

stresses of climate change), and mitigation (lowering greenhouse-gas emissions to reduce the severity of climate change).

Increasing our adaptability is crucial, and we

richer. Unfortunately, attempts to reshape human activities have been disappointing. The Kyoto Protocol specifies that by 2012, industrialized countries will collectively reduce

development; and third, ensuring any discussions transcend traditional boundaries, across space and time, and among academic disciplines or interest groups.

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have scientifically proven ways to do this, such as building dikes against sea-level rise, and developing temperature and drought-resistant crops. Such measures could sharply reduce climate vulnerability.

Mitigation efforts also need to improve, primarily through reducing emissions from energy use and increasing the re-absorption of atmospheric carbon dioxide by planting forests. This would result not only in lower concentrations of greenhouse gases, but also in better health due to reduced local air pollution, lower overall demand for energy, and greater energy availability for poor and rural areas.

One key path towards the sustainable lowering of emissions is the Clean Development Mechanism of the Kyoto Protocol, which came into force in February 2005 under the UN Framework Convention on Climate Change (UNFCCC). This permits industrial countries to transfer part of their obligations to reduce emissions to other nations in exchange for payment. For example, instead of retrofitting an existing power plant in a rich nation to reduce emissions at a cost of US\$50 per tonne of carbon removed, that country could pay a developing country to remove the same quantity of carbon by planting a forest (at perhaps US\$20 per tonne). If the poor country received more than US\$20 per tonne of carbon in payment, the transaction would become even more equitable, because of the income transfer from rich to poor.

Of course, such efforts raise tough questions about equity and burden sharing. To date, the bulk of greenhouse-gas emissions have come from rich countries. In 2004, their average per capita emissions were four times greater than those of developing nations. Yet poor countries will be hardest hit by climate change. They will also need to boost their energy use to alleviate poverty and promote development.

For now, developing countries should focus on adaptation, especially to protect their impoverished populations, whereas rich countries, which are better endowed financially and technically, should lead the mitigation effort and also assist poorer countries. Meanwhile, middle-income countries could join the mitigation effort over time as they become

their emissions by 5% relative to 1990 levels (developing countries are, so far, exempt). Yet global greenhouse-gas emissions have risen significantly since Kyoto. The 2007 UNFCCC meeting in Bali set out a road map for a post-Kyoto agreement but participants failed to agree on specific reduction targets. At the national level, however, the outlook is more hopeful.

SUSTAINABLE CLIMATE

Policy-makers preoccupied with immediate problems tend to focus on global warming only if it is clearly linked to national sustainable development. Fortunately, there are now practical ways to do just that. These tools should help to dispel the concern of many policy-makers that tackling climate change might divert resources that are sorely needed to deal with more immediate development problems such as growth, poverty, food security, ill health, unemployment and inflation.

One promising approach, known as ‘sustainomics’, draws on three basic principles: first, and most importantly, making development more sustainable; second, balancing the social, economic and environmental dimensions of

This last point is essential: the problem of climate change spans the planet, plays out over centuries and concerns every human being. These principles could help countries to balance their aspirations for development with the costs of curbing their emissions. Rich nations should display more leadership in this respect. Meanwhile, developing countries could learn from the experience of the industrialized world (where emissions rose with development), and adopt innovative policies that would allow them to follow a less carbon-intensive path while continuing to develop more sustainably. Science and technology will play a key role here. Financial and technological transfers from rich to poor countries would facilitate this process.

Three recent developments have combined to raise the profile of climate change and to help highlight the failure of policy-makers to come to grips with this important challenge. These are the release of the *IPCC Fourth Assessment Report*, the awarding of the 2007 Nobel Peace Prize jointly to the IPCC and to former US vice president Al Gore, and the UNFCCC conference in Bali in December 2007.

While there is a growing consensus worldwide about the need to take action, important practical issues remain unresolved, including how to share equitably the burden of climate change. Adapting to climate change and reducing vulnerability is best done within the broader context of making development more sustainable. This will be far more fruitful than addressing these complex issues piecemeal. ■

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VIEWPOINT | Luis Rafael Herrera-Estrella

The green revolution is slowing. What next?

We have witnessed a remarkable increase in crop yields over the past half-century, thanks largely to the impact of the green revolution, and its emphasis on the creation of new varieties of maize, rice and wheat through conventional plant breeding. Yet, the impact of the green revolution in terms of increasing plant yields has been slowing for some time. At the same time, the global population, especially in the developing world, continues to rise. Consequently, the ability to feed the world’s population might well depend on advances in our understanding of the plant genome and plant genetics, and on our ability to engineer new plant varieties that can meet the environmental and climatic conditions that farmers are likely to encounter in the future. Scientists working in these areas face two major challenges. One is scientific — that is, to continue to conduct the research that is necessary to make advances in the field. The other is to convince the public that the work of scientists is not only safe but also necessary, and that much good, not harm, can come from these efforts. I hope to deepen my research by continuing to analyse plant genomes that could be useful in increasing the efficiency of phosphorous uptake and thus limiting the amount of fertilizers necessary to grow high-yielding food crops. I also hope the same techniques can be successfully used to create food crops that are more resistant to drought.



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