.

Responding to climate change and adaptive measures being taken

INUIT COMMUNITIES are currently discussing how to adapt to the impacts of climate change, including potential changes in diet due to food availability. In some regions such as Labrador, the Inuit have already made adjustments to the times of year during which they travel by land, and some have begun collecting winter wood and other supplies in the spring, instead of the fall, because the fall freeze-up is occurring later and is more dangerous. In addition, Inuit fishers are checking fishnets more frequently and carrying out harvesting activities earlier in the year. These shifts of time and place of harvesting represent their ability to adapt to changes taking place. Inuit communities are also discussing the idea of community freezers to alleviate concerns of food security, and at the community level, heritage sites are being recommended to provide protection against erosion. A return to more traditional skills could also help alleviate damages as well as recover skills, and could help with including traditional knowledge in research and actions relating to adaptation.

These types of adaptive measures require a merging of both the scientific and the traditional Inuit understanding of changes taking place. Much needed funds, which are required to address the challenges of climate change, are eluding the Inuit—funds that are needed to build and maintain capacity to ensure that the Inuit address these challenges effectively and continue to exist. The Inuit recognize that adapting to climate change requires working at all levels of government and society.

The role of the Inuit Circumpolar Council and action at the international level

ACTION IN ASSISTING COMMUNITIES TO ADAPT, as well as mitigating the effects of climate change and reducing the levels of emissions, is required now. For this reason, the Inuit Circumpolar Council (ICC), which represents approximately



Local Inuit children in the fishing community of Kimmirut, Baffin Island, Nunavut, Canada.

160,000 Inuit living in the Arctic regions of Alaska, Canada, Greenland and Chukotka, Russia, has been very active in aggressively pursuing a response to climate change and continues to advocate for a seat at the negotiating table at the international level, within such processes as the UN Framework Convention on Climate Change (UNFCCC). The ICC's principal goals are to: strengthen unity among the Inuit of the circumpolar region; promote Inuit rights and interests at the international level; ensure and further develop Inuit culture and society for both present and future generations; seek full and active participation in the political, economic and social development in their homelands; develop and encourage long-term policies, which safeguard the Arctic environment; and work for international recognition of the human rights of all indigenous peoples.

Through the aggressive efforts of the ICC, Inuit voices are now being heard at the international level on matters related to climate change, along with the voices of many others, such as the small island developing States. However, there needs to be a more coherent effort, on the part of all indigenous peoples, in voicing our concerns within the UNFCCC process as climate change is severely affecting us all, interfering with our livelihoods and our rights, as recognized under international law. We need to be involved in the decision-making process and in intergovernmental negotiations regarding the roadmap for adaptation measures. In conclusion, governments need to consult with us when making decisions, as these decisions will ultimately impact on our rights and livelihoods. 

Violet Ford is Vice Chair of the Inuit Circumpolar Council.

Pacific Islands Under Threat!

BY GERALDINE KEARNEY

PACIFIC ISLANDS UNDER THREAT! This was the message we wore on our T-shirts as we set off from Australia, determined to voice our concerns on the global stage at the UN Climate Change Conference, held in Bali in December 2007. We were Pacific Islanders: from Australia (including those from the Torres Straits), the Carteret Islands and Kiribati.

As a delegation, we set off full of conviction but a bit tremulous. Would anyone really listen to us? Would we call out in vain? These were the fears we faced, but we remained undaunted. We had a message! We stood in solidarity! The urgency of the situation facing our peoples filled us with passion and propelled us into action as we set off inflamed by hope.

As leader of this delegation, my principal aim was to "let their voices be heard." These were real people, the flesh and blood behind the facts and figures of the impacts of climate change on our low-lying island neighbors, victims of the emissions of the developed nations, themselves only responsible for less than 0.06 percent of global emissions. Now they are in peril, under threat from the rising waters, and their islands are disappearing. Not only is it a matter of land-mass disappearing, but a whole people, their identity, their culture and their history are under threat.

Dangers faced by Pacific Islanders

AS A MAINLAND AUSTRALIAN, a Sister of the Good Samaritan, and a member of a developed nation, I shared the passion of



In Tuvalu, kids hang out on their "kaupapa," an outdoor sleeping platform, as very high tides inundate their neighborhood.

other members of my Congregation and the Pacific Calling Partnership in recognizing our ecological debt to our island neighbors, and the compulsion to advocate on their behalf, and to bring their voices to the ears of developed nations. I had lived in Kiribati for four years and experienced the high seas, the pounding waves and the gaping holes in the narrow causeway that links islets between Betio and Bairiki on the main island of Tarawa. With ocean to the right and lagoon to the left, and waves surging through the causeway, I personally felt vulnerable on this tiny slither of land, home to some 34,000 inhabitants. That experience left me with an insatiable passion to advocate on their behalf. There was no time to buy; action was needed NOW!

In his opening address to the seminar we conducted on climate change in Kiribati in October 2007, in preparation for our trip to Bali, President Anote Tong said: "We need partnership, compassion and sacrifice!" He spoke with such conviction and deep concern for his people, a population of 105,000, 50 percent of whom are under the age of fifteen. The facts were stark and frightening. By 2020, the population would be doubled, and what of the land? Already, coastal erosion is evident, seawalls are collapsing, trees and crops dying, and the water getting more brackish and severely limited in supply.

In September 2007, I walked with elder Ted Billy on Coconut Island in the Torres Strait. The patterns of nature were turned upside down and evidence of coastal erosion had the elders baffled. What was the future? Were other people in the world, including Australians, even aware of what was happening? Hardly! Carteret Islanders have faced similar perils with high seas and erosion already dividing one of the islands in two.

Pacific Islanders' voices heard in Bali

SO WITH PASSION AND HOPE IN BALI, we told our story, and I watched my small band bring a human face to the hard facts and graphic evidence that documented the impact of unremitting emissions on these people, the most vulnerable of my neighbors. The side event "Pacific Islands and Torres Strait Call Out," led by our delegation on the second day of the conference in Bali, gave flesh to their culture and their pain, their concern and their determination to let their voices be heard. And heard they were!

But hearing their voices is not enough. They need action and they need action now! They need substantial support for the process of adaptation. Already the Carteret Islanders are facing relocation and, by March 2008, the first families will be relocated to Bougainville, Papua New Guinea. Kiribati has already embarked on an adaptation program which includes developing policies that respond to climate change impacts, for example in its land use and infrastructure development plans. However, it faces capacity (individual and organizational) and financial constraints.

Urgent action needed now

AS A MEMBER of a developed country, I personally feel the responsibility to respond to this call to action. It is a matter of urgency. It is a matter of justice. Our failure to respond is a violation of human rights.

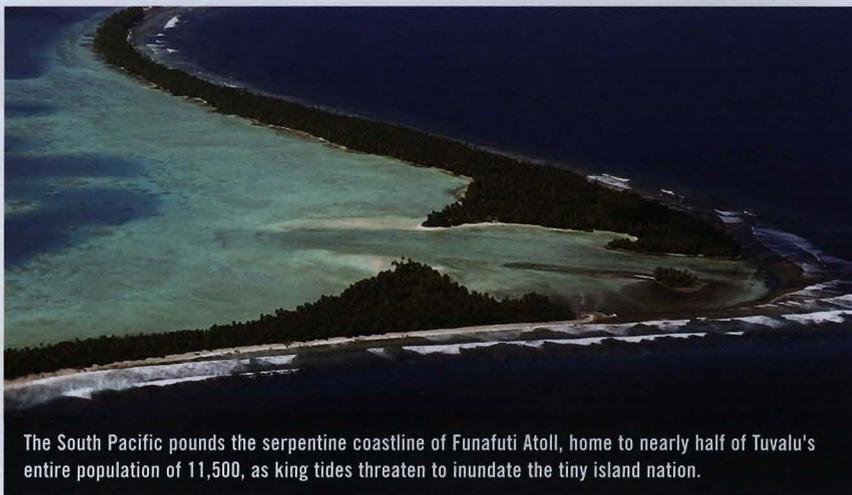
The Roadmap, negotiated and agreed to in Bali, is a fragile one. The impact of climate change on the most vulnerable victims is a global problem and demands a global response. The time is now! We cannot delay! We cannot continue to appease our greed, our insatiable thirst for profit at the expense of the poor and vulnerable! We cannot continue to rationalize lifestyles that further greenhouse gas emissions and continue to capitalize on the lives and situations of the most vulnerable. Our planet is calling each and everyone one of us to account for our actions.

I was heartened in Bali by the undying energy and commitment of so many good and passionate people, for example the members of Climate Action Network (CAN), Climate Action Network Australia (CANA), the Youth Climate Coalition and the World Council of Churches, to name a few. They were exemplary in their commitment to the justice that is being demanded.

Now that Australia has signed the Kyoto Protocol, I am filled with hope. Pacific Calling Partnership will continue to lobby the Australian Government for ongoing substantial funding to assist the adaptation process in these communities. We will also offer some strategic plans to work with the governments of Kiribati and the Provincial government of Bougainville, and to work in conjunction with the Australian Conservation Foundation in response to the Carteret Islands issue. We will continue to work for capacity building so that the delegates we brought to Bali are supported in their endeavors to take further action in the face of dangerous climate change in their communities. There is no turning back!

All of us need to change our lifestyles! This is global issue demanding a global response! It is not an economic issue, but a moral issue! It is time to act NOW!

Geraldine Kearney is a Sister of the Good Samaritan of the order of St. Benedict, Australia.



The South Pacific pounds the serpentine coastline of Funafuti Atoll, home to nearly half of Tuvalu's entire population of 11,500, as king tides threaten to inundate the tiny island nation.

Climate Change and Insurance Markets

BY ARVIND GUPTA

ADVERSE CLIMATE EVENTS such as droughts, floods, hurricanes, avalanches and mudslides have had enormous economic consequences and profound impacts on the lives, health and property of millions of people. It is estimated that the world has suffered nearly one trillion US dollars in economic losses due to 8000 natural disasters in the last 15 years of the 20th century. Three-quarters of the losses were weather-related and only one-fifth were insured.

The increased frequency and intensity of extreme climatic events over the last three to four decades have played a role in the rising costs of natural disasters. Given the projected changes in climate, the costs will only be magnified in many parts of the world. Not only are extreme weather events more frequent, but equally worrying is that even slight changes in the climate are likely to have disproportionately large impacts. For example, the doubling of wind speed due to climate change could lead to a fourfold increase in windstorm related damages, while a one degree increase in temperature in some locations



A gigantic cloud of dust known as "Haboob" advances over Khartoum, Sudan, in April 2007.

leads to an increase in catastrophic wildfires by as much as 143 percent.

Data compiled by insurance and reinsurance companies indicates that global losses from extreme weather events have been rising for more than three decades, especially during recent years. According to Swiss Re, one of the world's largest reinsurers, total financial losses from natural disasters were around US\$120 billion in 2004, while in 2005, they were up to \$230 billion. The increased frequency and intensity of extreme climatic events have played a role in the rising costs of natural disasters. Given the projected changes in climate, the costs will only be magnified in many parts of the world.

Every segment of society is vulnerable to weather risks, but the poor are the most vulnerable as they lack access to timely information on climate risks. Further, their ability to respond is constrained by inadequate capital to invest in adaptation or risk minimizing measures. Thus, socioeconomic impacts of extreme weather events on the poor tend to combine long-term financial, social and health effects, and perpetuate a cycle of inter-generational poverty.

The effects of adverse weather events, exacerbated by climate change, are serious for all countries, but even more so for developing countries, where availability and affordability of insurance is limited and governments lack the necessary funds to provide adequate protection to their citizens. In many cases, the adverse consequences persist over the long term, for example in Honduras, where four years after the devastation of Hurricane Mitch in 1998, the gross domestic product (GDP) was 6 percent below predisaster projections.

The role of insurance in coping with weather-related events

THE INSURANCE INDUSTRY plays a pivotal role in coping with the consequences of adverse weather events. It is a form of adaptation as it can assist in dealing with the impacts of climate change. Typically, insurance policies have been the primary instruments used to protect against weather-related losses. While insurance does not provide explicit coverage for climate change risk, policies do exist, which cover the types of damage that may be associated with it, such as floods and wind. Insurance does not decrease the losses from an adverse event; it spreads the financial impact by enabling those at risk to pay a relatively small premium so they can be protected



against a large loss that has a small chance of occurring. In addition to insurance policies that directly compensate policy holders, there are also insurance-related products such as derivatives and catastrophe bonds, which spread risk geographically, and savings, reserve funds and contingent credit arrangements, which spread risk over time.

Insurers underwrite weather-related catastrophes by calculating, pricing and spreading the risk and then meeting claims when they arise. Risks must be insurable, however, and a set of conditions and criteria must be met before insurers will be willing to issue an insurance policy. These are generally referred to as "Standards of Insurability," and are based on basic ideas of risk management. They include: predictable and diversifiable risks; identifiable and quantifiable chances of the event occurring and extent of losses likely to be incurred; setting of prices via actuarial processes; estimable and manageable, yet random, risks; and infrequent occurrence of a risk. In addition, losses associated with a particular risk ideally would be independent of each other. For example, correlation between different types of risks must be low and sufficiently spread broadly among the insured populations. The insurer must have the ability to set affordable premiums for each potential customer or class of customers.

Measuring climate risk

A CHANGING AND LESS PREDICTABLE CLIMATE reduces the insurance industry's capacity to calculate price and spread this weather-related risk while maintaining profitability and solvency. Measuring or even defining climate risk is not easy. The changing frequency and intensity of extreme climate-related events associated with climate change also renders past data less useful for prediction purposes. Available information is inadequate and the projections from Global Circulation Models not detailed enough, making actuarial calculations of extreme risk events highly uncertain. As a result, there is no immediate prospect that probability estimates will emerge in which the insurance industry can have sufficient confidence to expand their coverage under conventional arrangements.

The capital an insurer needs varies directly with the risk assumed. If an insurer takes on more risk, it must have additional capital to assure policyholders, regulators and investors that it will be able to honor claims while ensuring continuing viability of its business. Because weather risks and effects of climate change on weather risk are not fully understood, insurance companies will have to hold onto large amounts of back-up capital, the cost of which will increase insurance premiums.

The industry has been withdrawing from covering weather risks; the high uncertainty and ambiguity of the risks to be insured, the low capacity among many of the potential clients to meet the necessary cost of the premiums, and the reputational and political risks incurred while legitimately denying coverage or claims makes weather risk insurance an unattractive business for insurance firms. The industry has been trying to cope by increasing premiums for coverage applicable to weather-related events and catastrophes. Use of exclusions applicable to losses associated with climate change and deductibles for weather-related losses have both increased. Given that private insurers and reinsurers are driven by profit considerations, if climate-related risks have a high enough potential for causing catastrophic losses in specific areas, they will not want to continue offering coverage unless required by law.

Climate risks and insurance needs in developing countries

GENERAL WITHDRAWAL of the insurance industry from covering weather risks is happening at a time when risks are increasing and need is the greatest. If these trends are not addressed, adverse impacts on insurance affordability and availability could shift the burden to governments and individuals.

In developing countries, the problem is even more acute; governments, households and businesses cannot afford the premiums demanded by commercial insurance to cover their disaster risks. In addition, the insurance sector in general is underdeveloped and use of insurance, even basic standard insurance products, is limited. Insurance coverage for weather-related risks is even lower. According to a 2005 Munich Re study, only 1 percent of households and businesses in low-

income countries, and only 3 percent in middle-income countries, have catastrophe coverage, in comparison to 30 percent in high-income countries. In most developing countries, capital markets are undeveloped and the potential to use insurance related risk transfer instruments, such as derivatives and catastrophic bonds, is limited.

Thus, in developing countries, people will continue to cope with catastrophic risks by relying on family and community support systems or on government or international donor relief efforts, which will prove inadequate if weather-related catastrophic events were to increase in frequency and intensity. Evidence for this already exists. For example, government sponsored crop insurance systems wherever they exist (and they are limited) are under stress as crop and flood insurance losses have grown ten-fold in recent decades. The economic consequences are serious especially for the rural poor. Risk-averse smallholder farmers will seek to minimize their exposure by opting for lower-value, lower-risk, and therefore possibly lower-return crops, and over diversifying their income sources. These risk-management choices will keep them from taking advantage of profitable opportunities.

The foregoing suggests market failure, especially in developing countries. The private insurance industry will be unable and/or unwilling to provide affordable and comprehensive weather-related insurance coverage. Thus, relying on private insurance is unlikely to be an effective solution to the problems of weather risk and climate change.

The potential role of government

WITHOUT SOME SORT OF PUBLIC SECTOR INTERVENTION, climate insurance is unlikely to become widely available. Governments in developing countries will have to assume a considerable share of the exposures to the costs of weather-related events as is the case in developed countries. This will require developing country governments to rethink their public expenditure priorities, as well as the public sector's role. Allocating more fiscal resources to managing weather risks and climate change would require governments to exit more rapidly from direct engagement in economic activities such as manufacturing, trading, financial services and infrastructure services, where the private sector is willing and able to engage. The private sector would take on these activities especially if reforms in the business environment would reduce the cost and uncertainty of business investments and operations.

The case is compelling for the insurance industry, business, governments and community groups to work together in developing risk management programs and solutions that combine prevention and risk transfer. A fruitful approach could be one in which the public sector sets the policy framework and provides cover for high levels of risk or sectors with high administration costs, while the private sector provides services and cover for lower levels of risk and sectors that are easily accessible. Insurers, governments, industry regulators and the policy community also need to work together to better understand the physical and business risks. Insurers are well positioned to participate in public-private initiatives to monitor loss trends,

THE TURKISH CATASTROPHE INSURANCE POOL

The Turkish Catastrophe Insurance Pool (TCIP), launched in 2000 with the support of the World Bank, tackles the problem of insurance affordability in a middle-income developing country. Because of the high probability of a severe earthquake, earthquake insurance policies are now obligatory for all property owners in Istanbul and other high-risk urban centers. Property owners pay a premium based in part on their risk-reduction measures, such as retrofitting their apartment buildings, to a privately administered public fund. To ensure affordability for urban dwellers, the World Bank absorbs a pre-specified part of the risk by providing a contingent loan facility with highly favorable conditions and dependent on the occurrence of a major disaster. If claims cannot be met after a major earthquake, the Bank provides low-cost capital to the pool. The TCIP has been supported by the efforts of local universities modeling and simulating risks and working on prevention strategies. This program could be used to develop protection for other types of climate-related risks.

Source: Insurance for assisting adaptation to climate change in developing countries: a proposed strategy. Joanne Linnerooth-Bayer and Reinhard Mechler, Climate Policy 6 (2006) 621–636.



MEXICO'S CATASTROPHE BOND

In Mexico, a taxpayer-supported national catastrophe fund (FONDEN) provides the government with needed funding for post-disaster relief and reconstruction. Since current and predicted reserves are considered insufficient for a major earthquake or other severe catastrophe, the Mexican authorities developed a mixed catastrophe bond and insurance risk transfer strategy to protect FONDEN against catastrophic events. In 2006, Mexico became the first sovereign country to issue a catastrophe bond, which is an instrument whereby the investor receives an above-market return when a specific catastrophe does not occur in a specified time, but sacrifices interest or part of the principal following the event. The government's disaster risk is thus transferred to international financial markets. The development of Mexico's catastrophe bond was made feasible in the initial stages with technical assistance from the World Bank.

Source: Insurance for assisting adaptation to climate change in developing countries: a proposed strategy. Joanne Linnerooth-Bayer and Reinhard Mechler, Climate Policy 6 (2006) 621–636.

ETHIOPIAN WEATHER DERIVATIVES

The weather risk market makes it possible to manage the adverse financial impact of weather through risk transfer instruments based on the weather element—temperature, rain, snow, wind, etc.—which affects revenues, costs or margins. In its simplest form, an enterprise affected by weather pays a premium to a risk taker who assumes the risk, defined in terms of a weather element, posed by adverse weather. In exchange for the premium, the risk taker, under certain predefined circumstances, pays the buyer an amount of money, which corresponds to the loss or cost increase caused by the weather. The World Food Program (WFP) established a mechanism for accessing global risk markets to supplement traditional donor-based humanitarian relief. The WFP purchased a precipitation cover from Axa Re in order to prefund an emergency response in the event of a drought. The precipitation cover is a call option based on precipitation as measured at 26 sites throughout the country, converted into crop water-stress indices and combined in a national basket. A crop water-stress index above a pre-specified level at the end of the season indicating widespread drought and crop failure triggers the pay-out. The total amount covered was \$7.1 million with a premium payment of \$0.93 million provided by the WFP. This is an efficient use of donor funds—\$7 million leveraged using less than \$1 million of donor funds. Payment is immediate when the trigger level is reached. Rapid availability of funds means that the WFP can move quickly to provide aid on a timely basis, thereby reducing human misery, limiting population dependence on outside support, and ultimately reducing the total cost to the world donor pool of humanitarian assistance for this crisis.

Source: Weather Risk Management Association. <http://www.wrma.org/>





RISING SEA LEVEL WASHING AWAY VILLAGES IN INDIA

The edge of the sea encroaches upon the village of Kanhapur, Orissa, India. Kanhapur is one of seven coastal villages in the area, five of which have already been washed away by the sea, and residents believe their homes will be submerged within one year and are preparing to evacuate.

improve catastrophe modeling, address the causes of climate change, and prepare for and adapt to the impacts. The international aid community also has an important role to play by providing assistance to public-private risk transfer programs such as those in Turkey, Mexico and Ethiopia, where private insurers, governments and investors have come together to devise innovative means of spreading financial risk while fostering loss-prevention practices for weather-related insurance schemes (See box on previous page).

A number of basic questions would need to be addressed in establishing a public-private climate insurance partnership program, including the following:

- How should climate-related hazard events be defined? What data, techniques and models should be developed to support the measurement of risk and losses? How much coverage should be available, and how should premiums and deductibles be determined? Who should be eligible for government subsidies and to what extent? How can links between national programs, international financial mechanisms and private financial markets, and between services and the end-users, be established? How can monitoring and verification mechanisms be established and how should operational responsibilities be divided between the government and the private sector?
- What would be the most effective role for insurance companies in a public-private partnership? Using their expertise and existing infrastructure, can insurance companies provide many essential non-risk-bearing technical functions, such as technical support for risk assessment, risk management, product design, distribution, marketing, loss handling and administration? Can they use their knowledge of financial engineering to evaluate and design alternative risk transfer mechanisms such as self insurance, catastrophe bonds and weather derivatives?

What can governments do? Firstly, they need to address fundamental policy and political economy questions such as mandatory insurance in hazard prone areas and land use regulation to restrict construction in such areas. Designing and enforcing improved building codes (with manageable and affordable approval processes) and increased resource allocation for services and infrastructure in areas such as water management, flood control and agricultural extension services are important. Periodically, there is a need for governments to review "standards of insurability" to guarantee that insurance companies provide affordable insurance, and when not possible but necessary, develop policies for new standards.

In developing countries, governments need to ensure licensing and investment policies are designed not only to protect domestic incumbent interests, but also to facilitate rapid diffusion of insurance services. There is also a need for more rapid deregulation to enable better access to risk management technologies, more efficient distribution systems, cheaper access to reinsurance and more private capital.

Governments must also work with the private sector to collect and analyze more comprehensive data on weather-related losses especially on small-scale events. In this context, existing public services infrastructure could be made available to insurance companies to systematically build information on losses in sectors such as transportation, health and energy. Governments could also make sure that basic insurance loss data is readily available in the public domain, and in poorer areas could work with the private sector to develop innovations, such as microinsurance and microcredit, in order to reach the uninsured. Finally, and most importantly, governments can be part of collective action to curb emissions.

In conclusion, market based financing and risk transfer mechanisms will not be sufficient in mitigating the adverse economic consequences of natural disasters. The insurance industry has been withdrawing from weather risk markets because of the high uncertainty and ambiguity of the risks to be insured. It is not eager to get back into this business. Underdeveloped insurance markets, regulations and institutions further limit the use of market based financing and risk transfer mechanisms in developing countries. Private-public financing and risk transfer partnerships can contribute in overcoming the hesitancy of private insurers. Greater national, regional and global coordination between industry, governments and international financial institutions could increase the use of such partnerships. But governments will have to take the lead. They need to increase public investments in long-term mitigation and adaptation, set aside funds and enable fiscal space and flexibility, and continue improving the business environment so that private financial markets can play a bigger role.

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Microfinance

Climate change connections

BY KATHARINE MCKEE

IN 2001, THE IPCC concluded that “the impacts of climate change will fall disproportionately upon developing countries and the poor persons within all countries.” The poor are least able to cope on their own with the threats to their homes, communities, livelihoods and health. What role might microfinance—the delivery of financial services, including credit, savings, and insurance to the poor—play in reducing our greenhouse gas emissions and helping vulnerable low-income populations adapt to the impacts of climate change?

Just a few years ago, most people working in microfinance viewed environmental concerns as a luxury. While such worries were undoubtedly important for society as a whole,

expecting their low-income clients to adapt their enterprises and lifestyles towards “greener” practices were not only unrealistic, but tantamount to levying a tax on those least able to afford it. Innovation in the microfinance field focused on products that would help poor people increase their incomes and reduce vulnerability in the short term.

The past year has brought a sea change in this perception. The notion is gaining acceptance that incorporating a climate change lens to microfinance is essential and urgent. A growing circle of microfinance institutions (MFIs), networks and funders has launched new products and partnerships aimed at the microfinance-environment connections. For example, a pilot program—funded by the Citigroup Foundation and the US Agency for International Development and managed by the





Improved efficient cooking stoves that can be easily moved during flood seasons.

Small Enterprise Education and Promotion (SEEP) Network—teamed up six MFIs in Asia and Africa with renewable energy companies and organizations to explore potential collaborations and business models (SEEP 2007). A number of respected MFIs and networks—including ACCION, BASIX in India and Equity Bank in Kenya—are exploring products to respond to climate change challenges and opportunities.

Current practices and lessons learned

MOST OF THE EXPERIMENTS so far have focused on financing options to help low-income households acquire cleaner/renewable energy technologies such as liquefied petroleum gas (LPG), improved stoves and bio-digesters.

Other initiatives, such as the partnership between SEWA Bank and SELCO-India, seek to meet the energy needs of self-employed individuals and microenterprises for processing, agriculture and other livelihoods. In one case, the SEWA-SELCO partnership finances the acquisition of the technology package especially designed by the solar energy company to help low-income women who own solar battery chargers and rent out solar lanterns to vendors in evening markets.

Very recently, the World Bank's Carbon Finance Unit has signed agreements to buy the carbon credits associated with greenhouse gas reductions through installations of solar systems in homes in Bangladesh by the Grameen Bank's clean energy affiliate—Grameen Shakti (970,000 homes)—and its Infrastructure and Development Company Limited (227,000 homes). These agreements will help provide solar electricity to households that are not connected to the electricity grid and ordinarily use kerosene and diesel, thus reducing greenhouse gas emissions (Reuters 2007).

Several of the experiments appear promising and scaleable, and have commercial potential with little or no long-term subsidy. Others are less successful but provide important lessons for future work: demand from clients may have fallen far short of expectations, arrears have spiked, or

partnerships have been costly and problematic relative to the benefits for clients, MFIs and energy companies. A substantial and systematic exploration of lessons from the pioneer initiatives, and the broader question of how the rapidly growing microfinance sector might assist its low-income clients, while contributing to climate change mitigation and adaptation, is both important and urgent.

Challenges and opportunities

THE FIRST FUNDAMENTAL CHALLENGE is demand. Will the various client segments—such as households, communities, microenterprises, farmers and energy entrepreneurs—want improved technologies and practices and be willing to use finance for them? For typical microfinance clients, affordability of many of the household-level renewable energy technologies is certainly an issue, whether financing is available or not. Other factors, such as

perceived reliability and safety, access to installation and maintenance services, and cultural acceptability may be just as significant in limiting effective demand. In addition, low-income families may find it hard to justify investment in a household solar electricity system, at a cost of hundreds of dollars, when the savings are realized only over a number of years.

Supply-side issues also need attention if we are to design and deliver financing to meet these needs on a sustainable basis and on a large scale. What types of financial products are most suitable for clients, while fitting the capacity and business models of different types of MFIs? While many MFIs provide very short-term loans to groups of individuals with minimal credit analysis, this method would not work well in underwriting larger-scale, more complex and longer term financing needs, particularly in the enterprise and community market segments. And, if MFIs adapt their financial products accordingly, will they be able to get the additional financing they need to grow their climate change-related portfolios?

Innovative partnerships could offer one solution to both demand- and supply-side constraints. There are promising alliances being formed between financial institutions and providers of energy and environmental services; in some cases, these involve cooperatives and others with the capacity to aggregate demand and organize low-income consumers and communities, including NGOs, to manage more complex initiatives. In most cases, the jury is out on whether partnership models will be scaleable and sustainable for all relevant stakeholders.

There may also be potential for microfinance to support community-based enterprise and infrastructure models, such as processing facilities or bio-gasifiers run on renewable energy, pico-hydro facilities (hydroelectric power generation under 5kW), or community-scale solar plants. However, these financing needs are likely to be larger and longer term and present a different set of challenges, especially as these relate to longer term financing from MFIs. Additional challenges come from the need to create new microfinance products and partnerships to help clients adapt to threats to agriculture,



fisheries and forest-based livelihoods that are adversely affected by climate extremes and change.

“Smart subsidies” (i.e., short-term grants and concessional loans that build nascent markets while not undermining incentives for clients or commercial firms to do what they can) in both the financial and energy/environment spheres of developing countries will have an important role to play in making microfinance relevant and significant. Several leading social investors, such as Triodos Bank of the Netherlands, are keenly interested in the potential links between their microfinance and environment portfolios. A large number of mainstream funders—such as the World Bank Group and some of the big international banks—are now committed to financing clean energy and other adaptation-related interventions, and are interested in the potential role of microfinance providers. A key wild card is whether the carbon credit markets will evolve in ways that could support climate change-related initiatives of MFIs and their clients. Currently, these trading mechanisms are unwieldy, costly to use, and oriented towards large and very specific types of transactions. However, the carbon markets are evolving quickly, and could become more user-friendly, to the extent they offer sources of credit enhancement for MFIs or even bulk subsidies to clients. The World Bank-Grameen agreement is a promising start.

The awareness of climate change amongst those involved in microfinance—finance providers, donors, investors, policy makers and even clients—is growing at an astonishing pace.

Once viewed as a distraction or even hurdle to mainstream microfinance, more and more key players now see environment-friendly financing products and practices as critical to the future of the sector and, much more importantly, to the low-income and vulnerable clients microfinance was created to serve. But awareness will not mean much if it cannot be translated into smart, scaleable financing that is tailored to meet strong effective demand from low-income households, communities, microentrepreneurs, and small-scale energy and environmental businesses. Developing, testing and bringing these products and business models to scale is one of the biggest challenges facing the microfinance sector in the coming years.

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Adapting to Climate Change in Africa

The role of research and capacity development

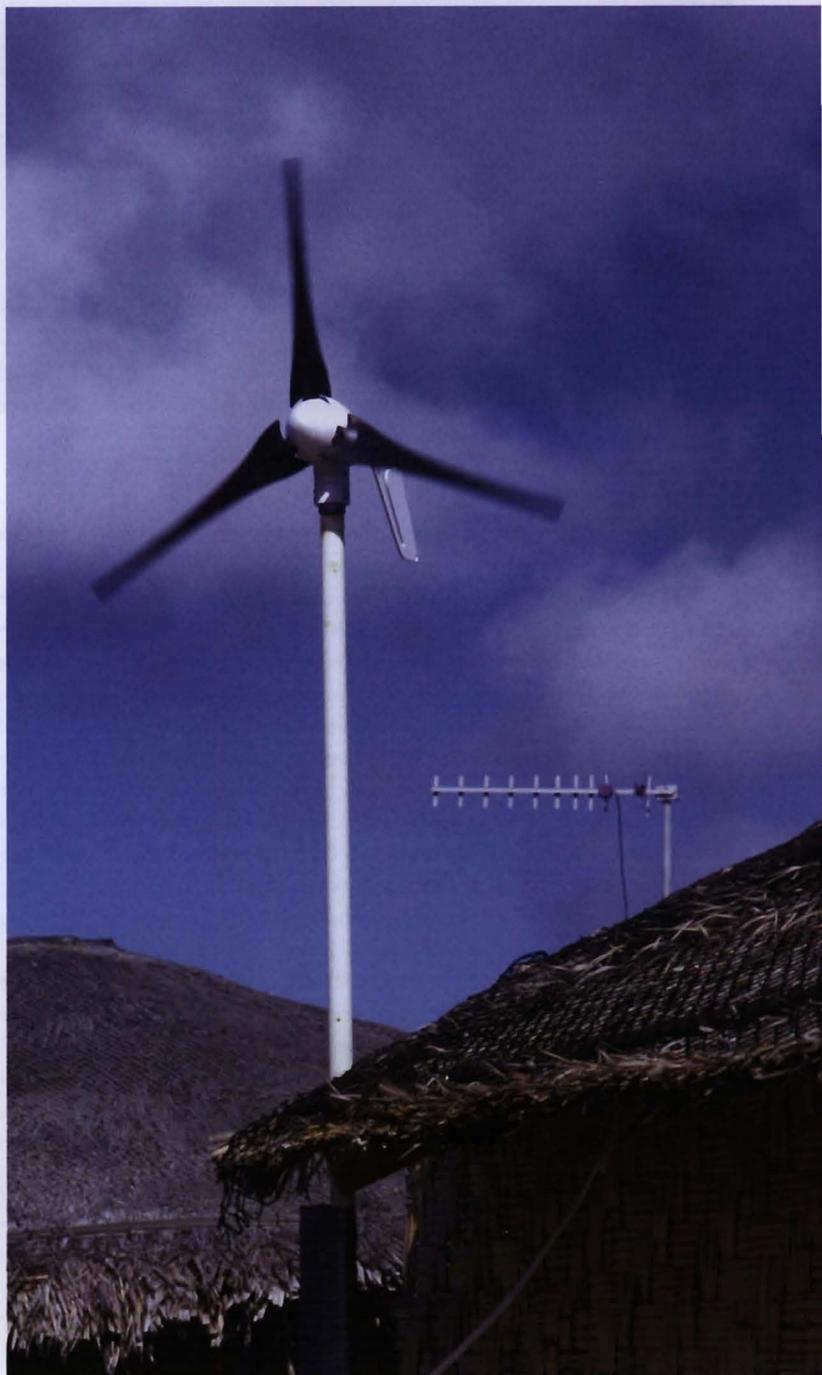
BY FATIMA DENTON, MARY O'NEILL
AND JOHN M. R. STONE

ADAPTING TO CLIMATE CHANGE is no longer merely a policy option—it is now an imperative. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, released in 2007, concludes that climate change is unequivocal, and a range of impacts over the next few decades are inevitable given the changes we have already made to the composition of the atmosphere. The report also reaffirms that Africa is one of the most vulnerable regions of the globe because of its high dependence on rain-fed agriculture and limited financial and human capacity to adapt to these changes. In sub-Saharan Africa, rain-fed agriculture provides food for roughly 90 percent of the population, generates around 30 percent of GDP, and provides some 75 percent of the poorest people with their livelihoods. Surface water is relatively limited. Five major river basins—the Nile, the Congo, the Niger, the Chad and the Zambezi—are major surface water sources and sustain 45 percent of the continent's people. These basins are projected to be adversely affected by changes in rainfall.

Given the threat climate change poses to the hard won development gains Africa has made over the last half century, Canada's International Development Research Centre (IDRC) and the United Kingdom's Department for International Development (DFID) launched the Climate Change Adaptation in Africa (CCAA) program in 2006. The CCAA aims to establish a self-sustained African body of expertise on adaptation that responds to the needs defined by African communities, decision makers and organizations. In recognition of the long-term nature of climate impacts, DFID and IDRC have made a five-year commitment, with initial five-year funding of Canadian \$65 million.

A need for capacity development

OBSERVED TEMPERATURE INCREASES indicate a greater warming in Africa in recent decades of



around 0.3°C per decade, although this has not been uniform. Rainfall changes exhibit even greater variation in time and space. Variability between years has increased in recent decades with more intense and widespread drought and floods. Medium-high IPCC emission scenario climate models project a warming for Africa of $3\text{--}4^{\circ}\text{C}$ by 2080, but with considerable differences across the continent.

African societies have continuously developed local adaptation strategies to cope with extreme weather events, such as droughts. But the expected regional changes in climate, and the subsequent impacts—especially on water availability, agricultural production and human health—will severely strain their coping capacity.

To build on existing know-how, while addressing the reality that many African countries cannot cope with the current impacts of climate variability, the CCAA program uses a multi-layered approach to capacity development. The concept of “participatory action research” is central to its approach and is applied at the level of individual projects. Project-level capacity is further reinforced through a series of education and training and knowledge-sharing activities that link individual project partners, and extend learning to the wider regional and international community. The aim is to see researchers, local stakeholder groups and organizations strengthened and capable of informing policies that will benefit vulnerable groups by providing solid, locally tested knowledge.

Learning by doing through participatory action research

PARTICIPATORY ACTION RESEARCH engages research users from the beginning to the end, from defining the problem to carrying out and monitoring the research. Depending on the context, the users may be small-scale farmers, local officials, national ministries, or other individuals or institutions that directly benefit from the shared enquiry. They set the context for the research, bringing an understanding of the many climate-related impacts they experience or expect, and identifying the resources available to respond. Capacity building is inherent, in that it is an active process of “learning by doing” whereby the skills and knowledge of all participants are increased. It is also inherently a development process, in that the research involves the direct testing of adaptation solutions. Implementation is thus built into the research.

Participatory action research weds scientific and local knowledge to assess climate-related impacts and the ability of stakeholders to cope with them, and tests and validates existing local adaptation strategies. The linkages between researchers, decision makers and communities help to ensure that the research is driven by the demands of research users, rather than the available supply of research organizations.



Building a base of strong African institutions for responding to climate change

THE CCAA PROGRAM sees capacity development as an ongoing process that should continue beyond the life of the projects it funds. The program thus aims to leave a legacy of strong African research organizations capable of contributing to the field of adaptation. To further strengthen the existing base, the program supports targeted capacity building activities, including education and training workshops: a program of policy research and teaching fellowships with related curriculum development and the strategic matching of African and international institutions, where outside knowledge and resources can enhance given areas of expertise.

Since July 2007, a series of education and training workshops has been taking place across the continent to enhance the skills and knowledge essential to undertaking action research on adaptation among the program's first funding recipients. Topics have included integrated climate risk assessment, research on policy linkages and project management. Training on participatory action research and gender analysis is planned for 2008. Training on proposal development for research institutions actively interested in the field of climate change adaptation has also been offered, following the wide response to the program's first call for concepts, which showed a broad range of organizations with strong potential for future contributions to the field.

In recognition of the existing organizations involved in adaptation research and training in Africa, in 2008 a series of research awards and fellowships will be launched by a CCAA-supported partnership, with START (the global change SysTEM for Analysis, Research and Training), the African Academy of Sciences, and the Institute of Resource Assessment (IRA) of the University of Dar es Salaam. The African Climate Change Fellowships will allow 58 early- to mid-career African professionals and researchers to pursue doctoral and post doctoral, teaching or policy-focused studies. It is hoped that teaching fellowships will permit African faculty to develop and implement new courses related to climate change at African universities.

Sharing knowledge for learning and policy influence

THE CCAA WILL ALSO ACT as a facilitator by creating opportunities for knowledge to be shared and translated into forms that can be applied to practices or policies that will benefit communities most affected by climate variability and change. Knowledge sharing is at the heart of participatory action research and is therefore core to every CCAA-supported project,

each of which aims to test and validate a combination of local and scientific knowledge.

To see the wide benefits that arise within individual projects, the CCAA will support a series of networking and knowledge exchange activities to extend the learning and policy dialogue. These activities will be coordinated by: the Forum for Agricultural Research in Africa (FARA), a pan-African agricultural research organization with its secretariat in Ghana; the Institute for Development Studies, a UK-based organization with extensive experience in developing and hosting knowledge services on international development issues; ENDA-TM, a major international NGO based in Senegal; and the IGAD Climate Predictions and Applications Centre (ICPAC), a leading regional climate information organization based in Kenya. As with other areas of the CCAA program, leadership of knowledge sharing activities will ultimately devolve to African organizations.

Addressing Africa's greatest climate adaptation needs

HELPING TO INCREASE RESILIENCE in the agricultural sector is an obvious priority, given its critical importance to both export revenue and subsistence livelihoods. Effective water resource management is critical in this context of dependency on agriculture. This emphasis can be seen in the focus of a number of initial research projects supported by the CCAA program. For example, in South Africa's Western Cape region, the heartland of the country's lucrative wine and fruit export industries, a team of researchers, led by the University of the Free State, is working with planners and farmers to develop modeling scenarios that will improve access to climate information and offer a range of options to help them prepare for a water-scarce future.

Likewise, in Benin, action research, led by the NGO Initiatives "pour un développement intégré durable," aims to reduce farmers' vulnerability and improve food security. This project involves various municipal-level actors—farmers, village leaders and elected officials—in local committees that will share practical knowledge through field schools and disseminate climate information through pre-alerts accessible to local farmers.

Other priority areas for action research are addressing the impacts of climate change on human health, coastal resources and urban development. An increasing proportion of Africa's population is concentrating in coastal mega-cities, such as Cairo and Lagos, which have poor infrastructure for dealing with rising sea levels and extreme weather events.

Building African leadership on climate change adaptation

THE PROGRAM'S COMMITMENT to building African capacity and supporting African leadership is reflected in the programming and governance structure, location of program staff and in funding criteria that favor initiatives led by or that gradually devolve to African institutions. The majority of



CCAA staff members are located in IDRC's regional offices in Africa—in Dakar, Cairo and Nairobi—ensuring on the ground engagement with stakeholders. To enhance African input into programming directions, while respecting the need for donor accountability, an advisory board, whose members are mainly from African countries, guides the CCAA. Progress is monitored using an approach called outcome mapping, an innovation of IDRC's Evaluation Unit, which focuses on behavioral changes in the program's "boundary partners"—those institutions and groups with which it interacts directly.

While it is still too early in the program's life cycle to point to concrete results, the program strategy developed in the CCAA's first year lays a valuable roadmap for progress. The strategy is conceived as a "living document" to be reviewed as needed over the life of the program, and revised on the basis of partner input and overall program learning. Consistent with the "learning by doing" philosophy at the heart of CCAA's action research orientation, the program itself has been learning continuously. Much of this learning is already being applied in the implementation of capacity development workshops, and in the plans for more targeted niche calls for future concept notes.

CCAA's efforts at fostering partnerships in its immediate constituency in Africa and beyond help the program to embrace emerging issues and trends. Knowledge gained from these initiatives helps to inform strategic directions for the program. Partnerships with other donors, other international programs, and African researchers, policy makers, community representatives and capacity developers will be instrumental in bringing significant benefits to the poorest and most vulnerable people in Africa. These partnerships will lay the groundwork for the gradual devolution of CCAA-supported activities to African institutions.

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For more information on the Climate Change Adaptation in Africa program, visit www.idrc.ca/ccaa.

Bali Climate Conference and Its Main Outcomes

BY LEILA MEAD, HABIBA GITAY
AND IAN NOBLE

EVERY YEAR IN LATE NOVEMBER or early December, the present 192 parties to the United Nations Framework Convention on Climate Change (UNFCCC) meet in a "Conference of the Parties" (COP) to negotiate joint action on tackling climate change and its impacts. During these meetings, countries negotiate their formal positions on climate change—what actions they are willing to undertake and when to protect the earth's atmosphere and adapt to changes already occurring. The 1997 COP, held in Kyoto, is best known for reaching agreement on the Kyoto Protocol in which developed countries agreed to meet targets for reductions in emissions

of greenhouse gases over the first "commitment period" from 2008 to 2012.

The 13th COP, held in Bali in December 2007, was a pivotal meeting. It was the culmination of two years of informal discussions to pave the way for setting new targets for a second commitment period of the Kyoto Protocol. A major task of the Bali Conference was to launch a formal negotiation process for new targets, which need to be agreed on by 2009 if countries are going to have time to prepare for their emission reductions beyond 2012. The Bali meeting agenda included developing a roadmap to guide this negotiating process towards a possible new regime, which will engage all countries, developed and developing. An added sense of urgency to the Bali meeting was brought about by a number of other factors, including the find-





UNFCCC Executive Secretary Yvo de Boer, UN Secretary-General Ban Ki-moon, and Indonesian President Susilo Bambang Yudhoyono.

ings of the IPCC's Fourth Assessment Report, the Nobel Peace Prize being awarded to the IPCC and Al Gore, acceptance from many countries that climate change is a threat to development and action to avert this threat is necessary, increased media attention, and the growing carbon market, which requires a long-term framework for carbon trading.

These meetings also provide an opportunity for organizations to showcase their activities that help with the climate change agenda or identify areas where assistance is needed in order to respond effectively. Many organizations also demand action and progress through demonstrations and protests, hoping to attract the attention of government delegates and the media. The Bali meeting was the biggest to date with a large number of government delegates, non-governmental organizations, UN bodies and agencies, intergovernmental organizations, media representatives and civil society groups.

Main Outcomes

A NUMBER OF BODIES (e.g., those that address technical matters and those that oversee implementation of the Convention and the Kyoto Protocol) meet during the two-week official conference period. However, given the importance placed on a future agreement, most attention was given to this agenda item. There were other significant outcomes as well, particularly those related to adaptation and avoided deforestation, which are important for the sustainable development agenda and are summarized below.

Bali Action Plan with four building blocks

THE BALI CONFERENCE culminated in the adoption of the Bali Action Plan—or “roadmap”—which sets out a negotiating process for a new global deal to be concluded by 2009, at the 15th Conference of the Parties in Copenhagen (IISD/ENB 2007). The Action Plan focuses on four key areas or building blocks: mitigation, adaptation, technology, and financial resources and investment (UNFCCC 2007).

specified numerically in the Plan, the 25–40 percent reduction by 2020 to below 1990 levels is implicit by a reference to the IPCC report where this range is specified. This range is associated with global average warming of 2 to 3°C, which has been suggested as the upper limit of temperature increase for avoiding extensive, adverse and irreversible changes to the Earth's system and thus human societies. As a comparison, the overall Kyoto Protocol reductions are 5 percent below 1990 levels. The Action Plan does explicitly mention that countries can use various instruments (markets, technologies, etc.) to achieve this target.

One of the most significant developments in Bali was that, for the first time, the outcome specifically calls for developing countries to undertake nationally appropriate (depending on their economic conditions) “mitigation actions, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner.” This formulation has far-reaching implications and links developing country actions to directly measurable technical and financial support.

The decision on long-term cooperative action also, for the first time, breaks down the strict separation of actions between developed and developing countries by not using language referring to “Annex I” and “non-Annex I” countries, categories previously used to distinguish between these two groups of countries. This offers the prospect of moving beyond the constraints of the current structure of the Kyoto Protocol for defining a future agreement and differentiating between developing countries. This new global deal will include all Parties to the Convention, including the US—who did not ratify the Kyoto Protocol—and developing countries—who did not have any commitments under the Protocol. Thus, it truly paves the way for the world as a whole to take collective action.

Countries have accepted that many developing countries face significant challenges in adapting to the impacts of climate change. Adaptation has been part of the UNFCCC discussions for a number of years, but the magnitude of the impacts from climate change and the risks they pose to development gains

add urgency for further action. Hence, the Bali Action Plan supports "enhanced action on adaptation," which includes:

- financial and capacity development support for integration of adaptation actions into sectoral and national planning for enabling climate-resilient development;
- risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance;
- linking disaster risk reduction and adaptation measures; and
- encouraging public-private-civil-society-multilateral organization partnerships for effective action on adaptation.

3 TECHNOLOGY DEVELOPMENT AND TRANSFER

This has been a major item in the UNFCCC deliberations for a number of years, and discussions at the Bali meeting and on the future agreement were no exception. Developing countries clearly expressed a need for what is often termed "tech-transfer," which, in the past, has been associated more with mitigation actions. Developing countries highlighted that efforts to date are insufficient and the negotiated text reflects that "enhanced action on technology development and transfer" would support action on both mitigation and adaptation. The enhanced actions include effective mechanisms for removing barriers—a major issue for many countries—to the scaling up of technology development. When technologies, especially those that are environmentally friendly, are transferred to developing countries, they are not necessarily promoted and made affordable and accessible; the text incorporates these mechanisms as part of the enhanced actions.

4 RESOURCE PROVISION: FUNDING AND INVESTMENT

The Bali Action Plan also includes "enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation." This includes "consideration of improved access to adequate, predictable and sustainable financial resources,



Nobel Laureate Al Gore meets with UN Secretary-General Ban Ki-moon in Bali.

and the provision of new and additional resources, including official and concessional funding."

Other major decisions

IN ADDITION TO AGREEMENT on the Bali Action Plan, other significant decisions came out of Bali, including the following:

- Reducing emissions from deforestation and degradation — or REDD—which is being seen as a possible mechanism for a post-2012 regime. Emissions from deforestation are estimated to contribute about 20 percent of global greenhouse gas emissions. A process was set up to proceed with "meaningful actions," including demonstration projects and capacity development. REDD could be a market and/or a payment mechanism for the carbon conserved.
- Launching of the Adaptation Fund. The Fund, currently worth about US\$30 million, is expected to grow to about US\$180-\$300 million by 2012 depending on the price of carbon. It is financed by a 2 percent levy on Clean Development Mechanism (CDM) projects (mostly energy projects implemented in developing countries) and will become operational at an early stage during the Kyoto Protocol's first commitment period (2008-2012). It was decided that the Global Environment Facility (GEF) will function as the Secretariat for the first three years with the World Bank serving as the Trustee. A Board was established that will manage the Fund under guidance of and accountability to Parties with developing countries representing a clear majority.

The road ahead

MUCH CAN HAPPEN between now and 2009, and the role of public opinion, the media, domestic politics and elections should not be underestimated. Although the final destination must still be defined, the Bali Action Plan did map out a general direction for future talks and the possibility of an ambitious, attainable and necessary target of 25 to 40 percent reductions in emissions for developed countries by 2020. The end point for the journey is only two years away, meaning the clock is already ticking for agreement to be reached and to ensure that a strong and sustainable climate agreement is implemented for the post-2012 period.

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Challenges and Opportunities

Knowledge for development under climate change

BY HABIBA GITAY AND MICHELE DE NEVERS

CLIMATE CHANGE IS AN EXAMPLE of three converging issues: i) technological advances that have allowed us to over-exploit a natural resource—specifically the absorption capacity

of the atmosphere ii) failure or lack of markets to balance greenhouse gas emissions with the absorptive capacity of the atmosphere and iii) a global resource (atmosphere) being treated as a externality at the national level (see earlier article by Sweeney). Given the recognition of the urgent need to address climate change and the need to deal with these three



Community based adaptation activities in Northwest Bangladesh: This billboard explains the causes of climate change, the impacts of climate change on the communities, and what can be done to adapt to these impacts.

issues, what are the challenges and opportunities for effective and sustainable outcomes for the climate system and development?

Earlier articles in this report deal with these issues from different perspectives: Stern and Noble have highlighted the financial support and/or investments needed to develop and/or implement effective actions for reducing greenhouse gas emissions and for adaptation. The articles by Gupta and McKee deal with some market approaches and microfinance for mitigation and adaptation. Sweeney, Ray and Xuedu, and his co-authors, have summarized the technological and regulatory frameworks for mitigation and approaches to adaptation, globally or in their respective countries. National policies and regulatory frameworks and collective action at the international level are indeed needed to begin internalizing the cost from greenhouse gas emissions—the Bali Action Plan is a start as pointed out by Mead and her co-authors. Denton and her colleagues demonstrate a “learning by doing approach” to knowledge generation and capacity building—an essential element in all three issues. This article concentrates on knowledge management and capacity enhancement challenges and opportunities for climate resilient development.



Strategic and concerted effort for knowledge management

ALTHOUGH THERE IS A NEED to generate knowledge for both mitigation and adaptation, a more urgent need exists for a concerted and coordinated effort to share existing knowledge and encourage its effective use both for analyzing and developing policies and for action on the ground. As this knowledge is applied, often new knowledge is generated and gaps identified. Since mitigation and adaptation actions are still in the early stages of implementation in many countries, capturing and widely sharing the knowledge generated becomes a necessity. Along with this, capacity development and/or enhancement are necessary to effectively apply that knowledge.

With the increasing interest in climate change, many organizations and funders are starting mitigation and adaptation activities in multiple countries and within various sectors in those countries. However, there is a concern that much needed resources—financial and human—would not be used effectively or few long-term benefits towards either low carbon economies or resilient societies would occur. Drawing on earlier work on development and experiences of countries, such

as Costa Rica, a set of potential actions could be taken to avoid these outcomes. They include:

- A national clearing house mechanism to assist in coordinating capacity development and knowledge generation activities;
- The establishment of learning and knowledge organizations with a clear mandate for knowledge management and capacity development to ensure sustainability over the long-term; and
- An effort to link financial mechanisms, such as microfinance, market mechanisms and national borrowing/grants from bilateral and multilateral development agencies, with climate change related actions. For some countries, this is very important as often climate change portfolios are not in the development line ministries that typically deal with these financial mechanisms.

As part of the Bali Action Plan and existing programmes under the UNFCCC (for example, the Nairobi Framework, which concentrates on mitigation, the Nairobi Work Programme on Impacts, Vulnerability and Adaptation, and capacity building activities), there are efforts to provide coordination at the international level. However, whether such coordination flows down to the national level is not yet clear.



energy, agriculture, health, etc. can be developed, there is a danger that such responses could lead to further problems. For example, agricultural policies that increase the areas under irrigation as a response to decreased and variable rainfall can affect hydropower production, water availability to urban areas downstream and the environmental flow, and thus the potential livelihoods of people. Hence, one challenge is for sector-based organizations to effectively work together, share knowledge and respond to the mitigation and adaptation challenge collectively. Past experiences in many sectors (e.g., water management, community development programs—Ostrom, 1990) demonstrate that an approach, which encourages full and active participation of the varied stakeholders, leads to effective knowledge sharing and use and thus a better chance for climate resilient development.

Knowledge for national and local climate risks

THE GENERAL AWARENESS of climate change has increased recently due, in part, to intensified media and political attention, and the fact that many societies are experiencing the impacts of the increased frequency and intensity of extreme climatic events. However, a deeper understanding of climate change is needed for countries to be able to develop their own context-specific policies and subsequent actions on a long-term basis and integrate them into their development agendas. Developing and/or enhancing human capital and skills is an important component for this.

A wide set of literature has shown that active participation and incorporation of country-specific and local-level knowledge is necessary for effective development outcomes. Broad stakeholder participation, including those with the local knowledge, would allow the incorporation of such knowledge into the development process (Ostrom 1990, Carr et al 2007). While the development community has faced challenges in valuing and incorporating a diverse knowledge base, developing and/or adopting this knowledge for climate change presents additional challenges for the knowledge agenda, namely the urgency for the knowledge to be generated and/or used for practical realities.

Knowledge and capacity are also critical for the development of policies that are coherent at the national level, particularly since climate change affects multiple sectors in multiple ways—be it in the way we produce and use our energy or how we deal with the impacts of climate change. Although sectoral policies for

Opportunities from climate change

CLIMATE CHANGE IS PROVIDING opportunities for additional innovation, moving towards collective global action, protecting a global good and sustainable development. Existing and new knowledge and the capacity to use that knowledge are extremely important along with various policy, financial, market and investment instruments. In this emerging field, knowledge must be generated, captured and used for practical purposes. However, climate impacts, adaptation options and development goals can be very context specific. Thus, there is a need to devise ways of maintaining local knowledge and skills over the long-term and generating knowledge for particular contexts. Enhanced capacity and skills would assist in improving our ability to manage climate risk in the short to long-term, and from the local to the national level, and to reach better outcomes for the atmosphere, human societies and, ultimately, our planet.

Habiba Gitay and Michele de Nevers are based at the World Bank Institute, The World Bank, Washington DC.

References

- Carr, E. R., P. M. Wingard, S. C. Yorty, M. C. Thompson, N. K. Jensen, and J. Roberson, 2007. Applying DPSIR to Sustainable Development. *International Journal of Sustainable Development and World Ecology* 14 (6) 543-555.
- Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press. 298pp.

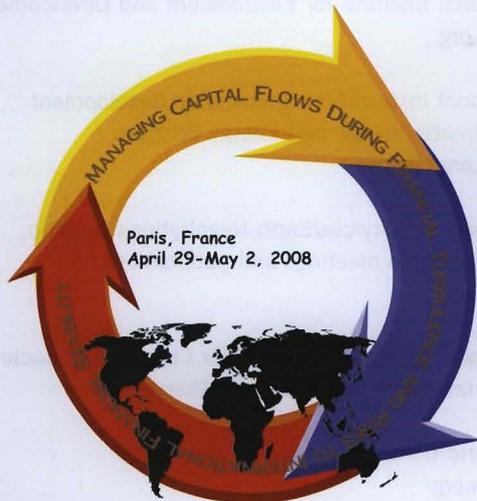
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AUDIENCE

This fee-based seminar (US\$2000) targets senior level government officials, officials from central banks, ministries of finance and planning, financial regulatory agencies, staff from investment and commercial banks, as well as staff from bilateral and multilateral financial organizations.

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<http://www.worldbank.org/wbi/capitalflows>

A GLOBAL SEMINAR FOR SENIOR POLICYMAKERS Managing Capital Flows During Financial Turbulence and Risks to International Financial Stability

Paris, France, April 29-May 2, 2008

The global economy is in its fifth year of continuous growth. However, overlapping with the global current account imbalances, the recent credit crunch crises in advanced economies arising from indiscipline sub-prime mortgage loans in the US is likely to have an impact on the global economy. These sub-prime mortgages have been packaged as securitized assets and sold to major banks and investors (equity and hedge funds) all across the world. The issue of re-pricing risk and market risk management practices overlaps with that of sub-prime lending and securitization because under-pricing of risk is argued to have spurred demand for such assets. This policy seminar provides cutting edge analysis of the current issues in financial market turbulence and widening global imbalances, coupled with the heightening of risks to financial stability and global economic growth arising from (1) unprecedented hike in oil prices; (2) declining value of US dollar against Euro and other currencies leading to a realignment of major currencies; (3) slowing down of the US economy. What are the policy options for central bankers and ministers of finance in economic management during such a confluence of rapid global changes? First, the seminar discusses stylized facts about the capital flows, including the factors determining the external positions and the international currency exposures. Second, the discussion centers around credit crunch, contagion across countries arising from securitized assets, role of sovereign wealth funds, hedge and equity funds in the ongoing financial turbulence. Third, the seminar focuses on international financial architecture issues, including implementation of the Basel II recommendations. Fourth, the discussion is on core subjects, such as currency and banking crises, issues in managing large foreign exchange reserves, exchange rate arrangements and monetary unions. Finally, risks to financial stability and options for economic management are discussed.

MODULES

- Current Challenges to the Global Economy;
- Financial Globalization and International Financial Architecture;
- Monetary Policy and Exchange Rate Regimes;
- Risk Management and Policy Options During Financial Turbulence.

KNOWLEDGE RESOURCES

UNITED NATIONS, ENVIRONMENTAL CONVENTIONS AND INTERNATIONAL ORGANIZATIONS

Websites of environmental conventions also include lists of upcoming meetings.

Gateway to the United Nations system's work on climate change, including links to relevant UN agencies and programs and international organizations and their work on climate change.

www.un.org/climatechange

UN Framework Convention on Climate Change

www.unfccc.int

Intergovernmental Panel on Climate Change

www.ipcc.ch

International Strategy for Disaster Reduction

www.unisdr.org/eng/risk-reduction/climate-change/climate-change.html

Ozone Secretariat

<http://ozone.unep.org>

Ramsar Convention on Wetlands

www.ramsar.org

UN Convention on Biological Diversity

www.cbd.int

UN Convention to Combat Desertification

www.unccd.int

United Nations Environment Program

www.unep.org/Themes/climatechange

United Nations Development Program

www.undp.org/climatechange

United Nations Forum on Forests

www.un.org/esa/forests/

World Bank Group and Climate Change

<http://go.worldbank.org/W13H8ZXSD1>

World Meteorological Organization

www.wmo.ch

NONGOVERNMENTAL AND RESEARCH ORGANIZATIONS

Climate Ark: Climate Change and Global Warming Portal

www.climateark.org

Consultative Group on International Agricultural Research

www.cgiar.org

Climate Action Network

www.climateactionnetwork.org

Climate Technology Initiative

www.climate-tech.org

Columbia University Earth Institute

www.earthinstitute.columbia.edu/sections/view/9

EcoEquity

www.eco-equity.org

Institute for Development Studies

www.ids.ac.uk

International Institute for Environment and Development

www.iied.org

International Institute for Sustainable Development

(IISD)-Climate Change and Energy Program

www.iisd.org/climate

IISD Reporting Services/Earth Negotiations Bulletin,

including links to meetings and publications

www.iisd.ca

International Research Institute for Climate and Society

<http://portal.iri.columbia.edu/portal/server.pt>

IUCN-World Conservation Union

www.iucn.org

Linking Climate Adaptation Network

www.linkingclimateadaptation.org

Oxfam Climate Change Campaign

www.oxfam.org/en/programs/campaigns/climate_change/index.htm

Pew Center on Global Climate Change

www.pewclimate.org

Red Cross/Red Crescent Centre on Climate Change and Disaster Preparedness
www.climatecentre.org

Renewable Energy Policy Network for the 21st century
www.ren21.net

Stockholm Environment Institute
www.sei.se/index.php

Tiempo Climate Cyberlibrary
www.cru.uae.ac.uk/tiempo

Tyndall Centre for Climate Change Research
www.tyndall.ac.uk

World Resources Institute
www.wri.org/climate

World Business Council on Sustainable Development
www.wbcsd.org

WWF
www.panda.org/about_wwf/what_we_do/climate_change/index.cfm

OTHER RESOURCES



DEVELOPMENT AND CLIMATE DAYS

Development and Climate Days is an event on climate change adaptation practices, planning, research and technologies in the development context. First held in

New Delhi, India, in 2002, during the Eighth Conference of the Parties (COP) to the UN Framework Convention on Climate Change, this event has taken place every year since, in parallel to the COP.
www.dcdays.org/index.html



DEVELOPMENT MARKETPLACE

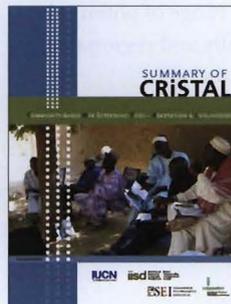
Development Marketplace (DM) is a competitive grant program, administered by the World Bank and supported by various partners,

that identifies and funds innovative, early-stage projects with high potential for development impact. DM competitions—held at the global, regional and country level— attract ideas from a range of innovators, including civil society groups, social entrepreneurs, academia and businesses. DM has awarded more than \$46 million in grants, supporting projects through their proof of concept phase. Using DM funding as a launching pad, projects often go on to scale up or replicate elsewhere, winning prestigious awards within the sphere of social entrepreneurship.
www.worldbank.org/developmentmarketplace



CARBON FINANCE

The World Bank Carbon Finance Unit (CFU) uses money contributed by governments and companies in OECD countries to purchase project-based greenhouse gas emission reductions in developing countries and countries with economies in transition. The emission reductions are purchased through one of the CFU's carbon funds on behalf of the contributor, and within the framework of the Kyoto Protocol's Clean Development Mechanism or Joint Implementation.
www.carbonfinance.org



CRiSTAL TOOL

CRiSTAL is a tool to help project managers integrate climate risk and adaptive capacity building into community-level projects. Written in Excel, CRiSTAL assists users to: (a) systematically consider the links between local livelihoods and climate; (b) assess a project's impact on livelihood resources that are important for climate adaptation (LCRA); and (c) devise adjustments that improve a project's impact on LRCAs. The tool has been tested and used on various projects in Africa, Asia and Latin America. Details are available at:
www.iisd.org/security/es/resilience/climate_phase2.asp

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE REPORTS

The Climate Change volumes of the IPCC provide a comprehensive assessment of climate change. The reports of the individual working groups of the fourth assessment completed in 2007 and the Synthesis Reports of both the fourth and the third assessments are listed here. They are all published by Cambridge University Press and are also available online. The summaries are also available in other languages and can be found on the websites listed under each entry.



CLIMATE CHANGE 2007— THE PHYSICAL SCIENCE BASIS Working Group I Contribution to the Fourth Assessment Report of the IPCC

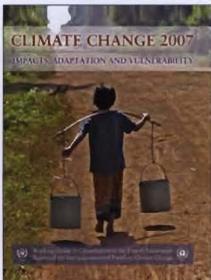
This report provides information on changes in greenhouse gas and aerosol concentrations in the atmosphere and

the extent to which they affect the climate system. It considers paleoclimatic information and current understanding of land-atmosphere-ocean interactions in its analysis. It provides details of recent changes in atmosphere, land and ocean temperatures, rainfall, glaciers and ice sheets, and evaluates the contribution of human activities to such changes. Projections of future climate change using climate models are considered broadly and cover near-term climate change and a range of potential longer term climate change both globally and regionally. The full report is available online at:

www.ipcc.ch/ipccreports/ar4-wg1.htm

A summary for policy makers written in less technical language is at:

www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf



CLIMATE CHANGE 2007— IMPACTS, ADAPTATION AND VULNERABILITY Working Group II Contribution to the Fourth Assessment Report of the IPCC

This report assesses current scientific understanding of the impacts of climate change on natural, managed and human

systems, the capacity of these systems to adapt and their vulnerability. It emphasizes observed and projected

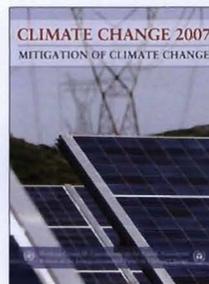
climate change impacts, including evidence that changes in many physical and biological systems are linked to anthropogenic warming, and changes in the natural environment, flooding, and food and water shortages. It analyzes future impacts and how far adaptation and mitigation can reduce these impacts, and addresses specific systems, sectors and regions.

The full report is available online at:

www.ipcc.ch/ipccreports/ar4-wg2.htm

There is also a summary for policy-makers written in less technical language is at:

www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-spm.pdf



CLIMATE CHANGE 2007— MITIGATION OF CLIMATE CHANGE

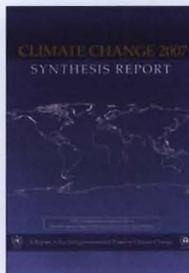
This report analyzes mitigation options for the main economic sectors in the near-term, and addresses cross-sectoral issues such as synergies, co-benefits and trade-offs. It provides information on long-term mitigation strategies

for various stabilization levels, paying special attention to implications of different short-term strategies for achieving long-term goals, and addresses the relationship between mitigation and sustainable development. The report highlights that the price of carbon could create incentives to reduce emissions, and considers the influence of lifestyle changes. The full report is available online at

www.ipcc.ch/ipccreports/ar4-wg3.htm

A summary for policy-makers written in less technical language is at:

www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf



CLIMATE CHANGE 2007— SYNTHESIS REPORT A contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

This report is based on the assessment carried out by the three working groups of the IPCC, and provides an integrated view of climate

change as the final part of the IPCC's Fourth Assessment Report. The report addresses six topics: observed changes in climate and their effects on natural and human systems;

causes of the observed changes; projections of future climate change and related impacts under different scenarios; adaptation and mitigation options over the next few decades and their interactions with sustainable development; the relationship between adaptation and mitigation on a more conceptual basis and over the long-term; and the major robust findings and remaining key uncertainties in the assessment.

The full report is available online at:

www.ipcc.ch/ipccreports/ar4-syr.htm

A summary for policy-makers written in less technical language is at:

www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf



CLIMATE CHANGE 2001— SYNTHESIS REPORT

A contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change

This report synthesizes the findings of the Third Assessment Report of the IPCC and specifically addresses nine

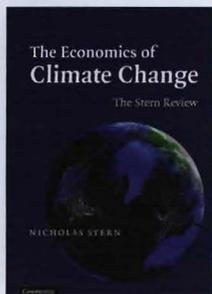
questions including what is known about changes in the climate systems and its consequences on the land, water and human systems, and what are the uncertainties. The full report is available online at:

www.ipcc.ch/ipccreports/tar/vol4/english/index.htm

There is also a summary for policy-makers written in less technical language is at:

www.ipcc.ch/ipccreports/tar/vol4/english/pdf/spm.pdf

OTHER RELEVANT BOOKS AND REPORTS



THE ECONOMICS OF CLIMATE CHANGE: The Stern Review,

by Nicholas Stern, Cambridge University Press, 2007.

The Stern Review is an independent, rigorous and comprehensive analysis of the economic aspects of this crucial issue, and will be invaluable for all students of the economic and policy implications

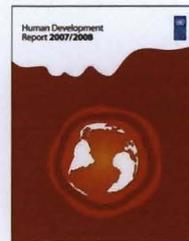
of climate change, as well as economists, scientists and policy makers involved in all aspects of climate change.

The full report of Stern's review is available online at:

www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

An executive summary is also available at:

www.hm-treasury.gov.uk/media/4/3/Executive_Summary.pdf



HUMAN DEVELOPMENT REPORT 2007/2008—FIGHTING CLIMATE CHANGE

Human Solidarity in a Divided World: The Human Development Report 2007-2008, United Nations Development Program (UNDP), 2007.

This report provides a stark account of the threat posed by climate change. It

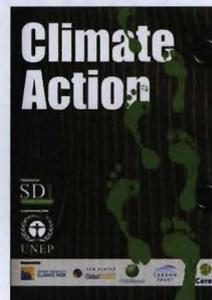
argues that the world is drifting towards a "tipping point" that could lock the world's poorest countries and their poorest citizens in a downward spiral, leaving hundreds of millions facing malnutrition, water scarcity, ecological threats and a loss of livelihoods.

The full report is available online at:

http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf

The summary is available at:

http://hdr.undp.org/en/media/hdr_20072008_summary_english.pdf



CLIMATE ACTION, *by Sustainable Development International (SDI) in partnership with the United Nations Environment Programme (UNEP), 2007.*

This book is part of an international communication platform established by SDI and UNEP to educate businesses, governments and NGOs as to what they can do to reduce their carbon

footprint and adapt to the impacts of climate change. This publication and its supporting website will assist institutional investors in analyzing and comparing companies that are responding to the business risks and opportunities resulting from climate change. More information is available at:

www.climateactionprogramme.org

To read the report online, visit:

www.climateactionprogramme.org/emagazine/2007

CALENDAR

MARCH 2008

- 4-6 Washington International Renewable Energy Conference (WIREC) 2008
Washington, DC
<http://www.wirec2008.org>
- 25-28 Opportunities and Challenges of Responses to Climate Change for Indigenous and Local Communities, their Traditional Knowledge and Biological Diversity
Helsinki, Finland
www.cbd.int
secretariat@cbd.int

APRIL 2008

- 7-11 33rd WEDC International Conference: Access to Sanitation and Safe Water
Accra, Ghana
wedc.conf@lboro.ac.uk
<http://wedc.lboro.ac.uk/conferences/33>
- 12-13 World Bank/IMF Spring Meetings
Washington, DC
www.worldbank.org
- 16-18 International Renewable Energy Conference in Africa
Dakar, Senegal
a.mhlanga@unido.org
www.unido.org/en/doc/76539

- 21 April-2 May Seventh Session of the UN Permanent Forum on Indigenous Issues: Climate change, biocultural diversity and livelihoods: the stewardship role of indigenous peoples and new challenges
indigenouspermanentforum@un.org
http://www.un.org/esa/socdev/unpfii/en/session_seventh.html

MAY 2008

- 5-6 Intergovernmental Panel on Climate Change Workshop on IPCC Guidance on Estimating Emissions and Removals from Land Uses
Helsinki, Finland
www.ipcc.ch (Note: must be nominated to attend)
- 19-30 Ninth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 9)
secretariat@cbd.int
www.cbd.int
- 22 IBD 2008: International Day for Biological Diversity
Multiple venues
secretariat@cbd.int
www.cbd.int/cepa/biodiv-day-2007.shtml

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- News and events
- Listings of PRI providers, brokers, and advisors



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International Trade and Climate Change

Economic, Legal, and Institutional Perspectives

Climate change is a global challenge requiring international collaborative action. Another area where countries have committed to a long-term multilateral resolution is the liberalization of international trade. Integration into the world economy has proven a powerful means for countries to promote economic growth, development, and poverty reduction. The broad objectives

of improving current and future human welfare are shared by both global trade and climate regimes. Yet both climate and trade agendas have evolved largely independently through the years, despite their mutually supporting objectives. Since global emission goals and global trade objectives are shared policy objectives of most countries, and nearly all of the World Bank's clients, it makes sense to consider the two sets of objectives together.

This book is one of the first comprehensive attempts to look at the synergies between climate change and trade objectives from economic, legal, and institutional perspectives. It addresses an important policy question – how changes in trade policies and international cooperation on trade policies can help address global environmental spillovers, especially GHG emissions, and how national environmental policies that are aimed at global environmental problems might affect trade and investment. It explores opportunities for aligning development and energy policies in order to stimulate production, trade, and investment in cleaner technology options.

"This is a timely, informative and useful publication; indeed, a valuable contribution to the pressing debate on the role that trade and trade policy play and can play in supporting climate change mitigation and the transition to a sustainable energy future."

– Ricardo Melendez-Ortiz, Chief Executive, International Centre for Trade and Sustainable Development (ICTSD), Geneva

November 2007 | 170 pages | 978-0-8213-7225-8 | Paperback \$20



Poverty and the Environment

Understanding Linkages at the Household Level

Drawing upon recent analytical work prepared inside and outside the World Bank, this report identifies key lessons concerning the linkages between poverty and the environment. With a focus on the contribution of environmental resources to household welfare, the analysis increases our understanding of how specific reforms and interventions can have an impact on the health and livelihoods of poor people.

"This volume offers a careful synthesis of key findings from growing literature on the environmental determinants of household welfare, as reflected by indicators of consumption, health, and income. The primary contribution of this study is that it has drawn out vital policy conclusions that will be of value to organizations and governments concerned about poverty and the environment in the developing world."

– Professor Christopher Barrett, Cornell University, Ithaca NY

November 2007 | 120 pages | 978-0-8213-7223-4 | Paperback \$18

Environmental Health and Child Survival

Epidemiology, Economics, Experiences

Each year, millions of children in developing countries fall sick and die from diseases caused by polluted air, contaminated water and soil, and poor hygiene behavior. These infections lead to repeated infections contributing to malnutrition in children, and subsequently impacts future learning and productivity. This book analyzes the linkages between environment-related infections and malnutrition and their impact on child growth and development; assesses the related burden of disease on young children and its economic costs; and highlights experiences in implementing environmental health interventions in developing countries.

April 2008 | 110 pages | 978-0-8213-7236-4 | Paperback \$18

Strategic Environmental Assessment for Policies

An Instrument for Good Governance

Environmentally and socially sustainable policies are essential for good governance. Strategic Environmental Assessment (SEA) is the key tool for integrating environmental considerations into policies, programs and plans. This edited book focuses on SEA applied to policies. Through lessons learned from previous use of SEA on policies, it draws lessons on the strengths and weaknesses of current SEA methodology. It then goes on to analyze how policies are formulated and implemented and proposes a new conceptual framework for conducting SEA of policies that potentially could be more useful in influencing decision makers to integrate environmental sustainability considerations into policy formulation and implementation. Currently this framework is being piloted in developing countries in different sectors by the World Bank.

May 2008 | 190 pages | 978-0-8213-6762-9 | Paperback \$10

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