EVALUATING CLIMATE CHANGE AND DEVELOPMENT

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Foreword

The International Conference on Evaluating Climate Change and Development, organized by an international partnership, was hosted by the government of Egypt and the Bibliotheca Alexandrina in May, 2008. It took place at a time that Egypt was intensifying its efforts to look at the potential effects of climate change on its environment and its people, in all sectors of government policies, and all its governorates. This conference contributed to this process. The Global Environment Facility (GEF) has been working for many years with Egypt and I was happy to see this confluence between an international initiative and national efforts to scale up the awareness of and preparedness for climate change.

The international initiative of the Conference came at the right time, at the moment that a strong consensus had emerged among nations that climate change needs to be addressed in a more integrative way. Nevertheless, clearly there are challenges to face: climate change mitigation is as we know difficult to measure, and in the case of adaptation it is even more difficult to judge results.

On mitigation, the Conference aimed to deliver good practices on how to evaluate interventions. This volume provides an overview of evaluation practices and shows examples of good evaluations. It delivers the promise that the evaluation community could actually establish best practices in this regard. This is important, because it is critical that we better assess the impact and the cost of our past actions and learn from our mistakes. As a result, decision-makers can propose the most effective and efficient ways forward.

Evaluation has always been a tricky business: we have struggled over the years to develop tools and methodologies to measure the outcomes of our activities. In the GEF we have adopted a consistent methodology for measuring greenhouse gases avoided by our energy efficiency and renewable energy interventions. We have also begun working with our colleagues to develop a consistent methodology for measuring mitigation in our transport sector interventions. This information is being supplemented with other qualitative and quantitative indicators linked to targeted outcomes. While we are doing a better job of tracking our results, we still need more robust information as we look toward the broader impacts of climate change. This publication provides inspiration on all of these issues and its applicability goes beyond the GEF.

The *mitigation* agenda itself is developing and we may see new subjects and issues emerging, which will also need evaluation. There are new insights about the role of forests and the sustainability of carbon sequestration, for example. There are also emerging linkages between the demand for biofuels and increasing food prices in the world that must be carefully weighed. As oil prices become even more volatile, markets may react suddenly and dramatically. One of the key challenges to the evaluation community is to explore the future of mitigation, as well, and see how that could be evaluated.

On the *adaptation* side, the GEF has been looking closely at funding adaptation projects in coastal areas, the agricultural sector, mountain ecosystems, and regions facing different hydrological challenges. Our goal has been to increase the resiliency of the social, and ecological systems faced with global warming. Now with the GEF Secretariat operating as the Secretariat of the Adaptation Fund, we will be asked to help direct and implement the decisions of that body which will include the largest source of international funding for adaptation activities.

Still, our understanding of adaptation requirements needs to be improved and enhanced. Resiliency is a concept that is quite difficult to measure in social, economic, and environmental terms. If our goal is to increase resiliency—the ability of systems to "bounce back"—we have to improve our understanding of what this means in the many sectors in which we work. We must also work hard to improve the way we value uncertainties and the well-being of future generations. Too often, current methodologies do not allow us to launch sufficiently ambitious programs to tackle climate change that can be justified from an economic standpoint.

The work presented during this conference represents some early, seminal work on the evaluation of adaptation programs. At GEF, we now demand that the possible consequences of climate change are factored into the design of each and every project that we finance. However, methodologies still need to be refined and we hope, in pragmatic terms, that the results of the conference, presented in this volume, can help shape that work into a constructive process. But beyond this, I would hope that this publication will also help the international community clarify what it is that we want to achieve in supporting the adaptation to climate change, and how, therefore, we might go about measuring and evaluating it.

The Conference has led to the establishment of a community of practice of evaluators and interested experts to further work on best practices and emerging new tools and methods for monitoring and evaluation. This work should be encouraged, and I sincerely hope that this volume will be a fundamental step in a process that will support both global and national efforts to deal with climate change and development.

Monique Barbut
Chief Executive Officer and Chairperson
Global Environment Facility

Introduction
The Dual Challenges of Climate Change and Development

Rob D. van den Berg and Osvaldo Feinstein

Climate change has become an urgent and politically hot topic. Certainly this is recognized internationally: from the Nobel Peace Prize for Al Gore and the Intergovernmental Panel on Climate Change, to the diplomatic efforts to reach agreement on reduction of greenhouse gas emissions in a successor agreement to the Kyoto protocol. Although critics initially denied that climate change was happening, many later acknowledged its occurrence, but then took a defeatist position that it would certainly be too costly to do anything about it. This case was most convincingly made by a group of economists in the so-called Copenhagen Consensus, who argued that efforts to reduce greenhouse gas emissions would have "costs that were likely to exceed the benefits".[1] However, Nicholas Stern countered with the calculation that doing nothing would in the longer run cost the world a decline in GDP of up to twenty percent.[2] The debate will no doubt continue.

On development issues, the debate is relatively lukewarm. In fact, several traditional development issues emerged quite high on the list of the Copenhagen Consensus, such as fighting HIV/Aids and malaria, as well as combating malnutrition. Furthermore, trade reform as a means to support development was considered to lead to large benefits—so it seems that at least on these issues we can talk of a real consensus. However, the relationship between developing countries, development and climate change is again an issue that leads to a hotter debate, most of it taking place at the Conference of the Parties to the UN Framework Convention on Climate Change.

While it is clear that most of the international environmental problems have their roots in developed nations, it is also increasingly clear that developing countries will have to carry a large burden in repairing the damage. This can be shown along two lines. Since the UN Conference on Sustainable Development in 1992, many developing countries argued that higher environmental standards, especially regarding greenhouse gas emissions, would make it impossible for them to develop to the same level as the developed world. In order to meet the standards, and achieve global environmental benefits, they would need to be compensated for the additional costs. This was the fundamental idea behind the emergence of the Global Environment Facility (GEF), which at that time already existed as a pilot program of the World Bank.

The second line of reasoning follows the consequences of climate change and calls for countries to adapt to what is happening. Simulations of potential changes show that the effects of higher temperatures, changing rainfall patterns, and rising sea levels, will be especially damaging and harmful in developing countries. Recognition of these rising costs have led to the emergence of "adaptation" as a second important effort of the international community to address climate change and development issues.

Many donors and international organizations have been active on global, regional, national and local environmental issues since 1992. Evaluation Offices of these organizations have undertaken ex post project, program and thematic/strategic evaluations of environmentally sustainable development interventions. However, up to May 2008 no international meeting was organized in which these offices and their evaluators could meet and exchange experiences and discuss best practices. When the Evaluation Office of the Global Environment Facility was made independent in 2004, a quick inventory of international initiatives revealed the lack of international information exchange, especially on ex post evaluation of environmentally sustainable development interventions and policies.

In 2006 the GEF Evaluation Office received an initial grant from the GEF Council to start up the process of gathering interested parties to organize, for the first time, an international meeting of evaluators on the subject of environmentally sustainable development. Three avenues of action were explored. Firstly, active participation was sought from various professional networks of evaluators, which led to a partnership with first the International Development Evaluators Association (IDEAS), later to be followed by the African Evaluation Association (AfrEA) and the International Program Evaluation Network (IPEN) of evaluators in the newly independent states of the former Soviet Union.

Secondly, donors were invited to become partners in the organization and to provide additional funding. After initial and very welcomed contributions from Switzerland, Norway and Denmark, many other donors followed, leading to full funding of the meeting. Thirdly, various partners contributed in-kind and through intellectual support, such as the Agence Française de Développement (who also donated money) and the Climate Change Adaptation in Africa program, based in Senegal.

In the process of organizing this first international meeting, it was decided to focus primarily on climate change. Other environmental issues, such as biodiversity, persistent organic pollutants, ozone depleting substances and land degradation would—if they were included—lead to an excessively varied continuum of subjects to be discussed. As a result of the generous financial and intellectual support, and the interaction with the professional evaluation community, interest in the proposed international workshop grew. The workshop turned into a conference—and the results are incorporated in this publication.

Rather than a publication of proceedings, the conference Steering Committee recommended to publish the most interesting and challenging presentations and papers as a volume that would stand on its own. This is the line we have followed as editors. Due to time constraints of some authors, we have had to leave out some exciting papers. However, we feel that the chapters included in this volume are representative of what was discussed at the conference, and that they provide rich material for learning, future collaboration and inspiration.

The book is organized as follows. The first section deals with the big picture, as well as the challenges that the world community is facing. Attention is paid to the approaches that evaluators can adopt to better understand the problems and assess interventions, strategies and policies. After this section, described below, other sections follow on monitoring and evaluation of mitigation, adaptation and vulnerability issues.

The challenge that climate change poses for developing countries is most clearly formulated by Ismail Serageldin. His chapter juxtaposes, on the one hand, the agricultural production necessary to feed the poor, with the threats imposed by climate change and the energy needs of the rich world, on the other. If developed countries will proceed with crop production for biofuels, this will lead to an additional challenge for agriculture in developing countries. Serageldin is especially asking attention for the perverse effects of subsidizing the transformation of food and feed into fuel, pointing to various efforts in developed countries to promote alternatives for fossil fuels. Furthermore, he highlights the environmental consequences of these actions: the amount of land under cultivation will have to increase, whereas land degradation will continue. Some of the possible consequences are illustrated by Serageldin with Egypt as an example. With a 0.5 to 1 meter rise in sea level, salt-water intrusion in the Nile Delta will destroy 1,800 km^2 to 4,500 km^2 of agricultural land.

Next, the inter-linkages between climate change and development are discussed by Robert Picciotto. His point of departure is that climate change is part of the overall development challenge, which he feels is characterized by insecurity at many levels: globally, regionally, nationally and locally. After enumerating the other major threats to human security: hunger, disease, natural disasters, violence, global economic imbalances and fragile states, he proposes to integrate climate change issues into a general framework of human security. In his view this could become a new development paradigm. This framework could provide the inspiration for evaluators to link climate change to development.

Picciotto calls for evaluations of global policies and collaborative initiatives that shape the international response to climate change and other global threats to peace and prosperity. Cognizant of the fact that currently no evaluation office is mandated to undertake this kind of evaluation, he proposes independent multi-partner evaluations of international efforts to tackle climate change and development. Furthermore, development evaluation has to break through the current asymmetrical attention to assessing the performance of recipients and neglecting the evaluation of donors' actions and omissions. This is not just an issue of perspective, but also an issue of involvement and implementation. In the words of Picciotto, "It would make sense for rich country policies that affect poor countries to benefit from evaluations carried by evaluation organizations controlled by poor countries."

Whether the new instruments for climate change mitigation recognize and act upon their intimate linkage of climate change to development is the subject of Gupta's chapter. She and her colleagues have evaluated projects under the Joint Implementation and Clean Development Mechanism of the UN Framework Convention on Climate Change. After a very interesting overview of the different interpretations of the concept of sustainable development, the actual practice is reviewed, leading to sobering conclusions. The market for carbon trading seems to display a "tendency toward a race to the bottom", i.e., to projects that do not display any acknowledgment of how they could contribute to sustainable development. Currently, the carbon side of these projects needs to be calculated from a baseline and needs to monitor achievements;

however, on the sustainable development side no such requirements are in place.

The respective sections on challenges and meta-evaluations, mitigation, adaptation and vulnerability, each provide a rich overview of issues, approaches, tools and food for thought. To follow on Serageldin's playful title, let us hope that this publication will feed and fuel the debate amongst evaluators on the linkages between climate change and development, so that they can play their role in supporting people, nations and civilizations in dealing with these problems that threaten human security in the coming decades.

Notes

1. See *Copenhagen Consensus: The Results*, 2004, p. 3—published on www.copenhagenconsensus.com (November 2, 2008).
2. "Stern Review on the Economics of Climate Change," published on http://www.hm-treasury.gov.uk/6520.htm (November 2, 2008).

Part I

Climate Change, Development, and Evaluation

1

Food, Feed, Fuel, and Climate Change: Challenges, Threats, and Possible Actions

Ismail Serageldin

1. Introduction

The world in the twenty-first century is facing unprecedented threats and complex challenges driven by population growth, growing demands for food and feed, and biofuels developments. The crisis is being exacerbated by human-induced climate change. This unique situation can be summarized by the following equation: 3Fs + 2Cs, where the three Fs stand for food, feed, and fuel, and the two Cs for climate change.

This chapter tries to present a realistic assessment of the likely problems that we are going to face over the next few years due to this nexus. If we do not change the policies on food, feed, and fuel, and engage in global actions to reduce greenhouse gas (GHG) emissions and alleviate the damages of climate change and global warming, the consequences will be disastrous. One of the immediate effects will be an inability of agriculture to provide the food needed to meet the demands of a growing population, rising incomes, and competing uses for land and water, with consequent repercussions on the poor and the hungry.

2. The Threat to Food Security

"We are all on this earth the guests of the green plants and those who tend them." These wise words by M.S. Swaminathan remind us that people, cities, and civilization owe their existence to the agriculture and the agricultural services; and that leads us to analyzing the first part of the equation, the 3Fs: the food, the feed and the fuel.

By food we mean promoting food security for a growing population that is expected to reach 7.29 billion people by 2015.[1] As defined by the

"Plan of Action of the World Food Summit," food security is the "access by all people at all times to sufficient food, in terms of quality, quantity and diversity, for an active and healthy life without risk of loss of such access."[2] However, it is necessary for food to be accessible at all places at all times at affordable prices without causing any damage to the environment. The solution therefore is to produce differently not less; i.e., we have to produce more but our means of production should change.

We also have to realize that increasing production is necessary, but not sufficient, to achieve food security. It is impossible to confine agricultural production to some parts of the globe and ship food to the rest of the world. Focusing on the smallholder farmer in developing countries is key to environmental protection, poverty reduction and food security. But, if current trends in demand continue, we are going to have shortages in the near future.

3. How Much Food and Feed Will We Need by 2020?

The relatively old, but still valid, forecasts by IFPRI reveal that almost all the increase in world food demand will take place in the developing countries. According to the IFPRI IMPACT simulations issued in July 1999, the developed countries will account for only 16 percent of the increase in global cereals demand by 2020, and the developing countries will consume about 85 percent of the net additional cereals production between 1995 and 2020 (Figure 1.1). When it comes to roots and tubers the developed countries will account for less than 3 percent of the increase in demand versus 97 percent for developing countries (Figure 1.2). The same is also true for meat products, with 16 percent increase in demand by the industrial countries and about 85 percent increase by the developing countries (Figure 1.3).

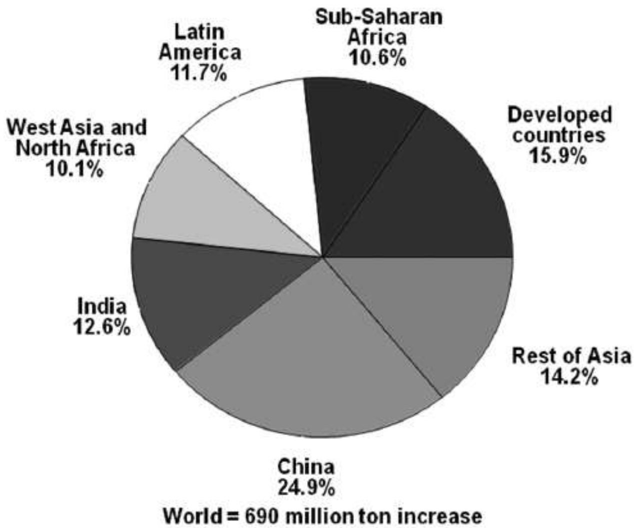
There is an assumption that in spite of incomes rise, India will still not significantly increase its animal protein consumption for cultural and religious reasons. If this assumption does not hold, the demand will be even greater, and that will, indeed, be a very serious problem.

4. Responding to the Production Challenge

Precision Farming

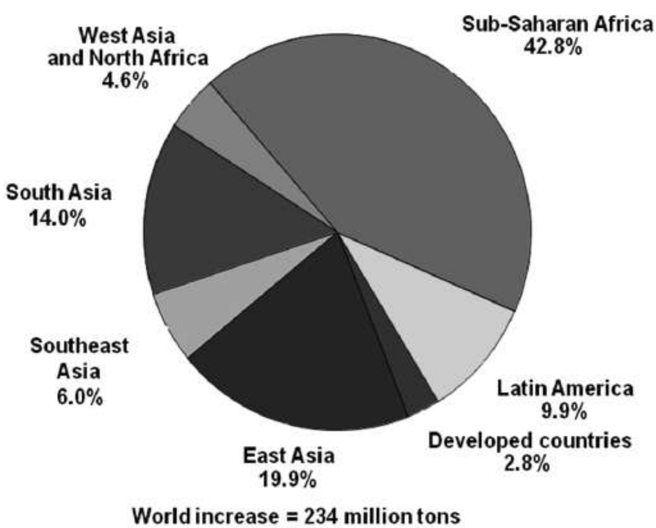
To be able to meet these high demands on food and feed we can either increase the area under cultivation (and this has a whole set of identified problems), or increase the yields through high input agriculture, or organic and peasant farming, or depend on sustainable precision farming which strives to combine best science and best management.

Figure 1.1
Share of Increase in Global Demand for Cereals, 1995–2020



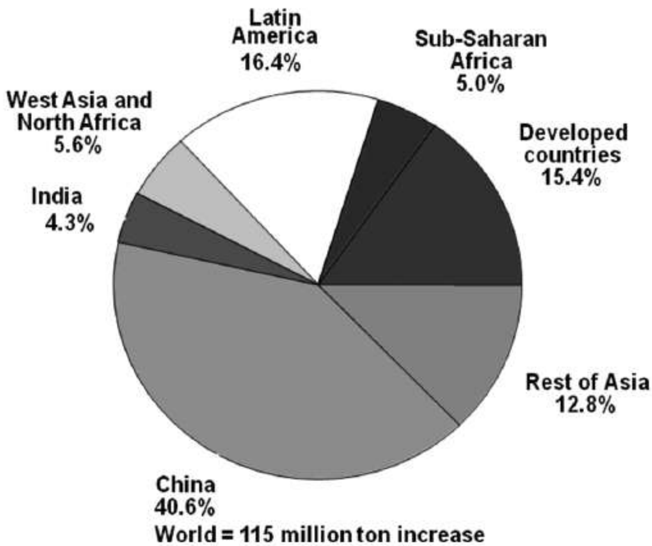
Source: IFPRI IMPACT simulations, July 1999.

Figure 1.2
Share of Increase in Global Demand for Roots and Tubers, 1995–2020



Source: IFPRI IMPACT simulations, July 1999.

Figure 1.13
Share of Increase in Global Demand for Meat Products, 1995–2020



Source: IFPRI IMPACT simulations, July 1999

Despite its efficiency, high-input agriculture has had environmental costs. Between 1950 and 2000, the use of fertilizers increased by 23 times and pesticide use increased by 53 times, which had huge impacts on the environment.

The agricultural research community believes that science can bring about a sustainable ecologically balanced precision agriculture. This can be achieved by maintaining the right balance between increasing the production and sustaining the environment. It implies managing the operations that increase biological yields, improve nutrient content, and intensify agriculture as well as managing natural resources sustainably. The role of science is to move from what was known in the seventies as the green revolution, to a "doubly green revolution."

Expanding the Narrow Food Base

Expanding humanity's narrow food base must go hand in hand with increasing the yields of traditional crops. There are more than 250,000 known plants, most of which are not edible and many are poisonous. However, of these 250,000+ known plants, at least 20,000 are edible. Of these, only 3000 were sampled, a few hundred were cultivated, and only a 100 were seriously cultivated (i.e., were in the crop lists some 50 years ago). Today, only 12 plants account for 95 percent of all human food crops, with the big four being: rice, wheat, maize, and potatoes. The big four alone account for 80 percent of the total consumption.

This very narrow food base needs to be expanded to other plants that are more resistant, like soybean. Gene banks and the biotechnological revolution are working on this kind of research. They can help move from a green revolution to a "doubly green revolution," then to an "ever green revolution," with more genetically diverse crops, less reliance on pesticides and chemical inputs, and more interaction with nature's biological controls. The ever green revolution also implies the integrated management of soil, water, and nutrients, and the recognition of the socio-economic and the gender dimensions of the land workers. For instance, it can be geared to solve the problems of the African female farmers who currently produce 80 percent of the food, but receive only 10 percent of the wages and own 1 percent of the land.

Equally important is the promotion of alternatives to slash and burn agriculture in sub-Saharan Africa to reduce post-harvest losses that sometimes reach 30 percent. Above all, as the primary purpose of agricultural production is to feed people, efforts must be geared toward increasing the nutritional content of the food. The potentials of genetics and biotechnology are unlimited, and the applications are diverse, however, focus should always be on adopting pro-poor, pro-women and pro-environment policies.

5. The Potentials of Biotechnology

Today, there is a widespread and accepted use of the modern molecular genetics in some issues like tissues sampling, marker edit assistance, and genetic mapping. The new biology opens completely new possibilities. Now with our genetic understanding, we are going beyond marker-assisted selection, tissue culture and genetic maps, to recognize the new revolution in genomics, the QTL analysis and the selection of valuable genes and not only phenotypes.

We can mobilize the genetic revolution to the use of biotechnology and genetic imperatives to improve the agricultural practices. By combining traditional wisdom with modern science, the limits can be pushed even further.

No doubt, different regions will need to address different problems, but all will require the best of science. To achieve this, the need rises to reinforce our scientific research capability, especially in agriculture, focusing on the problems of the poor, not on the extravagant needs of the rich.

Thinking about the future of biotechnology, I always imagined that we would be assembling genomes like Lego sets, and that maybe American farmers would make use of biotechnology to exponentially increase their yields or to produce huge size vegetables.

6. The Genetic Revolution and Human Nutrition

It is possible to gear the capabilities of science to respond to the needs of the poor. One of the applications could be to produce high resistant crops with increased nutritional content. For instance, we can, by 2020, produce super upland rice that is high yielding, disease resistant, drought, cold, and pest tolerant, with perennial stems, erosion minimizing, weed suppressing, adapted to adverse soils, nitrogen fixing, and deep rooted.

Some of the applications in targeting better nutrition already exist. Biofortification has been used to produce Golden Rice and edible vaccines. In spite of public fears regarding genetically engineered foods, all the academies of science assert that the final protein obtained, and not the genetic path, is what really matters.

Genetically engineered foods can help improve human nutrition. A case in point is "Golden Rice" or "Vitamin A rice." Given that vitamin A deficiency causes half a million deaths in children annually, as well as blindness in 14 million a year, Vitamin A rice can be improved for the poorest of the poor.

Biofortification of crops is an important solution that should be considered, not just to increase the amount of food produced, but also to better the quality of this production.

Another example of biofortification is "quality protein maize" that can be used to grow animals for human feed. This has been experimented on pigs and the results have been remarkable. Genetic engineering can also help in producing edible vaccines that can fulfill the future promise of creating vaccines capable of inducing longer and more productive lives.

7. Changing Diets and Feed Requirements

There is a livestock revolution driven by rising incomes, especially in China. As incomes grow, diets change to include more animal proteins. Between 2000 and 2020 world demand on meat will increase from 233 million tons to 300 million tons, and on milk from 565 million tons to

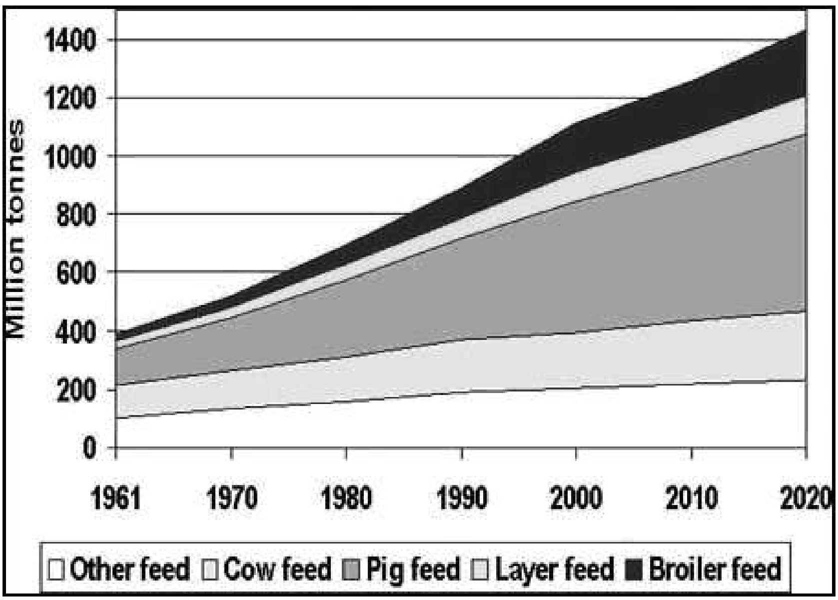
700 million tons, and on eggs the increase in demand is expected to reach 30 percent.

Figure 1.4 shows the FAO's forecast of the huge increase in feed requirements between 1961 and 2020, going from 400 million tons up to 1400 million tons over a period of 40 years (Figure 1.5). This increase will largely be met by industrial methods, not by small farmers.

Free range chicken farming method (which presents the risks of diseases, avian flu, and all the other associated problems), is currently losing ground to mass industrial farming.

In addition, there is not enough rangeland to graze cows any more. Increasingly, animal feed is needed to overcome that. Moreover, each of the animal products has a multiplier effect difference from human eating the grain itself.

Figure 1.4
All Feed Requirements to 2020 (projected world growth in demand for animal feed based on existing feed conversion ratios and carcass yields)



Source: Andrew W. Speedy, "Overview of world feed protein needs and supply," in *Protein Sources for the Animal Feed Industry*: *Expert Consultation and Workshop (Bangkok, 29 April - 3 May 2002),* FAO Animal Production and Health Proceedings (Rome: FAO, 2004).

First, there is the conversion ratio of food to feed, then what is known as the carcass yield is added (i.e., the net weight of meat to be eaten of the live weight of the animal). For instance, the beef converts at 7:1, which means that 7 kilos of grain are converted to 1 kilo of cow. With a carcass yield of 60 percent, each kilo of cow will give a net of 0.6 kilo of meat. Chickens are somewhat better, with a convert ratio of 2:1 and a carcass yield of 70 percent. Egg's production has a 2:1 food conversion ratio. Thus, the feed revolution is laying pressure on the demand for crops, especially maize and corn.

8. Biofuels' Requirements

The world food crisis is aggravated by biofuels developments and by the insistence of many governments to increase the share of biofuels in transports in the coming years. In addition to the economic and ecological considerations involved, human and ethical concerns continue to exhort that we should not "burn the food of the poor to drive the cars of the rich."

This is a veritable challenge, as a large part of agricultural production in the United States is being subsidized to move away from food and feed towards biofuel production. While the scientific community is actively discussing the "Wrong Way" and the "Right Way" to produce biofuels, the public opinion has been captured by enormous campaigns that boost the political determination to increase their share in transport.

The question is "how green are biofuels?" Surprisingly, almost all of them are absolutely 'not green'. In fact, they hardly present any balanced contribution to the environment.

There are different biofuels products the most important of which are: corn ethanol, cellulosic grasses, Bio-diesel from algae, and sugarcane ethanol in Brazil. These different products have different environmental benefits and costs. They also differ in their effectiveness to produce biofuels.

The corn ethanol being subsidized in the United States has, at best, a conversion ratio of 1.3 and a 22 percent increase in environmental benefits. Grasses are much better, because they grow from the root, and do not need to be replanted if they are properly harvested. Their conversion ratio is between 1:2 and 1:36, depending on the harvesting system and the production method, and they have a 91 percent increase in environmental benefits. There are also possibilities from the sea that are worth exploring, such as the German initiative to produce bio-diesel from algae. Sugarcane in Brazil has a conversion ratio of 1:8 and is 56 percent less in greenhouse gas (GHG) emission than fossil fuel. However, this system has a huge human cost because people who tend the sugarcane are working in very poor and unhealthy conditions. However, the Brazilian government maintains that these are very poor people who would otherwise be jobless.

Synthetic biology is offering new mechanisms to produce truly green biofuels. The Venter's Institute has filed patents in the United States and in more than 100 countries for a synthetic lifeform produced entirely in the lab. The new synthetic biofuels are produced from a single-cell organism, and are in no need of further purification.

9. The Impacts of the Food, Feed, Fuel Combination

The future of this food, feed, and fuel combination is still unknown. However, we should not be subsidizing the transformation of food and feed into fuel. The current policies, especially the subsidizing of ethanol, have had disastrous results. In 2006, federal and state subsidies accounted for about $6 billion (which is equivalent to roughly half its wholesale market price). Moreover, there is a 51-cent per gallon domestic subsidy, and an additional 54-cent per gallon tariff applied at the border against imported ethanol. Both, the subsidies and the border tariff, have led to an enormous increase in the amount of land that is allocated to bio-ethanol production.

If the target set by the Bush administration is to be met, by 2017, the entire US corn harvest would have to go for bio-ethanol. The withdrawal of such a huge proportion of maize from production for food and feed, will have an enormous impact on prices. Corn prices rose nearly 80 percent in 2006, and 80 percent more in 2007. This immediately affected the poor whose food is principally based on corn. In Mexico, which uses corn-based tortillas, tortilla riots raged as corn prices went up.

The environmental impact of such a combination has also been disastrous. If the food-feed-fuel combination is to be continued with the same rate on agriculture, the amount of land under cultivation will have to significantly increase at the time where natural eco-systems are disappearing very rapidly.

The environmental cost of losing forests for agriculture, especially monoculture, will have negative effects on climate change as well. Throughout the last decades land use has witnessed considerable transitions. Agricultural lands, rangelands, and urban areas have expanded threatening the biodiversity and the sustenance of the eco-system.

The most vital action that should be taken is to reduce the need for more land under cultivation, by protecting the existing forests, the loss of which is a very big environmental cost. Unfortunately, 44 percent of the total landmass of the planet has been lost to agriculture. It is also important to save agriculture, as this means saving habitats, biodiversity, and land and marine ecosystems. Reducing pollutants is equally essential in preserving the environment.

10. The Water Stress

Water scarcity and water pollution are among the major threats facing our planet. There are global water tensions driven by population growth, industrialization, rapid urbanization, growing food requirements, and changing diets.

Agriculture alone accounts for two thirds of global water withdrawals with 80 percent-90 percent in the developing countries. A recent study has revealed that, on average, a person consumes 2700 liters of freshwater per day, transformed in the form of food. This corresponds to one liter per 1 calorie.[3]

The current level of water use risks harm to the water ecosystem and does not leave us much room for more renewable water resources. One of the direct effects is that many rivers are running dry. Due to growing diversion of fresh water by individuals and countries, many of the rivers fail to meet their outflow to the sea during part or all of the year. The Yellow River did not reach the sea for 220 days in 1997. This outflow to the sea has several functions such as flushing out sediments and diluting polluted water.[4]

What would the situation be if this happens to the Nile? The Nile reaches Cairo with about 12 million tons of salt, and reaches the sea with 34 million tons of salt. If the Nile fails to reach the sea, these 34 million tons of salt will stay in the Delta and destroy the agricultural land.

Wetlands loss is another problem. In the last hundred years, 50 percent of the world's wetlands have been lost, some have been transformed to development and some to agriculture.

The situation is aggravated by the overexploitation of groundwater, which is being mined at unsustainable rates. About 10 percent of world grain production depends on unsustainable aquifer withdrawals. Also, subsidized energy draws down water tables, which are dropping at a rate of 1 meter per year, and even more in places like the Sahel. This causes human disasters in the poorest and driest areas of the world, and, if continued, it can result in droughts, desertification, and generate new forms of environmental refugees.

Such events have already taken place in some parts of the world. A few years ago Niger suffered from a severe drought that threatened the lives of 3 million people. At that time, existing food surpluses were used to save those people's lives. Today, buffer stocks are much lower and the prices are higher, and this will eventually lead to a major catastrophe.

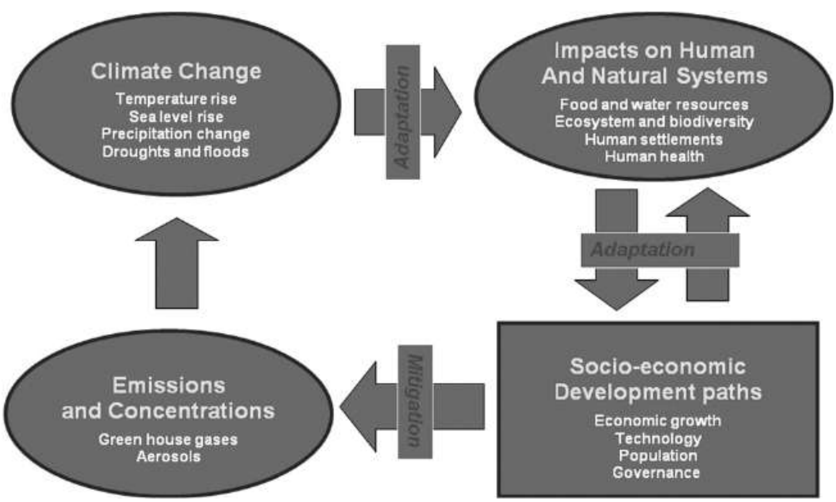
The solutions lie in improving water productivity to achieve "more crop per drop," in using supplemental irrigation, and in reducing water pollution. We also need to use new tools; one of which is bio-remediation that allows treated wastewater to be re-used.

11. The Impacts of Climate Change

Climate change is the most crucial issue facing humanity today. The effects of global warming already began; and here is where adaptation and mitigation come, between: our socio-economic development path, climate change, emissions and concentrations on one side and the impacts of all these on the various the eco-systems on the other (Figure 1.5).

The Economics of Climate Change: The Stern Review, by Sir Nicholas Stern, published in 2007, studies the possible impacts in economic terms

Figure 1.5
Climate Change, an Integrated Framework. This is a standard framework that has been around since the early 1990s, for thinking about the problem of climate change.



Source: Reproduced after The Intergovernmental Panel on Climate Change of climate change on different world systems, including food, water, eco-systems and extreme weather events. The report focuses on climate change and does not take into account the food-feed-fuel combination presented earlier in this chapter.

The climate change models predict more variability for the next coming years, including more storms and extreme weather events. This is supported by data and by past events. It is clear that between 1995 and 2004, with a warmer weather, the hurricane tracks became much more intense.[5]

Moreover, in the past five years, the hurricanes have had the most devastating, shattering, and long-lasting effects. Hurricane Katrina in New Orleans in 2005 was one of the strongest storms to hit the United States' coasts during the last 100 years. This alarming situation requires the governments that have long ignored the issues of global warming and climate change to act on alleviating their impact and preventing more deterioration.

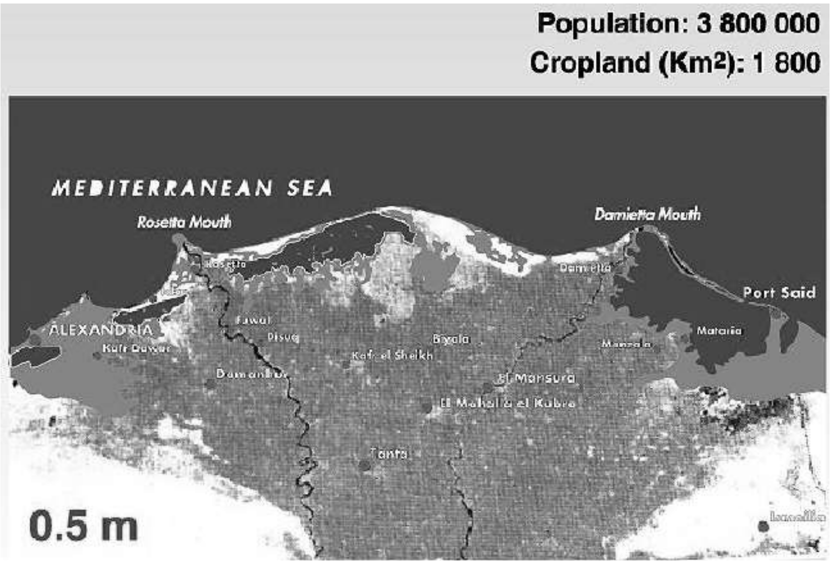
In addition to the risks of multiplying the extreme weather events such as storms, floods, droughts, and heatwaves, climate change will also result in rising sea levels and melting glaciers, affecting the availability of freshwater and contributing to an increased risk of coastal flooding. Some countries will suffer from the intrusion of salt water in their agricultural lands, in addition to threats to the large populations living in deltas.

Egypt is one of the areas most vulnerable to the effects of climate change. Even under the most optimistic scenarios, it faces a high risk of coastal flooding in the Nile Delta. With a 0.5 to 1 meter rise in sea level, salt water intrusion will destroy 1800 km^2 to 4500 km^2 of agricultural land. The rising sea level will also have an enormous impact on 3.8 million to 6 million people who live in the Delta (see Figures 1.6 and 1.7). Another impact of the climate change will be the rapid disappearance of the coral reefs, an important source of biodiversity, and a resource in which Egypt is very wealthy. By losing these coral reefs, the world is moving from magical gardens to dead landscapes.

12. How to Respond to Climate Change

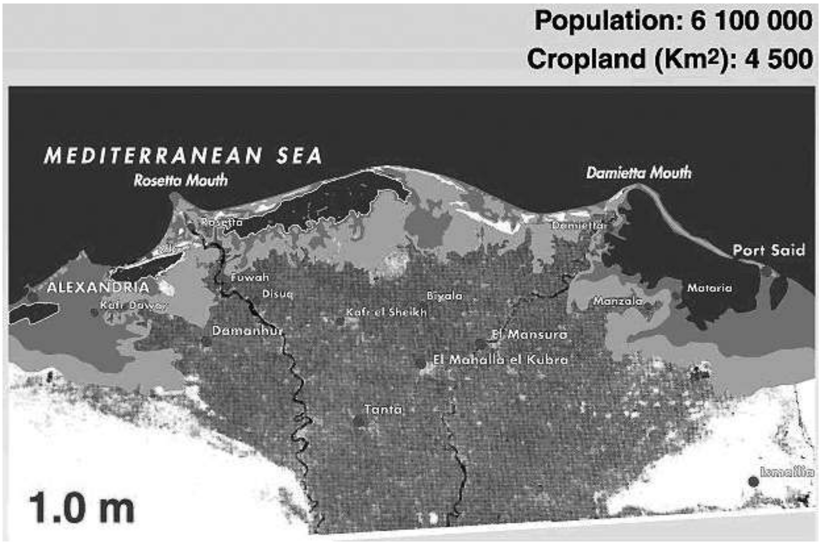
Responses to climate change should consider: the energy sector, the poor, and the human behavior. There should be a consensus on some global actions in the energy sector, like the adoption of cleaner energy and wiser policies. Next generation biofuels could provide some solutions but they are a decade away from commercial application. The commercially available biofuels are not the best answer to the problems of climate change, besides they are creating extreme pressure on food availability

Figure 1.6
Impact of Rising Sea Level on the Nile's Delta (0.5 m)



Sources: Otto Simonett, UNEP/GRID Geneva; Prof. G. Sestini, Florence; Remote Sensing Center, Cairo; DIERCKE Wellwirtschftsatlas.

Figure 1.7
Impact of Rising Sea Level on the Nile's Delta (1 m)



Sources: Otto Simonett, UNEP/GRID Geneva; Prof. G. Sestini, Florence; Remote Sensing Center, Cairo; DIERCKE Wellwirtschftsatlas.

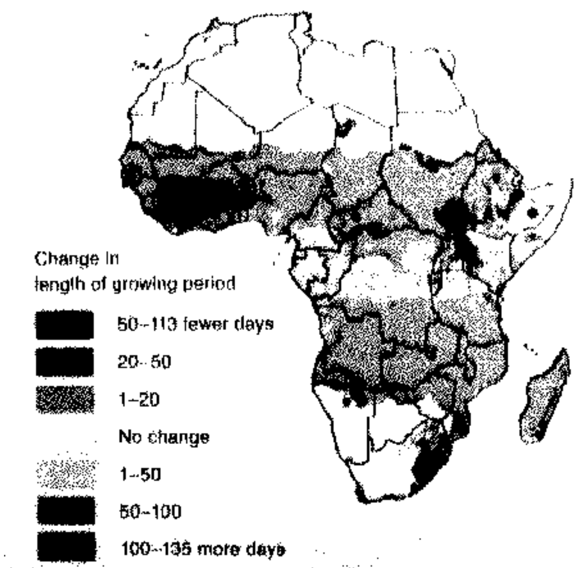
and prices. There is a need for environment friendly energy sources, especially in the growing mass transport sector, like fuel cell buses.

The renewable sources of energy must be revisited, including wind energy, modern wind energy, photovoltaics, both huge and small, atomic energy, and nuclear energy.

Climate change should also be placed within the proper context of sustainable development with focus on the problems of the poor. The poor should be the highest priority, as in developing countries, most farmers live precariously and will therefore fail to cope with the impacts of climate change.

In Africa, in particular, there will be an increase in rainfall variability increasing the insecurity of rain-fed agriculture. Consequently, the growing season will be dramatically reduced in the vast majority of Africa with the exception of some small scattered parts (Figure 1.8). This will lead to declines in crop yields increasing by millions the number of

Figure 1.8
Change in Length of Growing Period Due to Climate Change



Source: P.K. Thornton and al, "Mapping Poverty and Livestock in the Developing World," Report commissioned by the UK Department for International Development, on behalf of the Inter-Agency Group of Donors Supporting Research on Livestock Production and Health in the Developing World (Nairobi: International Livestock Research Institute, 2002) people at risk of hunger and malnutrition. As the risk of droughts and floods will increase, so will the vulnerability of the poor populations to their deadly impacts.

13. Conclusion

The strategic approach to addressing the problems of 3Fs + 2Cs revolves around six actions: public education, behavioral change, addressing priorities, engaging in immediate improvements, mitigating climate change effects, and harnessing new technologies.

Harnessing individual behavior, through public education and community-based actions, is vital to address the challenges facing humanity. It requires behavioral change and public awareness regarding consumption, waste and preserving the environment. It also requires reducing poverty and social marginalization, promoting a new role for women, and striving for dialogue and cooperation instead of wars.

Solving the food, feed, and fuel problem requires focusing on the priorities, a better management of our water resources to achieve more crop per drop, and better and more human agricultural policies to address the food insecurity, rather than focusing on biofuels developments.

In climate change, immediate improvements that do not require brand new technologies are possible, including mitigation on the global level and remedial actions in the affected areas.

Equally important is harnessing new technologies, like nanotechnology, remote sensing, and biotechnology, in order to find innovative solutions for the pressing problems of the world.

All these strategies have to be implemented simultaneously for maximum effect, and they should be implemented globally, and directed towards the benefit of the whole world and the next generations.

Acknowledgments

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Notes

1. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision.

2. Food security has been defined in these terms in the "Plan of Action of the World Food Summit" held in Rome in 1996.
3. International Water Management Institute, *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, edited by David Molden (London: Earthscan, 2007).
4. Ibid.
5. See Chris Caroll, "In Hot Water," *National Geographic* 2 (August 2005): 72-85.

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2

Evaluating Climate Change and Development

Robert Picciotto

1. The Challenge of Climate Change

After a long period of denial and evasion, a science-based consensus about the nature of climate change is at long last available. Facts evinced through modern research methods (ice borings, satellite observations and computer modeling) have confirmed laws of physics and chemistry known since the nineteenth century: increased carbon dioxide and other greenhouse emissions (e.g., methane and nitrous oxides) trap larger amounts of heat energy in the atmosphere and, since the industrial age, atmospheric greenhouse gas levels have risen from 280 parts per million (ppm) to 430 ppm. The earth has become warmer—by 0.7 degrees since 1900.[1] Voters everywhere have become convinced that something must be done.[2]

There Is Much That We Do Not Know about Climate Change

We lack reliable predictions about local impacts (let alone about the best ways to mitigate them and/or adapt to them). The impact of climate change will vary considerably from place to place. There will be winners and losers. Sorting out the effects of climate change, assessing local impacts and formulating mitigation and adaptation responses are critical priorities for evidence-based public policy and therefore for evaluation. The climate change challenge is fraught with risk and uncertainty and a complex research and evaluation agenda lies ahead.

We do not fully understand the mechanisms that translate the carbon-intensive character of current development patterns into higher temperatures. The contribution that industrialization has made to warming as compared to natural factors cannot be isolated with confidence. We do not know for sure how much time we still have to avert disaster.[3] Nor do we have clear-cut evidence about the speed of the on-going ecological deterioration or about the likelihood of large-scale, nonlinear disruptions in weather patterns and water availabilities.

Thus, there is uncertainty about the extent of future flooding of low-lying and coastal areas; the degree to which large-scale population displacement will result; the need for new coastal and flood protection infrastructure; the costs and benefits of adaptation programs, etc. A vast and complex evaluation agenda lies ahead. But there is incontrovertible evidence that rising population and energy intensive industrialization are the main root causes of an unprecedented and exponential rise in greenhouse emissions.

Human Activity Underlies the Global Warming Phenomenon

The Intergovernmental Panel on Climate Change (IPCC) considers it "very likely" that "most" of the 0.5 degree increment experienced over the last quarter of the twentieth century can be traced to population growth and fossil fuel-based production and consumption patterns that have accelerated the rate of warming over the past thirty years. The increments amount to 0.2 degrees per decade. The ten warmest years on record have been experienced since 1990. Sea levels are up. Rainfall patterns have become more variable. Ice sheets and glaciers are melting.

Stabilizing emissions while sustaining economic growth is a core development challenge. But little can be done to reverse the effects of past emissions. At current emission levels, greenhouse gas levels would still rise to 550 ppm by 2050 and available computer models project that as a result the temperature of the planet would increase by 2-5 degrees or more. Such temperatures lie outside the realm of human experience. Higher temperatures would be reached if economic growth continues apace without major changes in development patterns.[4]

Climate Change Is Part of the Overall Development Challenge

Because the climate change phenomenon is insidious, complex and fraught with unusual uncertainty, it is widely perceived as a free standing threat and an arcane knowledge domain reserved for specialists. In fact, it is an integral part of the development challenge if only because the on-going environmental degradation is due to unsustainable development policies that are making the eco-system more sensitive to climate change.

Unchecked development is inducing the rapid destruction of tropical forests. Many land-based species are facing extinction. Biodiversity hotspots are threatened. The environment of the Arctic and of mountain areas is under stress. The acidification of oceans is damaging mollusks, plankton, mangroves and coral reefs. Marine ecosystems and fish stocks are in jeopardy. Mammals in Africa and butterflies in Australia are at risk.

Ominously, complex feedback loops seem to be associated with the warming and drying of wetlands, the thawing of permafrost regions and the unabated destruction of rainforests that are curtailing the absorption capacity of natural carbon sinks. Already, warning signals point to serious and irreversible ecological damage. Catastrophic outcomes cannot be ruled out.

The Damage Will Be Far Worse in Poor Countries than in Rich Countries

Temperature rises due to the greenhouse effect are expected to be highest in high latitudes and continental regions. But Europe and North America will experience the countervailing cooling effect of disrupted ocean currents. These will initially moderate the warming effect of greenhouse gases. But as global warming takes hold, cold-related deaths will decrease and crop yields will initially improve (for temperatures rises of 3 degrees or less). However, they will eventually deteriorate when temperatures pass a critical threshold.

Once atmospheric temperatures rise and ice melts, more flooding is likely to occur so that major infrastructure projects will have to be built and large-scale population resettlements may have to be undertaken. While rich countries will be in a position to generate the resources needed to adapt to climate change, in the low latitudes the damages will be high and poor countries will be hard pressed to adapt to higher temperatures. The subtropics as well as the Mediterranean region and northern Africa will become even hotter and drier. Dry season water supplies will become scarcer in the Indian subcontinent, parts of China, and the Andes in South America.

The bottom line is that low latitude and low-lying areas will be the hardest hit and that crop yields will decline, especially in Africa. As a result, malnutrition is likely to rise[5] with deleterious health consequences especially if vector borne diseases are allowed to spread. The poorest countries will be especially vulnerable given their location (low latitudes), their reliance on climate sensitive sectors (agriculture and fisheries), their limited access to capital, their weak institutions—and their existing economic and social problems.

These stubborn realities confirm that the time has come to reconsider a development model grounded in the illusory notion that natural resources and the capacity of nature to absorb waste are infinite.[6]

2. Insecurity Characterizes the Prevailing Development Model

A Symbolic Policy Response

The burden of expert opinion is that emissions should be stabilized within a 450ppm to 550 ppm range.[7] The policy response to this challenge change has been inadequate and largely symbolic. The 1997 Kyoto Protocol was endorsed by 165 countries but it excluded developing countries; it was rejected by the United States (which accounts for 21 percent of emissions) and overall compliance so far has been spotty.[8] Absent a more robust response,[9] the burdensome consequences of global warming will be passed on to future generations. This is not altogether surprising: development cooperation writ large has not elicited the commitment of resources and innovation that it deserves either.

A Mixed Development Record

To be sure, the current market-driven, growth-oriented development paradigm has delivered impressive results. While it took the United Kingdom more than sixty years to double output per person (1780-1838), Turkey did it in twenty years (1957-77); Brazil in eighteen years (1961-79) and China and Korea in ten years (1977-87). During the second half of the twentieth century, life expectancy rose from 41 years to 65 years; infant mortality rates dropped from 11 percent to less than 6 percent and net primary school enrollments for girls rose from 67 percent to 82 percent.

These are extraordinary advances but they are far from universal. Most poor countries have been left far behind. Income inequalities are high and rising. The number of poor people living on less than one dollar a day is well over 1 billion. Outside of China it has gone up instead of down. Millions of lives are being lost to violent conflict and to disease pandemics. Last but not least, the physical environment is under severe stress: according to Worldwatch, nearly one in six species of European mammals is threatened with extinction; all currently fished marine species could collapse by 2050 and the Artic Ocean could be ice-free during the summer by 2020.

3. Climate Change Is One among Many Mega-Threats

The future is already here. Opinion surveys confirm that while environmental threats are fully recognized as serious by a majority of poor people they also perceive fewer economic opportunities and more insecurities than in the past. For most of them, there are far more immediate threats to their livelihoods than global warming.[10]

While climate skeptics are wrong on the science they are correct in stressing the dangers associated with a single-minded focus on global warming.[11] Other development obstacles must be addressed in parallel. Specifically, unless rich countries give development assistance the priority it deserves, poor countries are unlikely to do their part in addressing the climate change challenge. This adds up to a collective action dilemma: long-standing development risks are bound to be aggravated by global warming and undermine further the tenuous prospects for global poverty reduction.

Hunger

First and foremost, eradicating hunger is central to the vision of a world free of poverty. About 850 million people go to bed hungry every night. The number of food emergencies has risen from about 15 a year in the 1980s to more than 30 a year since the turn of the millennium. Most of the increase has been in Africa, where the share of food emergencies attributable to human causes (violent conflict, sub-standard economic performance) has doubled over the past two decades.[12] All in all, the number of hungry people has risen over the last five years for which data are available.

Overall progress towards the Millennium Development Goal of halving the number of chronically hungry people by the year 2015 has been slow and halting. Poor nutrition is an underlying cause of child mortality in more than half the cases. Every day 17,000 children die of malnutrition. The United Nations' Food and Agriculture Organization (FAO) estimates that the opportunity cost of current levels of hunger and malnutrition in developing countries amounts to about USD 500 billion a year in present-value terms. Recent food price rises and tight supplies have reached crisis proportions and are threatening global security.[13]

Disease

Poor health is connected to hunger. It can be tackled most readily with additional resources. Prevention could avoid most of the 10.6 million deaths of children that occur annually. Provision of clean water and sanitation would drastically improve health in poor countries. Meeting family planning needs and providing for safe abortions and adequate antenatal care is critical since complications from childbirth are the leading cause of death and disability among women in poor countries.

Disease and poverty are highly correlated. Poor countries account for 90 percent of diseases and only 11 percent of health spending. Vaccination for eight diseases could save 2.3 million lives a year in poor countries where traditional diseases such as tuberculosis, cholera, and malaria have not been eradicated. Indeed, they have spread while devastating new threats such as HIV/AIDS, hepatitis C, and Ebola have emerged.[14] Research and development spending in health is skewed against the problems of the poor. Only one percent of the drugs that reach the global market are targeted to tropical diseases that account for the greatest number of casualties.

Natural Disasters

Natural disasters have been growing in frequency and severity.[15] Twice as many of them were recorded in the 1990s as in the 1970s. The poorest countries have been the most vulnerable—53 percent of natural disaster deaths have taken place in very poor countries that are home to 11 percent of people exposed to natural hazards. The tsunami disaster, the ravages caused by Gulf of Mexico hurricanes and the Kashmir earthquake point to the need for vastly improved disaster preparedness capacities.

Violence

The center of gravity of violence has moved south. Even though the risk is vastly exaggerated by the politics of fear, there is little doubt that the threat of terrorism is getting worse. The number of attacks has grown more than eightfold over the last two decades. Most of its victims have been in developing countries. Since the end of the Second World War violent intrastate conflicts have continued to erupt, all of them in poor countries. They have involved grotesque human rights violations. Civilians rather than combatants have been the main victims.

Violent conflict is development in reverse. In Africa alone, the number of internally displaced people is 13 million and the number of refugees is 3.5 million. The average intrastate war costs about $64 billion. The Iran-Iraq war is estimated to have cost both countries around USD 150 billion; the 1991 Gulf War is calculated at USD 102 billion. The Kashmir conflict is estimated to have cost India and Pakistan together around USD 35 billion while, according to Joseph Stiglitz the cost of the Iraq war runs into trillions of dollars. Along with unprecedented economic opportunities, the process of globalization has increased the risks to human security through cross border spillovers of violence and increased economic volatility.

Global Economic Imbalances

Economic shocks are now transmitted instantly throughout the world. Financial crises are frequent and hurt the poor disproportionately (e.g., Korea's Gini coefficient went up from 32.6 to 37.2 following the crisis). Given divergent and self-centered national policies, imbalances have become engrained in the international economic system. The current account of the United States has shifted from rough balance to a deficit of over 6 percent of GDP since the 1990s.

The U.S. dollar is in decline and the U.S. national debt has ballooned to over $8 trillion (22 percent of GDP). For the first time since 1933 the personal savings rate of Americans has moved into negative territory. Conversely, foreign currency reserves outside the United States have jumped by $2 trillion since 2001. A paradoxical situation has been allowed to take hold: the low- and middle-income countries of the world are funding unsustainable consumption levels in the United States. From a poverty reduction perspective, there could not be a more shocking example of policy incoherence.

Fragile States Lie at the Core of the Security and Development Challenge

All of these insecurities have their greatest impact in fragile states that are home to a third of the absolute poor—Paul Collier's "bottom billion." These countries display regional imbalances, inadequate social services, lack of social safety nets and poor natural disaster preparedness. Many are ethnically fractured and saddled with a youth bulge that is heightening the risks of deadly strife given widespread unemployment and pervasive social exclusion patterns.

Consequently, for many fragile states the migrations caused by global warming; the predicted falls in farm incomes wrought by droughts and floods; the diseases caused by malnutrition and higher temperatures could mean a descent into civil unrest and violent conflict. Paradoxically, while fragile states desperately need aid to achieve peace and prosperity they are being shunned by a development industry intent on avoiding risk instead of managing it—the unintended consequence of faulty development effectiveness metrics.

4. Global Warming Is an Unprecedented Policy and Evaluation Challenge

Climate change confirms that in an increasingly interdependent world the problems of others have become our own. Other development problems (hunger, disease, natural catastrophes, violence, and economic stability) cry for attention but they are inextricably interconnected with global warming and like global warming they are problems "without passport" that only international cooperation can solve through clear-eyed policy making.

Unfortunately, the front pages of newspapers illustrate daily how the downside risks of economic growth are amplified by incoherent global policy responses made worse by inadequate evaluation. For example, the greatest shock to the global economic system since the Great Depression we are currently witnessing results from global imbalances, uncoordinated policy responses - as well as a credit crunch indirectly due to inept evaluations of mortgage loan applications and faulty evaluations of exotic financial instruments.

Similarly, floods in China and droughts in Australia have contributed to a looming food crisis that is threatening millions of poor people with starvation. These weather perturbations have been intensified by runaway greenhouse emissions due to energy intensive development policies. Soaring grain prices have also been caused by increased incomes in Brazil, Russia, India, and China and the resulting boom in meat demand met by corn-fed cattle and chicken industries.

In addition, food production has been held back by hideous distortions in international market prices that are the direct result of rich countries' protectionist policies. Equally, misguided promotion and subsidization of biofuel production by high-income and middle-income countries (facilitated by naïve environmental assessments) has been a significant factor behind the spiraling food prices. Equally, wrong-headed application of the precautionary principle has inhibited in biotechnology research and the advent of new genetically modified crop varieties adapted to arid climates.

On Its Own, the Market Cannot Solve Global Warming

Directly or indirectly, policy and evaluation dysfunctions have added to the insecurities of an interdependent global system. Inadequate evaluation of global policy is part of the explanation. This is because evaluation is to public policy what accounting and auditing are to private sector activity. Where markets do not exist or give the wrong signals (e.g., when human activities that depend on scarce common pool resources are carried out independently and without mutual agreement) evaluation is a critical component of effective governance.

For example, open pastures are subject to rapid deterioration as a result of uncontrolled grazing that is not properly monitored by a superior authority. Similarly, the natural sinks for greenhouse gases are gradually being overwhelmed by excess emissions. The resulting "tragedy of the commons" is notoriously hard to overcome since common pool resources encourage free riding and the market mechanism cannot be counted on to limit demand or generate an adequate supply of the public good.

Without institutions equipped to protect the public welfare, incentives are distorted. Thus, the individuals, groups, and nations that generate most greenhouse gases only bear a fraction of the costs of warming. They incur no direct penalty for their behavior, while losers are denied compensation since they are numerous, poor, weak, and dispersed.

Climate change is the quintessential global market failure. But it is not the only one. It merely illustrates the asymmetric character of an integrated global economy in transition. Nicholas Stern hit the nail on the head when he described global warming as "*the greatest and widest-ranging market failure ever seen*." Neither can the market on its own solve the human insecurities caused by hunger, disease, violent conflict, natural disasters economic volatility or state fragility.

5. A Broader and Deeper Global Compact

On the other hand, success in tackling climate change would show the way for the resolution of other development dilemmas. It would offer hope that all major development risks can be managed. But in order to tackle the climate change challenge, a broader and deeper compact between rich and poor countries will have to be forged, building on the foundations that were laid at the turn of the century when the Millennium Declaration of 2000 was endorsed by all heads of states and the Millennium Development Goals (MDGs) were unveiled.

The MDGs constitute a watershed in development history since they capture universal human aspirations and commit all countries rich or poor to reciprocal obligations. In pursuit of shared goals and agreed socio-economic objectives, detailed indicators of progress are being tracked on a global scale. We now stand midway between the date when the MDGs were endorsed and the target year of 2015. The aggregate target of reducing poverty by half is likely to be reached given the rapid economic progress of China and India.

But most developing countries will not be in a position to reach most of the agreed objectives. This is no reason for policy makers to turn their backs on the ideals of a great and honorable enterprise. Instead, they must face the reality that, sixty years after it was crafted by the architects of the post-World War II era, the development business needs renewal. The current rules of the global economic game are such that Organization for Economic Co-operation and Development (OECD) countries and a few developing economies (mostly in Asia) have captured a disproportionate share of the benefits of globalization.

Several of the policies of rich countries and the international institutions that they control need adjustment. First and foremost the international *trade* system is unfair. Developing countries suffer from high tariffs precisely where they are most competitive, including cereals, sugar, fish, fruits, and vegetables, clothing and footwear. The social consequences are highly detrimental since these products are produced largely by small farmers and relatively small enterprises in poor countries.

Even as tariff barriers have declined, non-tariff restrictions have proliferated.[16] Developed-country tariff-rate quotas are another area of concern. So are OECD agricultural subsidies. They are equivalent to the entire gross domestic product of sub-Saharan Africa.[17] Paradoxically, the cost of trade protectionism is borne by OECD consumers as well as by poor countries' producers.[18] Rich countries' *fishing subsidies* ($15-20 billion a year) have also caused massive damage to the coastal fisheries on which traditional fishing communities in poor countries depend.

Imbalance also characterizes *intellectual property* policies. Trade-related intellectual property regimes have restricted access to essential drugs and other knowledge intensive products and services. Through bilateral trade negotiations developing countries are being pressured to adopt intellectual property legislation compliant with the requirements of developed countries. Such standards impose heavy costs on poor countries that are net importers of technology.

Similarly current *immigration* policies are highly restrictive. They frequently obstruct the entry of asylum seekers; interdict entry by unskilled migrants and channel immigration opportunities towards well-trained professionals and skilled workers. Such discriminatory immigration policies favor illegal trafficking and induce a "brain drain" and a "skill drain" from poor to rich countries.[19] Last but not least, the *aid* industry should accelerate the pace of its long-awaited reforms.[20]

6. A New Development Consensus

In the words of Albert Einstein, "*we cannot solve problems by using the same kind of thinking we used when we created them.*" In an increasingly interconnected world, reducing global warming and managing other risks to peace and prosperity through the delivery of global public goods should move to the centre stage of the development agenda.

Defining Human Security

The weakest link in the chain that connects nations determines the level of aggregate security. Climate is only one facet of human security—a pure global public good: its enjoyment by one party does not detract its availability to other parties and its benefits are available to all. Left to market forces, it is undersupplied since it can only be generated by cooperation buttressed by institutional arrangements that overcome free riding and remove information asymmetries.

In pursuit of such goals, two definitions of human security are vying for influence. The UNDP/Japan model emphasizes soft security (freedom from want), i.e., the natural dignity of men and women, economic security, health, education, knowledge, freedom to migrate, right to development. The Canadian model highlights hard security (freedom from fear) i.e., safety of individuals and groups, core human rights, rule of law, responsibility to protect. Kofi Annan's definition ("*freedom from want, freedom from fear and freedom of future generations to inherit a healthy natural environment*") encompasses both meanings and adds environmental sustainability to the mix.

This is the right definition since climate change and other environmental threats breed insecurity and jeopardize livelihoods. Deforestation, desertification and pollution push poor people towards natural disaster prone areas. Competition for access to natural resources can ignite conflict among nations and groups. The large-scale population displacements and water scarcities that global warming will generate are likely to increase discord and precipitate violence. Indeed the Central Intelligence Agency of the United States recently characterized global warming as a threat multiplier and a major international security risk.[21]

A New Development Paradigm

To address global warming as well as other sustainable poverty reduction priorities a human security paradigm would better fit the nature of contemporary development challenges than the current human development model that makes light of downside risks. Human security is not simply a repackaging of human development. It pays privileged attention to the insecurities that affect the livelihoods of the poor and the weak. It emphasizes due diligence and prudence and it subscribes to the Hippocratic Oath ("first, do no harm").

Human security addresses hard and soft security issues and ascertains the linkages between them. It favors quality growth over rapid, inequitable, unsustainable growth. It gives pride of place to risk management while eschewing self-defeating risk avoidance. Finally, it requires a disciplined sequence of steps including: assessment, prevention, mitigation, coping and adaptation.

A new development consensus that stresses human security would privilege prevention; put the individual rather than the state at the centre of policy making, give pride of place to risk management and deliver results through partnerships that combine the efforts of governments, the private sector and the civil society. Under such a paradigm the three sectors would share common goals, accept reciprocal obligations and assume distinctive accountabilities for outcomes.

Thus, it is unfair to characterize human security as a soft analytical approach or a grab bag of disconnected initiatives. Human security combines policy coherence for development with risk analysis and results-based assessment of program solutions. It sets priorities based on probability weighted cost benefit-assessments. Where uncertainty prevails and catastrophic risks loom it concentrates on capabilities, resilience and adaptation. It eschews fear-based, populist decision making and favors public information and democratic debate.

7. What Is to Be Done?

From this perspective, tackling climate change is only one among many human security imperatives and rich countries should take the lead in meeting it given that they have contributed a disproportionate share of the climate change problem. But unless emerging developing nations also take on responsibilities for global welfare commensurate with their growing economic clout—and the rising threat caused by the rapid increase in their greenhouse gas emissions—an international agreement will not be secured. Achieving and implementing such an agreement would provide a template for other needed initiative and help revitalize the development cooperation enterprise.

Breaking the Vicious Circle

The core dilemma posed by climate change is easily stated. Current growth patterns, being energy intensive, accelerate the growth of carbon emissions and increase global warming. But giving up on economic growth in order to limit greenhouse gas emissions would be a cure worse than the disease: the resources needed for climate change mitigation and adaptation—let alone for poverty reduction—will not be forthcoming without accelerated economic growth. Can the vicious circle be broken?

In principle it can be since taxation and advocacy can encourage conservation; promotion of new production systems can restrain energy use; and technology and innovation can improve energy efficiency and non-carbon energy utilization. Through judicious research investment, gradual decoupling of growth from emissions could be secured. But it is unlikely that managing climate change will be a free ride.[22] Substantial costs will have to be incurred but the costs of prevention are likely to be far less than those that would be associated with the devastation of unchecked global warming.

Remarkably, the same precepts apply to the resolution of other development challenges. To combat disease, hunger, natural disasters or economic volatility, prevention is invariably cheaper than the cure. But prevention requires major changes in public behavior and basic reforms in policy. This is why public advocacy and good political leadership are critical. Both are needed to shift incentives, manage risks and invest in the research and evaluation needed to shape effective mitigation and adaptation programs.

The Road Ahead

Thanks to dynamic environmental activism, a strategic consensus has begun to emerge but in order to generate sensible decision making about policy design and implementation options and evaluation should gear itself to provide the evidence required. For example, a spirited debate is ongoing over the level at which emissions should be stabilized; the time period over which stabilization should be achieved; and the energy generation options and mitigation strategies that should be employed.

The target level of emissions requires an estimate of the level beyond which the costs of adjustment exceed the benefits.[23] Since only a single global target must be set, aggregation of costs and benefits is necessary and a social price of a unit of carbon must be estimated. Next, an aggregate cap on emissions combined with users' allowances must be agreed. In parallel, a capacity to trade these allowances has to be created in order to facilitate their effective allocation.

Finally, to the extent that mitigation fails to achieve desirable temperature reductions adaptation programs should be formulated and implemented. But for such measures to be taken a burden sharing agreement will have to be forged among all nations of the world. Such an agreement would have major implications for energy policy.

Energy Security

Adequate, reliable and affordable energy fuels the mighty engine of the global economy. To ensure that energy supplies are adequate will require a global framework within which countries can design national plans that limit greenhouse gas emissions while sustaining economic growth. Global cooperation will be critical to manage the transition, secure the massive cross border transfers of oil and gas required by an increasingly interdependent global energy system and adopt coherent policies that will tackle the climate change challenge.

Ensuring that energy policy takes adequate account of climate change considerations is a major test of policy coherence for major energy users and suppliers. One thing is clear: cheap fuels can no longer be the foundation of energy policy. Energy consumption must be contained. Major infrastructure investments must be funded to generate and distribute the fossil fuels that currently account for 85 percent of global energy supplies. The transition away from a carbon-based economy will also call for increased investments in alternative sources of energy.

Who Is Responsible for Cleaning Up the Mess?

Industrialized countries, home to 20 percent of the world's population, account for 63 percent of the carbon dioxide that has accumulated in the atmosphere since 1900.[24] They dominate global environmental management through the heavy ecological footprint of their production and consumption patterns as well as their influence over global regimes governing trade, investment, and the global commons.

Consequently, industrialized countries bear major responsibility for the ecological deterioration associated with global warming. Looking ahead, however, emissions of greenhouse gases by developing countries (which are emulating the practices of rich countries) will continue to rise. By the end of the century they will contribute 75 percent of global emissions. This means that the global warming problem belongs to everyone and that the main stumbling block lies in the negotiation of a burden sharing formula.

A breakthrough will only materialize if influential nations take the lead in forging a principled agreement among all the parties.[25] Developing countries made clear in the climate negotiations launched in Bali late last year that their willingness to act on climate change will depend on the level of financial and technological support they will receive. This is not surprising: industrialized countries currently emit four times more per head than developing ones.[26] Building low carbon economies in the south will call for major resource transfers from the north.

Differentiated Responsibilities

Europe bears the greatest responsibility since it accounts for 38 percent of emissions of heat-trapping gases over the last century (followed by the United States with 30 percent). While many European countries are lagging behind their Kyoto commitments others are over-fulfilling them and the European Union is giving priority to reaching an international agreement. It is time for the United States and China to do the same: together they account for 40 percent of global greenhouse emissions.

While the United States has rejected the Kyoto agreement it is moving to address climate change at the state level and the Bush administration has announced its intention to cap greenhouse gases by 2025.[27] Similarly, Chinese leaders recently suggested that they might be willing to make a commitment on the basis of "differentiated responsibility." If the two countries join forces to curb emissions instead of being locked into a "mutual suicide pact," a feasible global plan might eventually emerge.[28]

Burden sharing could be based on differences in (i) national wealth per capita (in line with the "capacity to pay" principle); (ii) aggregate contributions to greenhouse gas levels (in line with the "let the polluter pay" principle). This would be in line with the formula proposed by Eco-Equity and the Stockholm Environment Institute that would apportion responsibility for the costs of mitigating climate change based on historical contributions to accumulated emissions, population size and capacity to pay.

Such principles would be a fitting neo-liberal response to the Marxist challenge: "*From each according to her capacity; to each according to her needs*" and it would constitute a welcome precedent for further agreements to resolve other major global policy dilemmas. For example, trade negotiations could aim at aggregate reductions in protection levels and a cap set for the trading of protection allowances allowed to individual countries. Similarly, aggregate agreements on the reduction of barriers against immigration regimes could be negotiated and immigration restriction allowances awarded and traded.

Based on the estimates of the Stern review, the financial commitments required to tackle global warming in this way would amount to $64 billion annually, roughly double recent aid levels. The funds might be raised through carbon taxes or a Tobin tax on financial transactions.

Voluntary methods have not been able to generate the modest level of resources ($1.2 billion) that the Global Environment Facility sought to raise by September 2007 for low carbon investments and adaptation to climate impact projects in poor countries.

8. Putting Evaluation to Work

Only a grand global bargain will create an enabling environment that will salvage the environment, make globalization work for all and turn the ideal of human security into a reality for the "bottom billion." In such a context, evaluation will have a distinctive role to play in designing the metrics and tracking the performance of partners in the fulfillment of their reciprocal obligations under a broadened and deepened compact for equitable and sustainable poverty reduction.

But to do so, the evaluation profession will have to be reformed. Thus, climate change presents as stark a challenge to development evaluators as it does to development practitioners and politicians. If evaluators meet it, their profession would become far more relevant to the contemporary development enterprise. In an interconnected world, a reinvigorated evaluation profession would demonstrate that it can add value at the higher plane of global policy making by assessing interconnected threats to human welfare and the needed policy responses.

This will require shifts in the choice of evaluation objects; the design of new metrics; more emphasis on the policy dimension of rich countries' engagement with poor countries; an extension of the scope of development evaluation beyond aid; a greater focus on risk, uncertainty and complexity; a reinvention of project evaluation; full use of the evaluation tool kit and judicious evaluation governance arrangements.

New Evaluation Objects

A bewildering diversity of global initiatives has sprouted in recent years. These programs have largely escaped the scrutiny of evaluators even though serious questions have been raised about their governance, their efficiency and the results they have achieved. The time has come to close this gap. Thus, whereas the climate change phenomenon is global in its causes and consequences (and requires cooperative responses by a wide range of actors) the privileged units of account of development evaluation are still individual projects and more recently country programs.

Evaluation will have to focus on the global policies and collaborative initiatives that shape the international response to climate change and other global threats to peace and prosperity. Thus, climate change evaluations (including those of the Global Environment Facility) will have to tackle independent multi-partner evaluations of programs designed to deliver global public goods, share knowledge across countries or set business and/or professional standards.

New Metrics

The logic of internalizing the externalities implicit in climate change mitigation strategies argues for the adoption of "triple bottom line" or "green" national accounts that take account of resource depletion ("balance sheet") alongside income impacts for various groups and regions ("cash flows"). Such methodological trends will require the pendulum of evaluation practice to swing back towards multi-disciplinary approaches regulated by an overarching evaluation methodology that reflects the development preoccupations of the day just as cost benefit analysis did in the pioneering days. In particular, new metrics are needed to allocate aid among countries since the current performance-based protocols take no account of the benefits of conflict prevention or the cross border consequences of state fragility and instability.

New Emphases in Performance Assessment

As repeatedly stressed in prior sections, climate change will not be mastered without a resilient framework of shared objectives and reciprocal obligations. Yet, the development evaluation ideas with the most traction (e.g., results-based management; experimental methods, etc.) do not emphasize the distinctive accountabilities of partners in shaping outcomes. In particular, development evaluation has been asymmetrical. It has devoted disproportionate attention to assessing the performance of one side of the global partnership.

The poor countries: the Millennium Development Goals (MDGs) backed up by the Poverty Reduction Strategy (PRS) system, demand far more of developing countries than they do of developed countries. Most of the agreed indicators (35 out of 48) embedded in the MDGs point south. Conversely, there are no binding undertakings on rich countries to back up the accountability framework of MDG 8 that is directed to the obligations of rich countries. This imbalance has twisted the priorities of development evaluation and undermined its credibility. Vast resources have been mobilized to monitor progress in developing country policies and programs. No similar effort has yet been put in place to monitor the improvement of policies adopted by rich countries.

Evaluation beyond Aid

During the eighties and nineties the development evaluation community concluded that domestic policies exert a crucial impact on aid outcomes. In the new millennium, the same logic should be applied at the higher plane of global policy. Beyond aid, a wide range of policies matter to climate change and poverty reduction. Currently, development evaluators focus a disproportionate share of their time and resources on aid operations. Looking ahead, they will have to evaluate how effectively the transmission belts of globalization work for sustainable and equitable development.

Evaluation will have to take on vertical multi-country reviews of individual policies (aid, trade, migration, etc.) on a regional or global basis. Such reviews would require assessments of impacts of recent or proposed policy shifts on economic and social conditions in representative countries, both developed and developing, together with the compensatory arrangements proposed for losers in the adjustment process. Priority should be given to policy vectors that are the subject of new international agreements, well ahead of their formal negotiations.

Part of the global evaluation challenge would be met by systematic assessments of the whole of government policies on a horizontal basis. They might consist of self-evaluations of the environmental and developmental footprints of individual OECD countries' policies (viz. the GPRSP reports approach being piloted by some Nordic donors and the Netherlands). But in order to ensure symmetry with the PRSP system in place within poor countries, such initiatives ought to be combined with independent evaluations and multilateral oversight.

In addition, bottom up assessments of the impact of all OECD policies on a sample of representative developing countries could be carried out and the benefits of global policy adjustment estimated (e.g., increase in quality or quantity of aid, gradual removal of cotton subsidies, reduced immigration restrictions, etc.) together with the compensatory costs for alleviating the impacts on losers as a basis for recommendations made both to OECD and to the countries concerned.

Considering that the OECD proposes to target such policy areas as investment, business climate, technology and environmental sustainability as well as sectors such as agriculture and health where the private sector plays a major role, global policy evaluations will also need to include independent assessments of the impact of regulatory regimes and standards (whether voluntary or compulsory) on developing countries.

Accounting for Risk, Uncertainty and Complexity

Whereas climate change produces complex, long term and persistent impacts characterized by pervasive risks and uncertainties, the dominant conceptions of development effectiveness today are poorly adapted to complex systems and volatile operating environments. They tend to assume linear relationships between means and goals and do not take adequate account of uncertainty and risk. While their metrics give due weight to economic and social results they frequently neglect the all-important distributional and environmental dimensions.

Yet, risk management theory is well equipped to rank threats whether they originate from global warming, conflict, infectious diseases, natural disasters, or other threats to human welfare. Cost benefit analyses combined with probability theory could be deployed to evaluate alternative responses to identified threats. Under certain conditions, game theory and systems analysis could be mobilized to test the resilience of chosen responses. Similarly, institutional economics could be put to work to resolve collective action dilemmas and design incentives for cooperation.

The economics of risk mitigation measures and the value of safeguard policies depend on assessments of willingness-to-pay as well as attitudes to uncertainty. Equally, the distribution of risks is governed by contracts that define rights, responsibilities and obligations. Markets for rights and "entitlements" either exist or can be created or modeled to ascribe values to contracts. This includes incomplete contracts contingent on exogenous events and unintended consequences that require periodic adjustment and re-negotiation. Similarly, the economic justification of projects could be rooted in valuations of ownership and control, "rights" and obligations of stakeholders under various scenarios, etc.

Reinventing Project Evaluation

The concept of a project as a bundle of contracts offers scope for addressing more explicitly issues of risk assessment and risk sharing. In banking practice, the rights of creditors are defined in terms of absolute and relative seniority. Similarly, the attribution of project costs and benefits to stakeholders could be made transparent in the same fashion. Thus, financial analysis that combines assessments of assets and liabilities, cash flows and profit and loss statements would have a counterpart in economic evaluations of development programs and projects. This would also connect evaluation with governance factors, i.e., the explicit or tacit rules that influence the behavior of stakeholders, the assignment of risks and the allocation of benefits.

Fiduciary considerations that were once dominant when projects were the main aid instrument will be coming back to the centre stage but they will have to be incorporated into the evaluation method instead of being treated as "add-ons." Equally, legal considerations regulating conflicts of interest would have to become part of the analysis just as in project finance. In this context (just as in cost benefit analysis and in evaluation dependent on experimental designs), risks and rewards would imply the identification of a plausible counterfactual and the value of resource allocations would be based on their opportunity costs, i.e., the benefits derived from their alternative uses.

Agency and monitoring costs would have to be factored in for opportunistic behavior to be contained and for risks to be managed. To deal with them, contracts would be designed to include features that address contingent events. Where there remains a residual of uncertainty, incomplete contracts would be used and adjusted in case of contingency. Alternatively, the costs or benefits associated with the uncertainty would be assigned to project "owners." In this fashion, the externalities of risk and uncertainty would be internalized within contracts through assignment of rights and responsibilities. In parallel, oversight arrangements would ensure that contracts are fairly drawn and adequately enforced.

This approach is consistent with the concept of development as the expansion of freedom and at the same time it evokes the "theory of real options" in financial markets[29] that conceives of "an option" as the right rather than the obligation to buy or sell an asset at an established price. This definition relates notions of "contingent value" to "rights" and "capabilities" including those that flow from ownership, knowledge or access to services. It gives the holder of a "right" an "opportunity" to secure specified benefits or implement agreed actions under alternative scenarios. From this perspective, policies, programs and projects would be redefined as contractual realignment of rights, responsibilities and obligations. Capacity building through development cooperation and equitable access to services as well as safety nets would expand the choice among alternatives and enhance the freedom of the poor and the weak in society to secure their fair share of benefits.

In turn, the new institutional or policy arrangements would generate better allocations of risks and opportunities. This means that projects (or bundles of projects called programs) would no longer be defined in terms of physical asset creation. Instead, they would be conceived and assessed as policy opportunities that rearrange the capacities, rights and obligations of various groups in society faced by the risks and uncertainties that flow from market volatility, environmental stress, natural disasters, violent conflict or other contingencies of the new global order.

Making Full Use of the Evaluation Tool Kit

In sum, option theory would make it possible at least in principle to combine risk analysis, financial analysis and economic analysis to generate a new approach to project evaluation that transcends current qualitative methods of stakeholder involvement in decision-making. It would make explicit the distinct flows of costs and benefits accruing to different groups; it would assess the gaps between economic, social and financial returns but in addition it would allow for negotiation of options using simulation models that would guide their periodic adjustment as the operating environment evolves.

Rigorous evaluation has always implied the design of a counterfactual that projects the state of the world with and without an intervention. In certain situations, randomized control designs can define the counterfactual through random selection of treatment and control groups. In other situations, quasi-experimental designs that rely on statistical models are more appropriate.[30] But the validity of experimental and quasi-experimental designs can be marred by changes in the policies or programs being evaluated, selection bias (unrepresentative treatment group), substitution bias (access to other forms of treatment within the control group) and the behavioral consequences of the policy experiment either within the treatment group ("Hawthorne effect") or within the control group ("John Henry effect").

Practical, ethical, and political economy considerations also intervene to limit the scope of randomized control trials. They as well as quasi-experimental approaches provide very limited insights about the causality chains that connect treatment features with observed outcomes. Nevertheless, the momentum behind quasi-experimental designs is very strong since the method promises illusory certainty in the midst of uncertainty and provides policy makers faced with severe budget constraints with a technical rationale for canceling programs.

But experimental and quasi-experimental methods only make up a small fraction of the evaluation instruments available to the evaluation profession. The existing tool kit is well stocked to deal with other aspects of the global policy evaluation agenda. In particular, the objectives-based[31] approach traditionally used by development evaluators is well adapted to global policy evaluations. Typically, development evaluators compare results (outputs, outcomes and impacts) to the goals set at the outset of an aid intervention. Through "evaluability" assessments[32] they provide a useful link to internal management mechanisms.

Program evaluation theory is well adapted to the assessment of global collaborative programs and meta-evaluation methods combined with theory-based evaluation techniques,[33] realistic and participatory evaluations are instruments of choice for such programs. Country impact evaluations require the deployment of case study and policy research tools and the battery of "new public management" evaluation tools are appropriate for tackling assessments of regulatory regimes and corporate social responsibility standards.

Equally, development evaluators have ample experience with the evaluation of partnerships that lie at the core of the global policy evaluation challenge[34] but focusing on global policy evaluations, would add a twist to the traditional approach by bringing out in a transparent fashion the balance of interests that are actually served by policies, programs and projects. From a methodological standpoint, development evaluators will have to un-bundle program objectives and impacts among development partners and assess the balance of costs, benefits, and risks among them. This would help improve the accuracy and credibility of assessments and strengthen the participatory dimension of the evaluation process.

Through evaluation, new global policies aiming at minimizing the negative externalities of programs and projects would be emulated. Just as the social and environmental assessments are used as part of the appraisal of industrial and infrastructure projects, new "impact assessments" will emerge to guide major policy decisions. In time, this might lead to the adoption of safeguard policies that combine the Hippocratic principle ("first, do no harm") with the imperatives of development. Implementation of these sustainable development policies would be informed by impact assessments and in turn the new policies would provide a legitimate framework for independent verification mechanisms.

Another potential extension of development evaluation practice to global policy management would involve the systematic use of process evaluations. Such evaluations would address the relevance, efficacy and efficiency of institutional arrangements at national, regional or global level. They would examine: (i) coordination arrangements and participatory mechanisms; (ii) the quality of analytical capacity; (iii) the guidelines for policy making; (iv) the standards for assessing tradeoffs among primary policy objectives and developing country interests; (iv) the monitoring and evaluation arrangements.

New Evaluation Governance Arrangements

When connected to organizational performance mechanisms and backed by independence safeguards, evaluation can be used to strengthen accountability[35] and to promote realism in evaluation design and implementation. It can facilitate societal learning by inducing policy makers to face up to the actual impact of policy designs and operational practices. In parallel, evaluation linked to partnership assessments, helps to improve public accountability.

Furthermore, since citizens may misjudge risks or fall prey to risk panics, professional risk assessments and sober reflection are needed to inform public debate. Policy priorities are only legitimate if they are set following principled deliberations and safeguarded by checks and balances. At the national level, the debate should involve citizens, their representatives, and the independent judiciary. At the international level, new networks connecting government, the private sector and voluntary agencies should lend legitimacy and credibility to policy solutions.

In other words, methodological rigor is not sufficient to ensure credibility of evaluations. The design of evaluation governance to guarantee independence, objectivity and "value added" is of critical importance since verifiable truth can only be ascertained through iterative processes that recognize the limits of rationality and contestability challenges that take account of the power of vested interests. Checks and balances in evaluation are critical to credibility. To be sure, organizational design models that have proven effective in national and multilateral settings for development evaluation may not be applicable to global policy evaluations. Whereas development evaluation typically operates within a sovereign government or organization, the achievement of policy coherence from a development perspective involves reviews of actions taken by several sovereign nations and autonomous organizations.

Hence, there is a need to adapt the principles that underlie the design of sound development evaluation structures to the higher plane of global policy evaluation. Currently, development evaluation units focus on the programs funded by the agencies within which they are embedded. They do not normally evaluate global programs or policies that cut across the mandate of several agencies. This evaluation gap reflects a global governance gap. Until new evaluation architectures are constructed, ad hoc joint evaluations will be required.

Such arrangements will have to comply with the following principles that have withstood the test of experience. First, the credibility of the evaluation function hinges on arm's length relationship with line managers and policy makers. Second, its usefulness depends on its capacity to influence policy formulation and decision-making (independence is not isolation). Third, its integrity requires compliance with the same principles of accountability, learning and transparency that it is designed to promote.

The following lessons drawn from experience in joint development evaluations are likely to retain their relevance at the higher plane of global policy: (i) the major stakeholders should be involved in the design of evaluation objectives, standards, and methods; (ii) their respective responsibilities and obligations should be agreed at the outset; (iii) the evaluation team should be endowed with considerable autonomy; (iv) adequate skills and resources should be provided for the conduct of evaluation and the dissemination of its results.

Last but not least, credible global policy evaluation will imply a serious effort to involve developing countries in the process. A major commitment to evaluation capacity development from donors is imperative. Evaluation funding and governance arrangements should allocate substantive control of a major segment of the global policy evaluation agenda to developing country governments, organizations and citizens. Just as development projects and programs executed by poor countries have benefited from evaluations by donor organizations controlled by rich countries over the years, it would make sense for rich country policies that affect poor countries to benefit from evaluations carried by evaluation organizations controlled by poor countries.

* * * *

In the words of Sir Partha Dasgupta, "*The present is the past's future. Moreover, the future has an unnerving habit of becoming the present*." A thousand years ago, according to historian Brian Fagan, "*in Central America, great Maya cities tottered under medieval drought while Andean civilizations wilted in the face of an evaporating Lake Titicaca and faltering runoff in coastal river valleys*." Many developing countries today are as vulnerable to a great and prolonged warming as these defunct civilizations and we are already experiencing warming of a kind unknown since the Ice Age.

But the past need not be prologue. The world community can adopt early mitigation actions, invest in adaptation and act to master floods and droughts over the vast zones of turmoil and poverty of the developing world. For the late Eric Hoffer, the longshoreman California philosopher, "*change is an ordeal and its only cure is action*." And so it is with climate change. From a human security perspective, it is a privileged dimension of the overall development enterprise and it is undeniable that decision makers have begun to master its implications for development policy and evaluation. Focusing on practical solutions to climate change would also help make poverty and war history.

Notes

1. Nicholas Stern, *The Economics of Climate Change*, Cambridge University Press, 2006.
2. Global warming is perceived as a very serious problem by more than half the respondents of the Pew Global Attitudes Project. The highest percentages (65-85 percent) are found in Argentina, Bangladesh, Bolivia, Brazil, Bulgaria, Chile, France, Japan, Kuwait, Morocco, Peru, Slovakia, South Korea, Spain, Turkey and Venezuela. The lowest (40-60 percent) are in Canada, China, Egypt, Germany, India, Indonesia, Israel, Italy, Jordan, Lebanon, Malaysia, Mexico, Pakistan, Poland, Russia, Ukraine, and the United States.
3. Based on his assessment of the historical evidence, James Hansen, a prominent climate scientist, announced on April 7, 2008 that the likelihood of accelerated warming due to the melting of ice sheets (and the greater heat absorption of the ground as compared to ice and snow) had been underestimated. Stabilized at the current level of 550 ppm, temperatures could rise by 6 degrees instead of the prior estimate of 3 degrees. If so, the stabilization target of 450 ppm (previously endorsed and widely viewed as stringent) may have to be reconsidered since it may induce the disappearance of ice sheets in western Antarctica and a rise in sea levels of at least two meters in this century.
4. Some experts visualize temperature increases of 10 degrees and a rise in sea levels of twenty feet—enough to inundate most of Bangladesh and the eastern seaboard of the United States from Miami to Washington DC.
5. Currently 850 million people are hungry. One study estimates that another 200 million people would be at risk of hunger with temperature rises of 2-3 degrees.
6. Worldwatch Institute, *State of the World 2008, 25th Edition*, Earthscan, London, 2008
7. If only economic effects are considered and normal discount rates are used, more modest levels of CO_2 control would be justified.
8. Austria, Belgium, Canada, Denmark, Ireland, Italy, Portugal and Spain are off track to meet the agreed targets
9. Even if Kyoto were fully implemented it would shave a meager 7 percent of the increment in average atmospheric temperatures: a temperature increase of 2.42 degrees instead of 2.6 degrees would be reached by the end of the century.
10. Robert Picciotto, Funmi Olonisakin, and Michael Clarke, *Global Development and Human Security*, Transaction Publishers, New Brunswick, 2007.
11. Bjorn Lomborg, *Cool It,* Cyan Books and Marshall Cavendish Editions, London, 2007.
12. Conflict has prevailed in 18 countries more than half of the time for the past two decades. In 13 of these countries more than a third of the population is hungry.

13. According to Robert Zoellick, president of the World Bank, unrest due to food scarcity may soon affect 33 countries. Already, protests about food price rises, some of them violent, have taken place in Bolivia, Cameroon, Egypt, Haiti, Indonesia, Ivory Coast, Mauritania, Mozambique, Senegal, Uzbekistan, and Yemen.
14. The devastation of HIV/AIDS has only started, even though the disease has already claimed more than 20 million deaths and infected 40 million people. In Africa, life expectancy is now 47 years, compared to 62 years had there been no HIV/AIDS pandemic.
15. The extent to which natural disasters and global warming are connected is still unclear. The settlement of poor people in unsafe zones due to population pressure and wealth inequalities is a major and perhaps more critical factor behind the losses due to floods, hurricanes, and earthquakes.
16. In particular, incompatibilities between standards and methods of conformity assessment between developed and developing countries have been used as protectionist barriers.
17. The New Zealand government has estimated that the resources allocated for agricultural subsidies would allow first-class travel one and a half times around the world to all 41 million cows of the European Union with 1,000 euros still left over for their hotels and meals.
18. For example, US consumers pay 58 percent more (a markup of $27 billion) for textiles and clothing than they would under a free-trade regime.
19. Thirty percent of Mexico's PhDs and three-quarters of Jamaicans with higher education live in the United States. Albania has lost a third of its qualified people.
20. Tied aid adds 20 percent to the cost of goods and services procured and may account for about half of aid flows. Technical assistance accounts for 28 percent of aid flows. The proliferation of aid channels and the fragmentation of aid across hundreds of projects impose high transaction costs. Aid coordination is still a major problem. Harmonization of aid practices has proceeded at a snail's pace.
21. House Permanent Select Committee on Intelligence, House Select Committee on Energy Independence and Global Warming, *National Intelligence Assessment on the National Security Implications of Global Climate Change to 2030*, Statement for the Record of Dr. Thomas Fingar, deputy director of national intelligence for analysis and chairman of the National Intelligence Council.
22. Whereas Nicholas Stern estimates that the costs of stabilizing emissions at the 550 ppm level to be around 1 percent of GDP, other economists, such as Dieter Helm, believe that the cost will be much higher given that the decoupling trends on which they are based are illusory, since they do not take account of carbon outsourcing and also because of likely policy mistakes. Similarly, Nigel Lawson, former chancellor of the Exchequer, argues that the costs of shifting to expensive noncarbon sources of energy are prohibitive and the benefits limited.
23. Focusing on worst-case scenarios, rather than dealing with the probabilities attached to possible outcomes, is advocated by adherents to the "precautionary principle." This approach enjoys broad public support but can lead to excessive regulation, high costs, and even high risks if account is taken of the waste of resources frequently involved (e.g., the Iraq war decision based on WMD risks).
24. The United States with a population of 288 million is responsible for more emissions than 151 developing countries with a population of 2.6 billion people.
25. William Chandler, Breaking the suicide pact: US-China Cooperation on Climate Change, Carnegie Endowment, Policy Brief no. 57, March 2008.
26. Simon Retallack, *The Greening of the South*, Prospect, March 2008.
27. Most other developed nations intend to cut emissions below the 1990 level and the Intergovernmental Panel on Climate Change has issued projections that require

emissions by rich nations to fall by 25-40 percent below 1990 levels by 2020 to avoid the worst effects of droughts, floods and rising sea levels.

28. China has overtaken the United States as the biggest single emitter and India is set to become the world's third largest emitter by 2015.
29. G. Pennisi and P.L. Scandizzo, *Economic Evaluation in an Age of Uncertainty*, 2006, in Evaluation, Volume 12, Number 1, January, Sage Publications and the Tavistock Institute, London, UK.
30. George K. Pitman, Osvaldo N. Feinstein and Gregory K. Ingram (eds.), 2005, *Evaluating Development Effectiveness*, World Bank Series on Evaluation and Development, Volume 7, Transaction Publishers, New Brunswick, New Jersey, USA.
31. Nagy Hanna and Robert Picciotto (2002). *Making Development Work, World Bank Series on Evaluation and Development. Volume 4.* Transaction. New Brunswick.
32. This term was crafted by Joseph S. Wholey.
33. Carol H. Weiss (1998). *Evaluation, Second Edition*, Prentice Hall, Upper Saddle River, N.J.
34. Andres Liebenthal, Osvaldo N. Feinstein, Gregory K. Ingram (2004), *Evaluation and Development: The Partnership Dimension, World Bank Series on Evaluation and Development, Volume 6*. Transaction. New Brunswick.
35. Unfortunately, most development organizations are not equipped with genuinely independent evaluation organizations and they have tended to use results-based management more to enhance planning than to increase accountability. With the exception of the World Bank and some regional development banks, RBM systems used in development agencies have lacked independent ratings of professional quality and institutional performance in their scorecards.

3

Climate Change, Development, and Evaluation: Can Flexibility Mechanisms Promote Sustainable Development?

Joyeeta Gupta

1. Introduction

Created as a win-win solution for developed and developing countries, the Clean Development Mechanism (CDM) under the United Nations Framework Convention on Climate Change offers the potential for cost-effective greenhouse gas emission credits for the North, and sustainable development in the South. Theoretically, this is an ideal instrument with considerable potential.

However, it has been dogged by controversy from the start. A number of critical arguments have been put forward about the challenges inherent in such a mechanism (Maya and Gupta, 1996; Yamin and Depledge, 2004). Nevertheless, from the moment the mechanism was launched, the financial and environmental stakes in the instrument have increased so much that there is an in-built tendency to keep promoting the instrument in the hope that the major shortcomings can be incrementally addressed over time. Against this background, this chapter addresses the question: Is sustainable development adequately taken into account in CDM projects and can it be adequately taken into account?

In order to address this question, this chapter reviews the need for sustainable development in the context of a brief assessment of the advantages and disadvantages of project-based emissions trading; presents the results from five in-depth cases studies of Activities Implemented Jointly projects (the forerunner to the CDM), and of 44 current CDM projects financed by the Netherlands; before drawing some conclusions.

It may be appropriate here to recapitulate the history of flexibility mechanisms in the context of the climate regime with respect to developing countries. The context was the original nature of the deal between developed and developing countries. This was based on the acknowledgement that the developed countries were the major emitters of greenhouse gases into the atmosphere and needed to reduce their own emissions of these gases. The developing countries would have to grow in order to meet the basic needs of their populations. Since the developed countries also had easier access to better technologies and were in general richer, they should provide access to resources to the developing countries which would help the latter group of countries avoid making the same mistakes that the developed countries had themselves made in the growth process (Gupta, 1987).

Against this background, let us turn to the evolution of the flexibility mechanisms. In the Climate Change Convention in 1992, there was subtle reference to the possibility of countries jointly implementing their obligations under the Convention. Three years later, at the first meeting of the Parties to the Conference, a decision on a pilot phase of Activities Implemented Jointly was adopted. This decision allowed investors from developed (Annex I) countries to invest in projects in developing countries that would reduce the level of greenhouse gas emissions from these projects. Such projects needed to be in line with national priorities (and thus not divert scarce resources to non-priority areas) and host country approval was essential. Because of the controversial nature of such projects (see next section), it was not allowed to credit emission reductions to investors during the pilot phase.

Developing country objections were overcome through the provision that participation was on a voluntary basis. By 1997, it was clear that most developing countries were still skeptical about project-based emissions trading and the European Union began to support the use of this mechanism only with respect to countries in transition (Joint Implementation (JI) as reflected in Article 6 of the Kyoto Protocol of 1997). In the meanwhile Brazil proposed a Clean Development Fund to be funded through fines levied on developed countries in non-compliance with their emission targets. During the negotiation process, this instrument morphed into a Clean Development Mechanism which is project-based emissions trading under a different name (Article 12 of the Kyoto Protocol). A key difference between this CDM and JI was that the former would focus on sustainable development more explicitly than the latter. Other key differences include the different administrative structure of the crediting processes.

2. Sustainable Development in the Context of the Advantages and Disadvantages of Project-Based Emissions Trading

This section explains the significance of sustainable development in the context of these flexibility mechanisms and places this within a brief analysis of the pros and cons of project-based emissions trading. Let us first turn to the issue of sustainable development. Although the policy and academic literature is very expansive on this subject, translating this concept to project level is very difficult; and open to multiple interpretations.

Sustainable Development

This section elaborates a little on the philosophy for including such a concept; the content of the concept; the application of the concept at project level; the political decision with respect to sustainable development in the context of project-based emissions trading; before drawing some inferences.

The underlying philosophy of including sustainable development into CDM discussions can be traced to a number of arguments. Resources are scarce in developing countries. Such resources include human resources, institutional, financial and technological. There is increasingly a major fear that project- based emissions trading, which seeks essentially to reduce emissions cost-effectively will focus more on developed country interests than on developing country interests. This could lead to a diversion of scarce national and foreign resources to sectors and projects that are not national priorities. Hence, the decision of the first Conference of the Parties stated clearly that there was need to align such projects to national priorities and to the goal of sustainable development.

Second, a focus on sustainable development implicitly implies taking environmental aspects into developmental projects and helps developing countries to leapfrog towards the use of modern technologies. Such projects could help trigger off a shift towards the adoption of such environmentally friendly technologies and could help shift the entire development process in such developing countries (Grubb, 1999).

The literature on sustainable development tends to focus on three aspects of the concept—the intergenerational nature of the concept—that development must meet the needs of the present generation without compromising the ability of future generations to meet their own needs (WCED 1987). However, a greater focus on future generations over current generations tends to protect the needs of the rich as against that of the poor. The second focuses on addressing the economic, ecological and social aspects of a project. Addressing all equally is a feature of hard sustainability; making trade-offs between the three aspects is seen as soft sustainability (cf. IPCC 2007). A greater focus on economic and/or ecological aspects as against social aspects tends to protect the interests of the rich as against the poor. The third focuses on whether sustainable development is more a process or a goal. Where sustainable development is defined as a context relevant process aiming at securing the legitimacy, accountability and transparency of a broad-based decision-making process aimed at understanding the next steps of society—it is seen as a contextual process. Where sustainable development is defined as goals for a society it is seen as a final destination.

Sustainable development is thus an abstract concept. When one tries to scale it down to individual project-level, the issue becomes controversial. How does one decide at project level whether a project meets the needs of current generations without compromising the ability of future generations to meet their own needs? How does one decide how many social aspects need to be taken into account against a clearly defined profit motive and the need to reduce greenhouse gas emissions? How does one define a participatory process for a legal contract-based agreement?

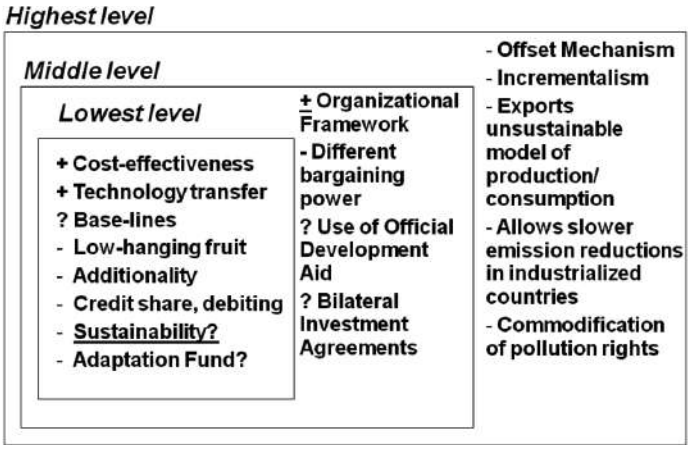
Finally, sustainable development is a contextual issue; it depends on the situation that pertains in a particular region of the world and how society views it. This is the reasoning behind the decision at the Conference of the Parties at Marrakech in 2001 that the determination of whether a project aimed at sustainable development should be left to national governments. This also shifted the burden of responsibility from the project developers to the national governments and while this acknowledges the sovereign right of states to make their own decisions regarding what is sustainable, it also makes them more vulnerable. Most developing countries are so hungry for foreign investments that they are unlikely to create new problems for the investors.

3. Project-Based Emissions Trading

This section integrates the sustainable development aspect of project-based emissions trading within the context of existing advantages and disadvantages of this mechanism in terms of three levels of analysis—the instrument level, the organizational level and the ideological and power level (see Figure 3.1).

At the level of individual projects, CDM is attractive because it minimizes the costs of emission reduction. However, the cost-effectiveness

Figure 3.1
Assessment of Project-Based Emission Trading



goal may lead to minimizing all other costs (social and ecological) in order to maximize profits (Mintzer, 1994). There are trade-offs between cheap emission reductions and achieving sustainable development (Ellis et al., 2007; Olsen, 2007; Sutter and Pareno, 2007). CDM is also attractive since it can potentially transfer modern technologies at less than market prices to developing countries in return for credits (cf. SWCC 1990; Gupta, 1987; Forsyth, 2005). However, only about one third of the projects claim to transfer technology (Haites et al., 2006).

But there are other problems. Determining baselines against which emission reductions can be calculated remains problematic despite the development of a number of methods (Bode and Michaelowa, 2003; Winkler and Thorne, 2002; Boyd et al., 2007). CDM may encourage foreign investors to pick the cheapest options in the developing countries and leave them with the more expensive structural changes in the future (low-hanging fruit argument). The concept that CDM projects should be additional to the business-as-usual situation in terms of environmental or financial additionality is also complex; the former may not allow projects that fall under policy objectives even if such policies generally are not implemented in developing countries, thus having a counterproductive approach; while the latter checks if the project would not have happened had it not been for the finances CDM raises (Schneider, 2007). Existing analytical methods—barrier analysis, investment analysis, common practice analysis are being used but also have limitations (Michaelowa and Purohit, 2007; Haya, 2007; Schneider, 2007). Furthermore, should crediting be allowed for all foreign direct investment, which in the context of developing countries should be bringing in newer technologies? Should debiting be permitted where foreign investors bring worse technologies? Since a percentage of the proceeds from the CDM are used for financing adaptation activities, this is seen as an unfair tax levied on North-South cooperation. Lastly, although such projects should help developing countries achieve sustainable development, how credible is this goal in the light of the cost-effectiveness objective?

In order for a mechanism like CDM to be successful, it is necessary that a supportive organizational framework exists (the middle level of analysis). The CDM involves a complex process at national and international level. Project developers have to prepare the Project Design Documents, to be validated by the Designated Operational Entities and then submitted to the Executive Board for approval. Following approval, the investor has to submit a monitoring report to a different Designated Operational Entity who has to submit a report about whether the emissions can be certified. The next step is the actual issuance of certified emission reductions through the CDM registry. The process is expensive and time consuming with high transaction costs (Chadwick, 2006; Krey, 2005) and new problems keep developing such as long times of approval from the executive board (Ming et al., 2007) and competition between Designated Operational Entities to be selected by clients (Schneider, 2007). At the level of the negotiations between hosts and investors, there is often unequal bargaining power. Third, increasingly, this market mechanism is being subsidized through financing from official development assistance, despite the substantive arguments against its use, a decision of the Conference of the Parties at Marrakesh (COP 13: 17 CP7), by the OECD Development Assistance Committee (OECD DAC, 2004). Finally, most of these projects are written into legal contracts that are subject to international investment law (bilateral investment agreements (BITs); and should these projects fail, they will most likely be subject to international arbitration.

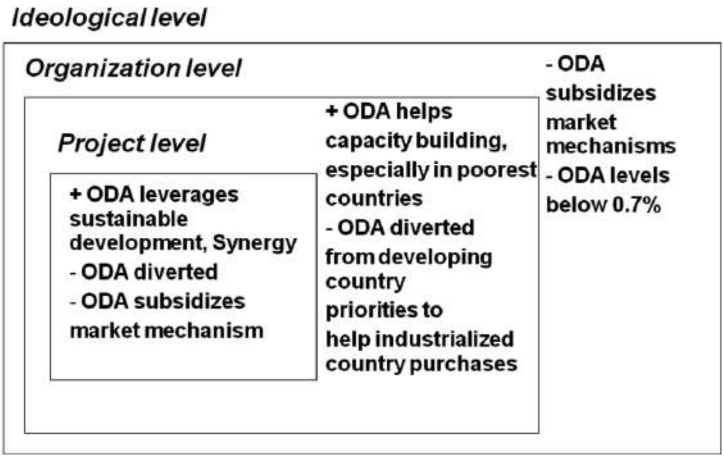
At a more abstract ideological level, five arguments are critical with respect to such instruments. First, is the offsetting nature of the CDM instrument. Emission reductions through the CDM should compensate for increases in the developed world. However, if more emission credits are issued than there are reductions in actual emissions, CDM will lead to an increase in emissions (Boyd et al., 2007). Furthermore, there may be "leakage" either through a forestation project in one area leading to a deforestation project in another area (primary leakage) or through market forces where projects may change the relative price of commodities leading to changed behavior that is counterproductive to the goals (secondary leakage) (Boyd et al., 2007). Second, is the incremental nature of the instrument and its basis in the free market ideology which tends to lead to more and more consumption instead of less and careful consumption. Third, this instrument exports unsustainable patterns of production and consumption to different parts of the world. Fourth, it reduces the need for the developed countries to themselves seek alternative technological and lifestyle approaches that may be commensurate with a low greenhouse gas economy. Finally, it commodifies pollution rights and allows trade in such rights (cf. Juma, 1995).

Let us briefly now turn to the use of official development assistance (ODA) resources for subsidizing CDM. At the project level, making links with ODA expertise and resources might in fact be the critical factor that secures the sustainable development component of project-based emissions trading. However, there are also real fears that ODA resources will be diverted from key issues such as access to drinking water and food to issues related to emission reduction. At the organizational level, on the positive side, ODA resources can be used to build capacity in countries to set up their designated national authorities and create the awareness to develop such projects. On the negative side, such ODA may serve more the interests of the donor countries than the priorities of the recipient countries. At the ideological level, the very goal of project-based emissions trading was to unleash the forces of the market to serve climate change goals. If the market is indeed capable of being shaped to function in specific ways, there should be no state subsidy for this. Instead the meager subsidies should be used for items that cannot be left to the market to resolve. Lastly, current ODA commitments of most developed countries fall well below 0.7 percent of the Gross National Income as promised in several international political declarations. The developed countries had promised new and additional resources, new and additional to the ODA commitments. But there is now increasing fear that there will be very little new and additional resources; instead climate change will be "mainstreamed" into development cooperation (see Figure 3.2).

4. Project-Based Emissions Trading: An Assessment of Projects Supported by the Netherlands

Against the general discussion of project-based emissions trading, this section examines Activities Implemented Jointly and Clean Development Mechanism projects supported by the Netherlands Government, which

Figure 3.2
Assessment of Using ODA for Project-Based Emissions Trading



has actively supported this concept from the start. This section builds on the work of a team of authors (Gupta et al., 2007) focusing on the question: "How and to what extent do or will AIJ/CDM projects carried out in the context of the Netherlands UNFCCC and/or Kyoto Protocol policies, contribute to sustainable development in the developing host countries?"

Five AIJ Projects

This section focuses on the five AIJ cases that received 90 percent of the Dutch government resources (Gupta et al. (eds.), 2007; Gupta et al., 2008). Following the development of a comparative method that included examining the context of the project, project documents and their claimed contribution to sustainable development; the host country's position on sustainable development; and project evaluation against the research team's criteria for assessing the sustainable development contribution of each project, a team of Dutch and host country researchers assessed five AIJ projects. The research was based on studying the project documentation, relevant policy documents of the governments concerned, and interviews with local stakeholders. The five cases focus on a wind power park in Costa Rica, a small-scale biogas technology plant in Vietnam, a mini-hydropower plant in South Africa, a greenhouse in China and a biomas gasifier in India.

The Costa Rican project between the Dutch Essent energy B.V. and the Costa Rican public sector power company—ICE was initially developed as an idea in 1992 and the contract was signed in 2000 and the project presently provides wind energy. However, during the long gestation period, other commercially viable wind plants were developed making the additionality of the project questionable. Maintenance is a key challenge as the responsibilities appear not to have been allocated clearly. Although the plant reduces greenhouse gas emissions in relation to the baseline, the project did not invest in any additional features to contribute to the local economy and compared to the other commercial projects that have such features, does not do well on sustainable development based on our assessment.

The Vietnam project between the Netherlands Development Organization in Vietnam (SNV-VN) and the Vietnamese Ministry of Agriculture and Rural Development has led to the large-scale promotion of biogas technology in 12 provinces. Negotiated in 2002, the project is now in its second phase. Farmers are subsidized through the post office system and provided technical assistance to install the technology and use it. The project is very successful and many farmers participate in the program. Two remaining problems include that richer farmers can also receive the subsidies and the gas and slurry have not been optimally used. However, through changing the subsidy system and providing specific capacity building both problems can be addressed. The project focused on a number of social, environmental and economic needs of local stakeholders and does well on sustainable development.

The South African project between NuPlanet with offices in both countries and E3 an engineering company aimed to set up a mini-hydel project in Bethlehem. Following an idea in 1997, the contract was signed in 1990 but had not yet entered into operation at the time of the field visit in 2006. The delays were essentially caused by the unique nature of the project that called for a large number of permissions and government authorities took time to accept and support the project. The project meets national regulations but does not go beyond that in terms of contributing to sustainable development.

The Chinese project between the Energy Research Centre in the Netherlands and the Ministry of Science and Technology in China aimed to set up a sunny greenhouse in Shougang in Shandong province. Although the demonstration greenhouses have been set up, the on-site visit revealed that these greenhouses are not being used optimally and as the baseline was not clear, GHG emission reductions are negligible. The project has low involvement of local stakeholders and does not meet any other sustainability criteria.

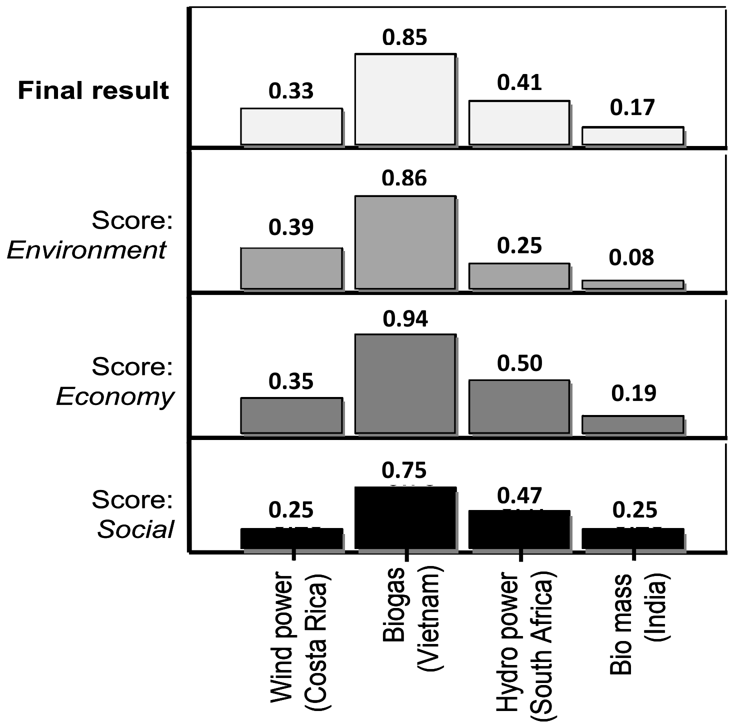
The Indian project between the Dutch company NICIS, and India's Development Alternatives and DESI Power, signed in 1999, aimed to promote six biomass gasifiers, of which one was investigated. This project aims to reduce greenhouse gases in comparison with diesel generators in the baseline situation, but has made very few additional contributions to the local economy.

All projects aim at promoting renewable energy that theoretically should result in reduction of greenhouse gases and could prima facie be seen as contributing to sustainable development. However, this determination can only be made on the basis of the methods to evaluate emission reductions. While four of the projects reduced greenhouse gases in relation to their own baselines, the China case study had a poor baseline and the reductions are less obvious. Furthermore, the baseline used in the Vietnamese case study does not conform to the baseline method developed to deal with biogas and hence the project did not qualify to be accepted as a CDM project.

While these projects did not explicitly have to meet sustainability criteria, they were meant to be aligned to national priorities. Sustainability was not explicitly taken into account except in the Vietnamese project. If one argues that renewable energy is per se sustainable then all five projects meet the criteria. If one argues that host country approval is prima facie proof of alignment with national priorities, then all five projects meet those criteria. However, if we assess the projects based on our own criteria, we find that the Vietnamese project scores the best and the Chinese project the worst (see Figure 3.3 below). The first row shows the overall comparative result, the second, third and fourth rows reflect on the environmental, economic and social contributions of the projects.

Although the Vietnamese project has not qualified as a CDM project, the Costa Rican and the South African ones have. The case studies reveal that demand-driven projects are most likely to be successful in terms of both reducing emissions and achieving sustainable development if these criteria are explicitly taken into account. They also suggest that: active engagement of local stakeholders in project development may enhance the quality and implementation of the sustainability criteria; projects must be designed in accordance with the applicable rules regarding baselines methods if they are to successful in generating certified emissions reductions; small and relatively affordable renewable projects have low negative environmental impacts; clear and measurable sustainability targets need to be set; the nature of the relationship between the project

Figure 3.3
Scoring and Ranking of Four Case Studies on the Basis of Equal Weights for Environmental, Economic, and Social Impacts



Source: Gupta et al. (eds.) 2007

partners is a vital ingredient in the success of such projects; a clear division of responsibility between project partners is critical; and, lastly, the technology to be used should be geared to local circumstances.

Our case studies show that the Vietnamese project reduced CO_2 emissions at a cost of 38 euros per ton and this was also the most sustainable project, in terms of its own baseline. The Costa Rican project cost 548 euros per ton of CO_2 and had a much lower impact on sustainability. With only five case studies, it is not easy to generalize, but the Vietnamese project scored both well on cost-effectiveness and sustainability countering the analysis of Sutter and Parreño's (2005). It should be noted that innovative projects in a particular context often are accompanied by higher transaction costs as the first mover has to secure all the permissions needed to undertake such a project. Good project documentation is critical to the successful evaluation of the project and four of the five projects have demonstrative effect.

5. CDM and Sustainable Development in the Dutch Portfolio

This section examines the potential contribution to sustainable development of 44 representative projects (in terms of technology, geographical distribution of host countries, size of projects, CER acquisition tracks used and phase of project development) out of a total of 150 CDM projects in the Netherlands portfolio. Projects in this portfolio have been developed by private entities, multilateral organizations and private financial institutions and are currently being implemented.

About 75 percent of the projects focus on electricity production; while the small renewable energy projects are expected to have the highest sustainable development benefits. Some projects focus on reducing HFC-23 and capturing fugitive gas—and these have the lowest contribution to sustainable development. Based on a survey among the designated national authorities in the host countries where a Dutch embassy is located, Dutch projects supported by the national governments have a tendency to contribute to energy security by helping reduce the use of imported fossil fuels and by increasing access to energy supply and improving the chances of income generation for local populations. However, hydropower projects often have negative side effects.

The research shows that sometimes the sustainable development contributions of projects are a direct result of the component of the project that focuses on GHG abatement. These contributions such as technology transfer, or improvement of local air quality, reduced dependence on fossil fuels, energy supply diversification etc. should automatically arise from achievement of the GHG abatement. However, where the sustainable development components are indirectly connected to the project's GHG abatement aspects (e.g., investment in the local community and their priorities; investment in abating other local pollutants), there has to be additional investment in such aspects to ensure that these are achieved; and the likelihood that these proposed indirect sustainable development benefits are eventually achieved may be low.

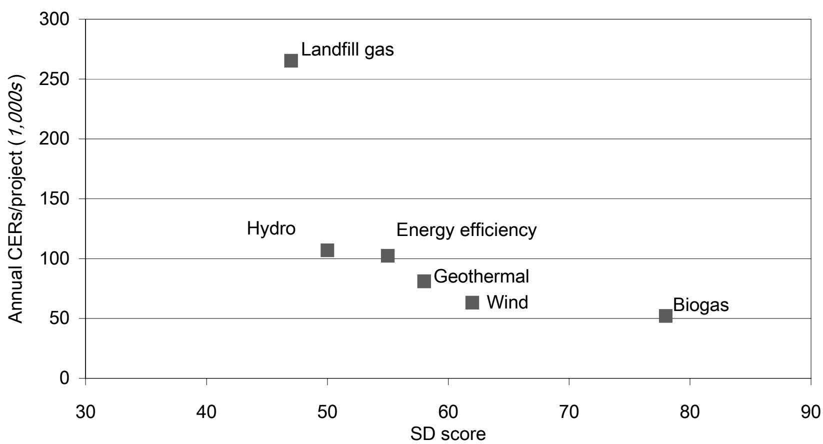
Based on an assessment of the score that host country Designated National Authorities (DNAs) gave to these projects, a biogas project in Nicaragua received the highest score. Others that scored well are wind, coalmine methane, geothermal and energy efficiency type of projects. Although the HFC-23 projects score high on emission reduction credits, they tend to score poorly in the area of sustainable development. Figure

3.4 below shows that in our limited case study those projects that had a high contribution to sustainable development tended to have a low greenhouse gas abatement potential and those that had a high greenhouse gas potential tended to have low sustainable development contributions.

Combining the above information, one can argue that seven project types (all biogas projects, the coal mine methane project in China, the three energy efficiency projects initiated in Moldova, both projects analyzed in Colombia (hydro and wind power), and the landfill gas project in Costa Rica) have potentially a very high contribution to sustainable development. Eighteen projects with a potentially high contribution to sustainable development fall into ten categories. Medium contribution is expected in twelve project types including HFC-23 projects, the geothermal power project in the Philippines, the biomass projects in Brazil, the hydropower projects initiated in Ecuador and Honduras, the landfill gas projects in Argentina and South Africa, and the wind power projects in Costa Rica and the Philippines.

This indicates that the context where a project is implemented is critical for determining whether there will be a contribution to sustainable development. Although investor and host government criteria may call for greater attention to sustainable development and this may lead to proposals in project documents for additional activities with respect to local communities, since the sustainable development component is

Figure 3.4
Trade-off between Sustainability and Annual CERs per Project



Source: Gupta et al. (eds.) 2007

not monitored by the Executive Board and is not critical to the success of the legal contract, such activities may remain on the wish list and not always be implemented.

In this research, we were able to classify how host countries assess sustainable development in CDM projects. This ranges from an attempt to be comprehensive by applying sustainable development criteria, through assessing whether the project meets the needs and priorities of the people, to whether it complies with existing national legislation and this is shown in Table 3.1 below.

Investor countries may also have sustainable development criteria. For example, the Netherlands tries to ensure that its portfolio of CDM projects should: have no large-scale adverse impacts on society or ecosystems; follow OECD guidelines for Multinational Enterprises; not support nuclear projects; support large dams only if they meet criteria set by the World Commission on Dams. Furthermore, they require that: projects that have a high sustainable development impact can potentially qualify for higher CER prices; priority projects include renewable energy, clean and sustainable biomass, energy efficiency, transport, fossil fuel switch, methane recovery and carbon sequestration; and capacity building may be funded by official development assistance, but CDM should primarily be funded through specific environmental funds.

Clearly, there remain significant challenges to achieving the sustainable development component of CDM projects. As long as the formal CDM monitoring and verification procedures only check on the greenhouse gas abatement and not on the related sustainable development component, the latter will be relegated to a lower status. Although host governments can insist on the sustainable development component when approving projects, there is no way to ensure that their achievement is vital to the issuance of certified emissions reductions. Many alternatives are pos-

Table 3.1
Types of Sustainable Development Criteria in Host Countries

SD criteria (operational SD approach)	Needs and Priorities (context-specific)	Environmental Impact Assessment/ national legislation (compliance-driven)
Brazil, China, Colombia, India, Indonesia, Philippines, South Africa, Sri Lanka	Costa Rica, Honduras, Jamaica, Moldova, Nepal, Nicaragua, Peru	Argentina, Chile, Ecuador

sible. Host governments may tax such projects and use the resources for sustainable development components. Investor governments may insist on checking on the sustainable development components of such projects before purchasing the credits. They may be willing to pay a premium price for "good" credits; or a low price where the sustainable development aspects are not implemented. In any case, this might frighten investors from making superlative claims about how their projects are likely to contribute to sustainable development. Possibly, the CDM Executive Board should itself set up a system to monitor sustainable development benefits.

Second, there is the contentious issue of whether official development assistance should be linked to CDM or not. The deal made in the climate change convention was that "new and additional" resources to official development assistance should be made available to deal with the climate change problem. However, in practice, some developed countries have been using ODA for CDM. Here there are two categories of investor countries; some that use ODA for capacity building and distinct private or other funding for the actual CDM projects—such as the Netherlands, and some where it is not entirely clear who is doing what. The advantage of the former is that it tries to meet the strict new and additional criteria. The advantage of the latter is that it may be easier to generate additional sustainable development benefits.

6. Sustainable Development: Are We Chasing an Illusive Dream?

Let us then return to the question: Can project-based emissions trading help achieve sustainable development? In principle, under the climate change regime, sustainable development is something host countries determine, so if they say "yes" there should be no problem. However, as stated above, country definitions of sustainable development vary considerably and there may be a tendency towards a race to the bottom. I would argue that sustainable development in relation to project-based emissions trading is likely to remain an illusion as long as it is dependent on host country approval and there is competition between host countries; as long as contractual success is not based on achievement of the SD component; as long as the sustainable development component is not verified and examined prior to purchase; and as long as the component tends to be written in vague terms.

The sustainable development component could be concretized if it could somehow be translated into quantitative goals that can be measured, if local conditions are taken into account (e.g., Humphrey, 2004), if local capacity to enhance the sustainable development component can be increased (e.g., Ellis and Kamel, 2007), where contractual fulfillment and approval of the CERs are based on the achievement of the sustainable development component, or when a percentage of the costs are dedicated to meeting sustainable development components.

Such analysis is critical as we move into the next phase of project-based emissions trading where governments are seeking to differentiate and improve the mechanism further to meet the changing circumstances of developing countries—as well as deal with the existing critique through ideas such as discounting, multiplication, positive and negative lists, demand and supply quotas, ineligibility and preferential treatment.

The question however remains: Is a project-based incremental approach suitable for the drastic change in production and consumption patterns that the world needs in order to become a low greenhouse gas economy? The ultimate success of the CDM may be that it has popularized the idea of climate change and the need for greenhouse gas emission reduction in corporate investments and brought it to communities that normally would have been less influenced by such a process.

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Part II

Challenges and Lessons Learned from Evaluations

4

Challenges for the Evaluation Community

Osvaldo Feinstein

The chapters in this section either draw lessons from a range of interventions or evaluations, or address how interventions should be evaluated in future. They thus pose a special challenge for the evaluation community: whether we have progressed far enough for valuable meta-evaluations and portfolio analysis, and whether the tools and methods that we apply as evaluators are up to the highest international standards, and if not, how we can improve them.

In the first chapter of this section, by Alan Ries et al., an interesting analysis is made on the portfolio of the Agence Française de Développement on energy efficiency and renewable energy projects, discussing two approaches to estimate the climate impact of this type of projects: an absolute inventory of greenhouse gas emissions and a relative or differential inventory with respect to a baseline situation. It shows that these two approaches are complementary, though insufficient, to assess climate impact and recommends the use of an efficiency indicator such as the ratio between emission reductions and the amount invested, and that a comparison be made between tonnes of avoided CO_2 emissions and tonnes of absolute emissions.

The second chapter, by Claudine Voyadzis and Bastian de Laat, shows the importance of using a multi-disciplinary approach in the evaluation of natural disaster prevention and mitigation projects. Examples derived from evaluations of flood prevention, environment and earthquake-related projects are discussed, highlighting the need for evaluation to combine engineering components with environmental and socioeconomic analyses. The chapter also includes a brief review of the evaluation experience of international financial institutions in disaster risk management and underlines the strong convergence in evaluation results.

In the third chapter of this section, Howard White argues that the selection and design of climate change interventions should be based on existing evidence of what works and what does not, why, and at what cost. White argues that such analysis has been under utilized, resulting in misallocation of resources at both the global and national level. The chapter shows how the cost effectiveness of climate change interventions should be assessed, indicating that a full cost-benefit analysis, rooted in a quality impact evaluation, is necessary to capture all costs and benefits and understand why interventions do or do not work.

Fatima Denton, in the last chapter, suggests that evaluation offers both opportunities and challenges in a complex social and environmental scenario: opportunities to acquire more knowledge, to measure progress and to make crucial adjustments; and challenges due to the context of uncertainty and adaptive capacity that evaluators have to take into account, particularly in the case of Africa, where the population faces multiple threats. Denton argues that what participatory evaluation can do for those vulnerable groups is to assess whether their coping ranges are being expanded, to identify and learn from their existing coping strategies under varying climate scenarios and to make adjustments that will increase their resilience.

5

Early Lessons from Analysis of the AFD/FFEM Renewable Energies and Energy Efficiency Portfolio

Alain Ries, Koulm Dubus, and Jean David Naudet

1. Introduction

The crucial importance of global issues such as global warming and conservation of biodiversity is leading donors to adjust their strategic positioning. This is the case of the Agence Française de Développement (AFD), a specialized financial institution founded in 1941 by the French state, and of its subsidiary Proparco, founded in 1977 and specializing in financing for the private sector. The AFD's positioning, initially focused on economic growth and poverty reduction in the South, was recently broadened to include protection of global public goods. The Agency thus became involved in financing energy efficiency and renewable energy projects contributing to the major objective of fighting against climate change.

The renewable energy sources and energy efficiency sector is innovative, complex and growing extremely fast internationally. It involves activities in a number of fields: not only harnessing renewable energy sources (wind, solar, biomass, biogas, mini-hydraulic systems, etc.), energy efficiency (energy-saving buildings, machinery, production processes and transportation systems), but also the establishment of appropriate legislative and regulatory frameworks (construction standards, price incentives, suitable taxation, etc.).

As a result, it displays the particularity of being a cross-sectoral theme in an institution that is strongly compartmentalized, both technically and geographically. It is difficult to ensure that information passes from department to department, especially since the operational staff are very occupied in identifying further operations and meeting targets for growth in the AFD's commitments. These teams need rapid feedback, but only a few operations have been completed and are ready for normal ex post evaluation. Overloaded on the operational front, they do not have enough time to draw the lessons from their experience and to share them.

This chapter aims to improve information flow between the professionals and the departments concerned with energy efficiency and renewable energy sources within the AFD Group and to highlight the first lessons derived from analysis of the project portfolio.

The scope of this "early lessons" study covers the projects of the AFD, Proparco and the Fonds Français pour l'Environnement Mondial (FFEM—French Global Environment Fund), a bilateral fund set up in 1994 with the AFD serving as its Secretariat. The FFEM's funds come from France's central government budget, in addition to France's contribution to the Global Environment Fund (GEF).

The portfolio of the FFEM is older than that of the AFD and consists primarily of pilot operations undertaken in the expectation that they will be scaled up by other donors, such as the AFD, which have greater financial resources.

The chapter maps the various energy efficiency and renewable energy projects from a number of analytical angles. It specifies the narrow field for conventional ex-post evaluations due to lack of completed projects.

In addition to a short presentation of the conventional ex-post evaluations conducted, it examines three crucial issues for donors engaged in the financing of energy efficiency and renewable energy projects: (1) What are the conditions required for the emergence of projects? (2) Can these projects be financed on commercial terms or are they eligible for better-than-market terms? (3) From the standpoint of selecting the best projects, how should the climate impact of projects be assessed?

2. Analysis of the Existing Portfolio

The portfolio was mapped on the basis of a classification of projects financed by the AFD, Proparco and the FFEM from 1994 to 2006, according to a classification scheme developed by the AFD's technical departments (see appendix).

The statistical database compiled on that occasion provides a breakdown of projects by technical sector, donor and type of financing and to track their development over time.

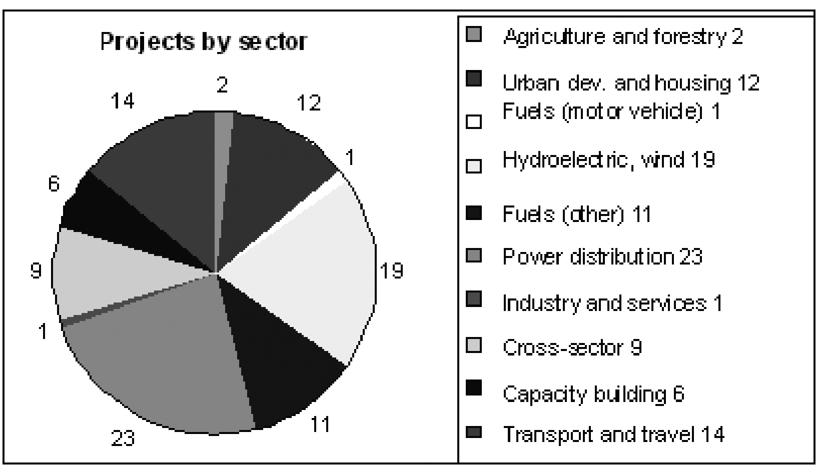
The main characteristic of the portfolio of projects financed from 1994 to 2006 is the diversity of the sectors concerned, as can be seen in the figure below:

Many of the sub-sectors listed in the classification scheme have not yet been addressed by any projects: production of renewable energy from geothermal sources, development of local production of energy-efficient goods (refrigerators etc.), attention to unmotorized or lightly motorized travel. Certain sectors, such as the energy upgrading of energy-greedy industries and demand management on power grids, are targeted only by a single pilot project.

Projects to develop renewable energy sources are more numerous than energy efficiency projects. This characteristic is found widely at the international level as well, as energy efficiency projects have proved more difficult to conduct than renewable energy projects because they are more dispersed and intertwined with other issues (industrial upgrading, improved comfort in housing etc.).

It should be emphasized, however, that the database compiled covers only those projects for which energy efficiency or renewable energy is the main objective. As a result, many projects having an energy efficiency component are excluded from the scope of this study. Urban hydraulic projects, for example, will include a component aimed at reducing leakage, and the resulting reduction of water losses will reduce the energy consumption of the water supply system. Projects in support of local authorities can also include an energy efficiency component.

Figure 5.1
Projects by Sector



The dispersion of the portfolio is a positive factor in the current phase, when the AFD is looking to expand its activity, but it generates high operating costs. In a second phase, it will be necessary to concentrate the Agency's efforts on the key points identified.

An important characteristic of the portfolio is its rapid expansion. Total commitments of the AFD, Proparco and the FFEM hovered around €50 million annually from 1995 to 2001 and rose to €250 million in 2004 and over €450 million in 2006. It should be noted, however, that commitments dropped sharply in 2000, 2002 and 2003. The curve of change in commitments over time is very similar to that of the trend in the price per barrel of crude oil. Low oil prices in 1998-99 and 2001-02 were followed one year later by a decline in AFD Group and FFEM commitments in this sector.

Although the annual data have little significance, the general trend of the curve seems to show that the AFD responds strongly to the energy context prevailing at the time of project appraisals, above and beyond its declared intention of long-term engagement with this set of issues.

The number of completed projects is very limited so conventional evaluations are only starting. An ex post evaluation of three energy efficiency programs in the construction sector that received FFEM subsidies in the late 1990s (Lebanon, Tunisia and China) is ongoing and will be available by September, 2008.

3. Early Lessons Concerning the Conditions Required for Project Start-Up

As part of this drive to draw lessons from first experience, a review of energy efficiency and renewable energy projects allows us to identify some common conditions that are conducive to the set-up of this type of operation.

Sufficient political will and an adequate legislative framework as well as the existence of locally owned technical capacities prove to be necessary conditions for the emergence of a large number of projects in a given country. The same holds true for appropriate financing methods. This point is further developed in the next part, owing to its operational importance for a donor like the AFD.

Lastly, a positive climate impact should not be allowed to obscure the need to conduct broader environmental and social impact studies, as is the case for any project of significant size.

National Context

In an increasingly globalized world, it must be recognized that national policy frameworks—particularly the regulatory framework and the pricing and tax measures adopted as well as the political will that underpins them—are of great importance in the emergence of projects.

Regulatory standards. The presence of restrictive regulatory standards is a factor that promotes the development of renewable energy sources and encourages energy savings. An example is an obligation to capture methane emissions from landfill sites.

The regulatory framework must take into account the constraints facing the country. For example, several countries have made it a requirement that a percentage of ethanol be gradually incorporated in petrol. However, their domestic markets did not produce enough ethanol, making it impossible to comply with the regulations, which had not been coordinated with the development of agro-industry.

Adopting a given regulation is pointless unless it can be and is complied with. Thus, it is recommended that the establishment of standards be accompanied by capacity building for the various parties involved, and particularly the future inspectors. Donor support can be useful here if it is requested by the competent domestic authorities.

Labeling household appliances, housing and engines in terms of energy performance makes it possible to establish a regulation in a controlled manner. The least energy-efficient classes can be prohibited gradually, allowing manufacturers and other parties to adapt to the future regulation. Labels also encourage virtuous behavior on the part of those who wishing to go further than is required by standards.

Pricing and tax aspects. Renewable energy projects can be encouraged by:

- an obligation to purchase electric power generated from renewable sources,
- fixed pricing for purchase of power over a period long enough to amortize plant, which may also be subsidized,
- tax incentives.

The obligation to buy power from renewable sources is not in itself a sufficient condition. Solvent customers are also needed. This is a particularly delicate point in some countries where power distributors are in poor financial shape.

Without a fixed purchase price, it is hard to make a profit on power from renewable sources if the price of conventional energy production does not reflect the real costs involved, notably the cost of purchasing the oil products needed to produce it. Similarly, the development of the biofuels sector is extremely dependent on the price of oil. A state guarantee of fixed purchase prices is needed to ensure the sustainability of this type of sector.

Subsidized power prices and subsidies for investment in more energy-efficient power plants, transport systems or appliances have a cost for the public budget. This foregone tax revenue can be partly offset, however, by reduction of the share of the central government budget to grant price subsidies for power generated from oil or gas when this kind of policy is implemented.

In addition, fiscal subsidies can serve as a means of redistributing taxes levied on energy consumption or on energy-greedy products (automobiles, aircraft, low energy efficiency industries, air conditioners etc.).

In order to promote the use of public transport, it is similarly necessary to grant subsidies for investment and/or subsidized user rates. The development of mass transit is favored in countries and local communities that have transport regulatory authorities.

Political will. Apart from the tax and regulatory framework, political determination to develop renewable energy sources and energy efficiency increases projects' chances of success.

In Tunisia, for example, political support, including from the highest level, has been particularly strong since the third oil shock in 2004. This has made possible the implementation of a comprehensive, coherent program of energy saving and promotion of renewable energy sources, accompanied by a legislative and financial framework and supported by a public agency endowed with serious resources.

In addition, synergy between energy saving programs makes it possible to mount joint communication campaigns targeting manufacturers, individuals and public officials, thus reinforcing the positive impact of each project.

Financing

Access to appropriate financing is a crucial issue for promoters of energy efficiency and renewable energy projects. Donors such as the AFD should adopt an innovative approach to financing and facilitate the use of the Clean Development Mechanism (CDM) in developing countries.

Suitability of financial instruments. A major factor holding back projects is the difficulty of obtaining financing. This difficulty may have several causes:

- insufficient financial capacity on the part of the project promoter,
- project risk perceived as high by banks that are not well acquainted with innovative renewable energy and energy efficiency technologies (trigeneration plant, biomass power plants etc.) or lack the capability for rational evaluation of the risks and benefits,
- financial instruments having an inappropriate term,
- projects too small to interest a donor.

Increasing the equity capital of the project promoter is one response to the first difficulty. Specialized investment funds have been developed in recent years, and the stiff competition among them works in favor of project promoters. The profitability levels expected by equity investors have fallen substantially, opening the way for a new generation of projects. Guarantee funds could be at least a partial response to the second difficulty.

Project owners are in search of loans having a term corresponding to the time required to cover depreciation of the installations financed. Local banks often make difficulties over granting this type of loan, which leaves a niche for international donors who can thus undertake operations on a subsidiary basis. This will be true in particular for small hydroelectric dams.

Many small projects fail to attract donors because the investment required is too small. Innovative financing methods such as the environmental lines of credit introduced in recent years by the AFD are designed to remove this sort of barrier, in partnership with local banks.

Lastly, projects owners generally do not wish to borrow to finance studies in the upstream phase of the project. The development of funds to grant subsidies for launching projects can remove this obstacle.

CDM financing. The Clean Development Mechanism (CDM) is an additional financial resource that can have a favorable influence on the investor's decision to invest. This source of funding is different from those of a donor because the credits are not obtained until after the project has been carried out and because the funding received depends on the market price of a tonne of CO_2.

For a project to be eligible for the CDM, the project owner must develop methods of accounting for greenhouse gas (GHG) emissions—an expensive, time-consuming procedure but also the principal means of ensuring the credibility of the mechanism. Access costs are thus very high for a project owner wishing to register an innovative project for which no such methods have been developed.

Helping developing countries to develop CDM methodologies in innovative sectors thus offers considerable leverage, as similar projects around the world will benefit later on. The AFD and the FFEM have undertaken their first actions in this regard. However, the support provided is currently targeted to specific geographical areas rather than to innovative sectors not currently registered with the CDM.

Technical Capacity

A shortage of technical capacity is a major factor limiting the emergence of projects. This shortage takes the form of insufficient familiarity with technology and a lack of specialized operators.

Familiarity with technical sectors. Potential project promoters, often SMEs or local authorities, are not sufficiently aware of the existence of specific technical sectors and the energy savings that could be reaped. In developing countries, for example, the development of photovoltaic energy is hampered by the low level of local technical know-how and the lack of private sector operators of appropriate size.

Setting up subsidized pilot projects and drawing lessons from the experience they provide can be used to present an innovative technology or arrangement, demonstrate its technical and institutional feasibility and prove that it is economically worthwhile. The FFEM is particularly well positioned for this niche, and the AFD can also engage in it through its subsidized loans (see below).

The development of ESCOs. Energy saving service companies (ESCOs) are firms that provide industrial customers with diagnoses of how to reduce their energy expenditures. The ESCO is remunerated by sharing the operational savings generated with the customer. These companies have the advantage of directing the entire project: design, search for financing, project preparation, execution and operation. Moreover, they are capable of rallying all stakeholders in the sector and of financing either large or small projects.

The portfolio of the AFD Group and the FFEM contains few projects in which ESCOs are involved. This is due in part to the fact that ESCOs are in short supply, but also to the small scale of their projects, which make it difficult for a donor to become involved directly.

Social and Environmental Factors

Negative environmental and social impacts are always a barrier to development projects of any kind. This obvious fact remains true for projects in the energy efficiency and renewable energy portfolio, many of which are infrastructure projects: dams, railways, CHP plants etc.

The differential positive impacts of reduction of GHG emissions obviously count in this respect, but they should not make us forget the major population movements that can be caused by large infrastructure projects. Agro-industry projects such as the development of biofuels raise a conflict over soil use with food crops and may pollute soils and surface water. On a small scale, wind farms cause visual and noise pollution that hampers their development.

To ensure the smooth conduct of such projects, a rigorous environmental and social impact study is needed, accompanied by an environmental and social management plan and if necessary a plan for relocation of the population affected.

4. Early Lessons Concerning the Terms of Project Financing[1]

A growing number of projects aimed at developing renewables energies are now financed on market terms. These projects generally arise in a favorable national policy framework (for a wind farm, for example, the obligation to buy the power produced at a subsidized price that is guaranteed over the long term) and employ tried and tested technologies. The projects financed, however, are far from corresponding to the scale of the identified technical potential and the public policy objectives of the countries where they are implemented.

The insufficient profitability of projects can be a major obstacle to their development. In other cases, technically innovative factors will entail a high level of risk that neither the project promoters nor the local credit market are willing to take on by themselves At a more advanced stage, there are entire sectors which, although experimental projects have proved their viability, cannot be developed owing to threshold effects or to a shortage of appropriate financing.

A debate arises as to whether it is legitimate for donors to finance projects in the emerging countries with loans on concessional (lower than market) terms, known as “soft loans”. Those opposed consider that such loans distort competition and create windfall effects for those who would have made the investment anyway, even without the concessional loans. Those in favor consider that the projects could not be undertaken without these loans.

This section examines the cases in which the AFD provides soft loans for energy efficiency and renewable energy projects. It also describes the lines of credit specializing in energy efficiency and renewable energy that the AFD is setting up to reach a larger number of projects.

Concessional Financing of Energy Efficiency and Renewable Energy Projects

A review of the portfolio of energy efficiency and renewable energy projects financed on concessional terms reveals that there are in fact *three operational approaches*, corresponding to different conceptions of additionality that lead to different practices and diagnoses.

The first approach is purely financial. Compared to a loan on market terms, a concessional loan increases the profitability of a project. The project financed is "additional" if it is initially below the profitability threshold needed for it to be launched, and above this threshold once the financial benefit of the concessional loan is factored in.

Under the same financial reasoning, a concessional loan can also change the conditions prevailing on a local market, leading for example to a lower consumer price. In this case, additionality is measured in terms of the social gain to consumers.

This financial approach is in keeping with the AFD's approach to building its range of financial products: the less profitable the project is in financial terms, the greater the aid component in the AFD's contribution. This principle is applied in several cases of power generation from renewable sources (wind etc.).

The approach raises a number of difficulties, however. It is not always easy to define a counterfactual case making it possible to assess additionality, and in particular to evaluate the profitability threshold leading to initiation of a project. The approach can produce windfall effects, for example in the case of projects whose revenues are indexed to skyrocketing energy prices.

Changing the profitability equation by granting subsidized loans proves to be appropriate for:

- situations where the profitability of the investment is the decisive factor in decision-making (e.g., construction of a wind farm coupled with a diesel-fired plant instead of the diesel plant alone),
- projects in which supplementary costs arising from tangible factors can be easily identified (e.g., isolation of the project site), in which case the donor's contribution is subsidized so as to offset these costs in a transparent manner,
- monopolistic projects aimed at poor or isolated groups that have access to a costly form of energy (e.g., decentralized rural electrification using photovoltaic generation),
- stable conditions in terms of project inputs and outputs (e.g., distribution of solar water heaters).

The second operational approach is to finance innovative operations. The soft loan should give economic agents incentive to undertake innovative or high-risk projects. In this case, the additionality is based on removing barriers that are unrelated to project profitability, such as risk and technical expertise.

This approach of providing incentive for innovation is in keeping with projects:

- that include technical uncertainties (e.g., wind farms at high altitude, where the reduced density of the air may affect the operation of the turbines to a degree that is not easy to evaluate);
- that are innovative within their geographical area (e.g., recovery of landfill gas in sub-Saharan Africa),
- or, more broadly, that entail intangible additional costs (learning costs stemming from a change of technology, more extensive mobilization of the company than in the case of a conventional project).

This rationale is rarely used today by the AFD to justify the provision of concessional loans. The reason probably lies in the fact that, in a loan application, it is necessary to show that the technical risk is under control, whereas for the subsidy of a pilot project the emphasis will be laid on its innovative aspect and knock-on effects. An innovative project will thus be more readily supported through a subsidy or equity investment than through a concessional loan.

The third and last approach is to finance operations on a strictly sectoral or technological basis. The aim is to create an incentive to improve energy or environmental performance in a given sector. In principle, this approach is no longer applied to isolated projects; rather, it entails taking account of all projects in a given sector (energy efficiency in manufacturing, CHP, solar water heaters etc.).

The starting point is often a market analysis revealing that a given sector shows potential for projects but that these projects find it difficult to get off the ground. The decision to grant concessional financing is not based on calculation of profitability project by project or on identification of a counterfactual. The financial benefit is a premium whose role is to influence, along with other factors, the decision to invest. The premium is available to all project promoters in the sector. The existence of windfall effects for those who would have made the investment in any case is accepted from the outset, the aim being to minimize them. The quid pro quo is the requirement that the project be monitored and evaluated to enable ex post assessment of the additionality really generated.

This sectoral incentive approach is well suited to:

- support for public policies,
- promotion of environmental practices aimed at a large number of economic agents,
- sectors in which pilot operations have succeeded in removing the non-financial obstacles,
- narrow sectors that display potential for projects but have proved unable to realize it.

Specialized Lines of Credit for Energy Efficiency and Renewable Energy Projects

Compared to direct financing, the main advantage of lines of credit is that they make it easier to finance a large number of small projects. The line of credit is particularly suited to the sectoral approach described above, but may also, in some cases, be based strictly on profitability criteria.

The approach developed by the AFD is primarily based on analysis of the country context (existing public policies and regulations, the financial market, the environmental and energy context etc.), which is used to identify the sectors to be assisted.

Setting up lines of credit is a delicate matter, in terms of the selection of eligible sectors (or, more generally, the selection of eligibility criteria), selection of partner banks and assessment of their environmental impact.

Eligibility criteria. Eligible sectors are very often technical in nature: wind farms, dams, CHP plants, biofuels production, installation of solar water heaters, energy-saving plant and equipment in the industrial sector etc.

In view of its size and the project potential identified per sector, the line of credit is made available to several sectors that face different sets of problems. Increasing the number of eligible sectors increases the potential number of projects and hence the likelihood that the credit line will be used quickly. It minimizes the risk that no-one will draw on the credit line due to poor assessment of the barriers to the development of a given sector, but increases the potential for windfall effects. The reason for this is that the credit line will be used preferentially in those sectors where the projects are easiest to set up. A line of credit open to a wide variety of sectors is recommended for a first operation in a given country; the criteria can subsequently be made more selective as knowledge of the country context improves.

Distortion of competition. One advantage of the line of credit is that it avoids distortion of competition among those enterprises in the selected sectors that have access to credit and that are or can become customers of the bank handling the line of credit. In principle, all enterprises are eligible on the same terms, the only limit being the amount of the line of credit. The risk of distortion of competition must also be evaluated on a second level, however: that of the competition between banks eligible for the line of credit and the other banks in the local market. In practice, given the size of the markets in which the AFD uses these lines of credit and given that its presence in most of these countries is recent, it is difficult for the AFD alone to work with all banks in the country. Here again, a learning process is needed. The most elaborate forms of joint action, i.e., financial market instruments funded by several donors, take time to build. Initially, a certain level of distortion must be accepted. In any event, it is limited by the size of the financial markets of the emerging countries in which the AFD operates.

Evaluation of lines of credit. Lines of credit are too recent at the AFD to raise the issue of ex post evaluation of their impact and effectiveness. The bank intermediation between the AFD financing and projects certainly makes it more difficult to assess results.

Pilot monitoring and evaluation practices should be tested soon on real-world cases. Where the nature of the projects allows, approaches such as "output-based aid", in which the financial assistance is tied to evaluation of results, offer interesting prospects and should be examined further.

5. Early Lessons Concerning Measurement of Climate Impact and Project Selection Criteria[2]

Energy efficiency programs have been repeatedly criticized for their lack of accurate measurements and estimates of the energy savings and GHG reductions obtained.[3]

An official listing of energy-related and environmental indicators is helpful to public institutions like the AFD and the FFEM, not only in their decision-making on what to finance but also in ex post evaluations to justify the soundness and efficiency of projects.

This section highlights the practices currently used by the AFD and FFEM to measure GHG emission reductions and describes the initiatives taken. It concludes with proposals for better methods of taking climate impact into account in selecting projects for AFD financing.

FFEM and AFD Practices and Initiatives for Measuring GHG Reductions

To assess the climate impact of a project, two types of carbon inventory can be performed. The first is the *absolute inventory* of the project in terms of GHG emissions, with no consideration given to what would happen if the project were not undertaken. The absolute climate impact of the project is estimated by calculating the number of tonnes of CO_2 emitted during the set-up and operating phases. Virtually all the projects financed emit GHGs into the atmosphere; the most virtuous of them have almost no impact.

The second is the *relative or differential inventory* of the project with respect to a baseline situation corresponding to the absence of this project. Thus, even when a project has a GHG emissions inventory greater than zero, it can help reduce such emissions in comparison to what would have happened on the market without this project.

The FFEM systematically calculates the number of tonnes of GHGs emitted with respect to a baseline scenario for its energy sector projects and gives details of its calculations. The AFD recommends the use of the "GHG emissions reduction" indicator in its strategic framework document on climate.

The AFD is currently developing a new indicator: the total amount of CO_2 emitted during the lifetime of the project, calculated on the basis of an absolute carbon emissions inventory. The aim is to use this indicator at a preliminary stage of the project cycle to decide whether the decision to finance the project is justified.

Avenues for Improvement in Methods of Taking Climate Impact into Account in Projects Financed by the AFD

Carbon inventory: absolute and relative to a baseline scenario. The objective for AFD Group is to determine the climate impact of a project. To accomplish this, it is necessary to calculate both an absolute and a relative carbon inventory.

The two types of inventory are complementary and are not used in the same cases. Moreover, they do not always lead to the same conclusions.

A project selection criterion based on an absolute carbon inventory leads to selection of projects with low GHG emissions. It reflects an environmental approach that reasons in terms of stocks rather than solely in terms of flows, the reason being that the main determining factor of global warming is the cumulative concentration of GHGs in the atmosphere rather than annual emissions. Since past emissions are over and done with, however, the only actions that can be taken to stabilize the concentration of GHGs are those concerning future emissions.

The relative carbon inventory compares project impact to a scenario without the project. A project selection criterion based on this inventory favors projects leading to large emission reductions. Such projects, incidentally, can be large GHG emitters, such as public transport projects. This criterion is currently used by the AFD and the FFEM for projects financed in the emerging countries.

Which criterion should be chosen? The aim here is not to choose one criterion over another, but to combine the two approaches. The table above compares the absolute and relative emissions of various standard projects financed by donors like the AFD. However, there are some extremely virtuous projects that generate low absolute emissions and bring substantial reductions. For example, institutional projects designed to draw

Table 5.1
Approximate Ranking of Absolute Emissions and Emission Reductions Relative to a Baseline Scenario for a Few Standard Projects

Emission reduction relative to a baseline scenario extrapolated from current trends

Absolute emissions		Negative	Low	Average	High
	Negative			• Sequestration • Afforestation • Agro-ecology	
	Low	• School • Health facility	• Other renewables (wind, photo-voltaic)		• Energy regulations • Urban transport plan • CO2 capture/ storage • Large dam • Nuclear power plant
	Average	• Extension of drinking water network	• Biofuels project		
	High	• Airport • Road • Extension of power grid	• Reserved track public transport		• CHP plant

up energy sector regulations, labels or national strategic plans display *substantial leverage* for reducing CO_2 emissions. They have a low cost, often requiring aid in the form of a subsidy or technical assistance. Such priorities should thus be preferred in the emerging countries, where the AFD's mandate is to reduce GHG emissions.

A criterion that can be used to reconcile the absolute and relative approaches and to assess a project's utility in combating climate change is the following ratio:

$$\frac{\textbf{tonnes of avoided } \mathbf{CO_2} \textbf{ emissions}}{\textbf{tonnes of absolute } \mathbf{CO_2} \textbf{ emissions}}$$

Efficiency indicator. Alongside the "tonnes of avoided CO_2 emissions" indicator, it would be useful, as in the case of the absolute carbon inventory, to highlight the efficiency of the project by relating emissions to a sum of money.

The efficiency indicator to be used is:

$$\frac{\textbf{tonnes of avoided } \mathbf{CO_2} \textbf{ emissions}}{\textbf{total project cost}}$$

This indicator serves as a decision support tool, along with the indicator "total emissions per euro of loan or grant" and the indicator "emission reduction per tonne of CO_2 emitted."

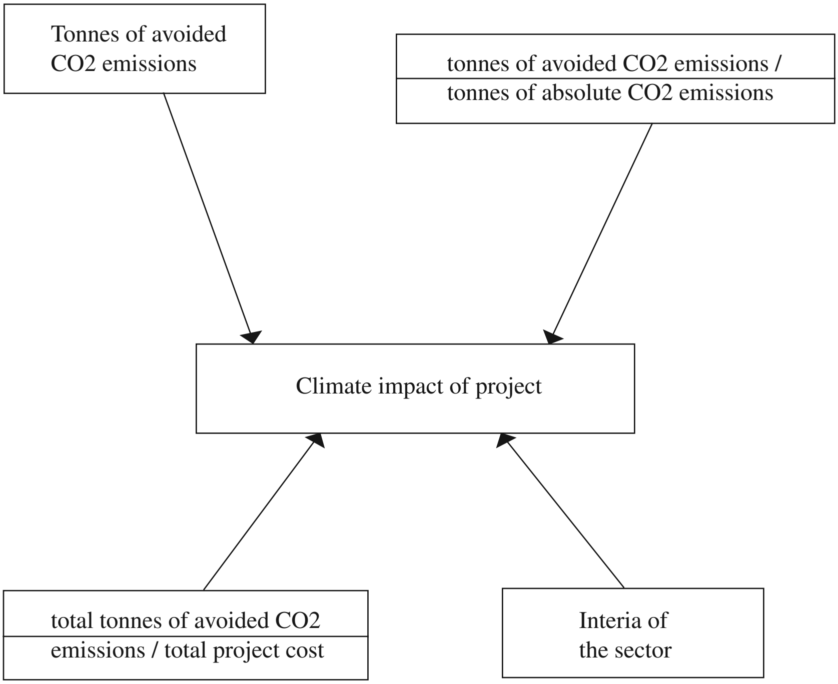
Inertia of GHG emissions. Another important aspect of climate impact efficiency is the inertia of the sector. This inertia is very strong in the case of transport, housing and urban planning projects, where investments not undertaken today will make emissions reduction much more costly in the future. The expected lifetime of an investment gives an idea of its inertia.

Review for decision-making purposes. The figure below summarizes the main factors that the AFD proposes to take into consideration for a decision on project financing.

In conclusion, the climate-related challenges facing the planet justify proactive public policies that will contribute to general awareness of climate issues and the emergence of projects with the support of the financial community.

In addition to what the financial market does on its own account, donors can use concessional loans to encourage the emergence of a new generation of projects having a positive impact on the climate.

Figure 5.2
Factors to Consider in Determining the Climate Impact of a Project



As resources in the form of soft loans are necessarily limited, it is very important to make the most efficient possible use of them. This requires more in-depth research on the incentives one wishes to create. It also requires the ability to select the most relevant and efficient projects from a climatic standpoint, and hence to develop adequate impact measurement tools and indicators.

Appendix
Classification of Renewable Energy and Energy Efficiency Projects

The development of energy from renewable sources and energy efficiency concerns a number of sectors: energy production and distribution, industry and services, transport and mobility, urban development and housing, agriculture and forestry. Financing provided by the AFD, the FFEM and Proparco may be either directly related to one of these sectors or multisectoral in scope (e.g., lines of credit and investment funds specializing in energy management).

Energy production and distribution

Low-carbon power plants connected to the power grid:
- Large-scale hydraulic (pm)
- Mini-hydraulic
- Wind
- Geothermal

Fuels (other than motor vehicle)
- Modernization of traditional fuel sub-sectors (cooking and heating)
- Industrial processes to convert biomass[4] into energy (heat and electricity) through carbonization, gasification[5] and multiple fuel combustion[6]

Motor vehicle fuels
- Development of biofuel chains (sugar/ethanol and vegetable oil/biodiesel)

Power distribution
- Demand management on the power grid (plan to manage demand for power and price incentives)
- Reduction of power losses in transmission
- Sustainable rural electrification (photovoltaic generation or independent local networks)

Industry and services
- Energy upgrading of energy-greedy industries (steel, petrochemicals, metallurgy, textiles etc.)
- Plants producing energy-efficient devices (engines, refrigerators, lamps, solar modules etc.)
- Energy management in the services sector (offices, shops, hotels, hospitals etc.)

- Promotion of energy saving service companies (ESCOs)
- Energy recovery from agro-industrial waste

Transport and travel
- Intensification of the energy component of transport plans (both people and goods)
- Rationalization of energy management in formal and informal transport fleets (buses, minibuses, taxis etc.)
- Revival of low-consuming forms of mass transit (rail, subway etc.)
- Taking account of unmotorized or lightly motorized travel (bicycles, pedestrians)

Urban development and housing
- Intensification of the energy component in urban planning and in urban transit plans
- Management of the energy consumption of local communities and public facilities
- Programs for construction climate-friendly housing (both new construction and renovation) and energy-efficient durable goods (domestic solar water heater, energy-efficient appliances)
- Composting or energy recovery from household waste

Agriculture and forestry
- Forest development plans for energy purposes and regulation of forestry operations
- Local/regional plans for management of and energy recovery from agricultural biomass
- Agricultural and agro-industrial output for energy purposes (sugar, vegetable oil, etc.)
- Development of irrigation methods that consume little energy (and water)

Local capacity building and support
- Building local capacities (support for project preparation, including CDM projects), technical assistance, training for managers in technical and banking fields, informing and sensitizing business to climate issues, studies)
- Establishment of a monitoring and evaluation system for AFD-financed projects.

Notes

1. This section draws on Ries (2007).
2. This section draws on Guillaumie (2007b).
3. Geller and Attali (2005).
4. The term biomass refers to the biodegradable by-products from agriculture and related output, as well as municipal, industrial, hotel, and restaurant waste.
5. The biogas used in power plants comes either from natural decomposition of municipal waste (landfill sites) and effluents (sewage treatment plants), or from fermentation of these materials in methanisers (digestion).
6. CHP plants, or cogeneration plants, produce energy (electricity and/or heat) from fossil fuels (gas, LPG, diesel) and biomass or biogas. In the industrial sector, the main purpose of such plants is self-sufficient production of electric power and heat.

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6

Evaluation Techniques for Disaster Assistance Projects: Toward Multi-Disciplinary Approaches

Claudine Voyadzis and Bastian de Laat

1. CEB's Activities in Disaster Mitigation and Rehabilitation

Set up in 1956, the CEB is the oldest multilateral financial institution in Europe and the only one with an exclusively social mandate. The CEB is a development bank with 40 member states—including 18 Central and Eastern European countries. Since its inception, the Bank has granted over 26 billion euros in loans. One of the CEB's priority lines of action is assistance to victims of natural and ecological disasters. Over the past 10 years the CEB has financed projects for over 2 billion euros in the natural disaster sector alone. In 2007, the Bank approved 35 projects for a total of 2.44 billion euros, of which about 400 million for natural disasters mitigation, rehabilitation and prevention.

Natural disasters are more frequent and have a greater impact than before. Severe flooding in many parts of Europe has become a frequent, annual happening. Forest fires are increasingly intense and often linked to droughts—the extensive Greek forest fires in the summer of 2007 are an unfortunate example. Landslides and avalanches are common. Southeastern Europe and Turkey are particularly vulnerable to seismic events.[1] Assisting regions hit by natural or ecological disasters is a statutory priority of the Bank, and its member states are expected to be increasingly affected in the decades to come.

The purpose of the operations carried out by the Bank in this area is twofold: (1) to provide national and local authorities with assistance involving immediate financial support for the reconstruction of the affected areas and (2) to develop means for the prevention and mitigation of natural or ecological disasters, along the lines of the Hyogo Framework. Emphasis increasingly lies on prevention of, in particular, flooding. Hence, the CEB's most recent projects in this area concern rehabilitation of areas prone to flooding followed by support to water management and construction or consolidation of riverbanks. Substantial projects of this nature were approved in Hungary, Poland and Romania, all three suffering from major floods in the recent past. The importance of natural disaster mitigation in the CEB's portfolio justified this area to be the first to be evaluated.

2. CEB Evaluation of Disaster Assistance Projects

Innovative Evaluation Approaches for Disaster Mitigation Projects

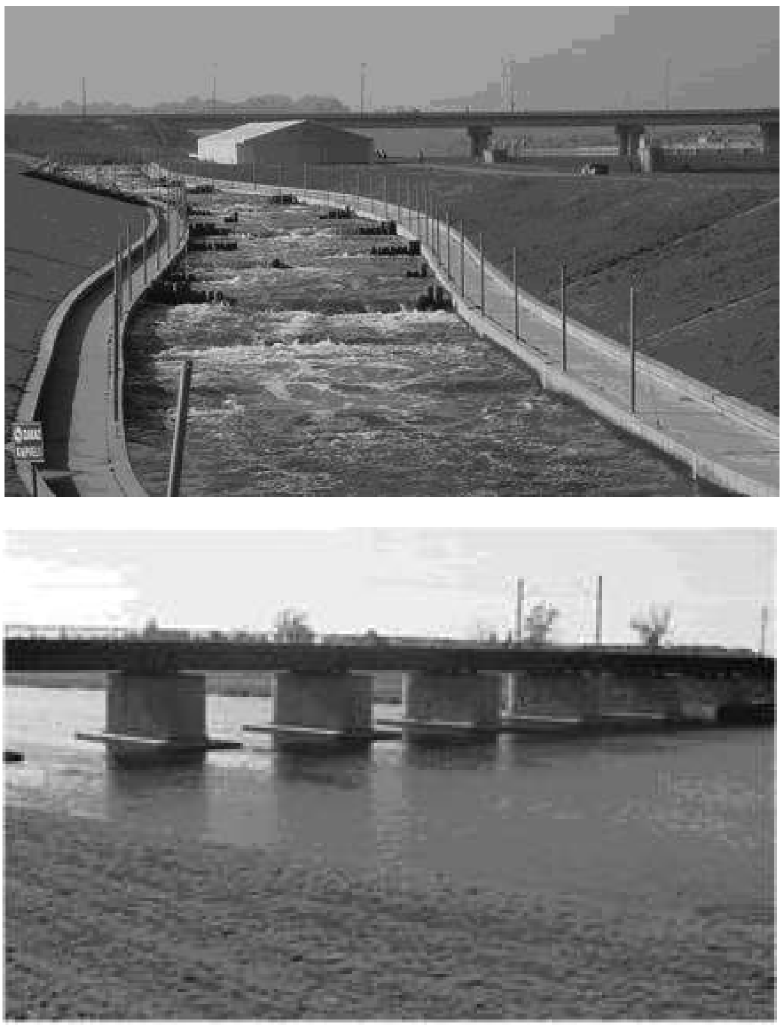
The ex-post evaluations in the area of natural disaster mitigation and prevention covered 11 loan projects to 5 different member states (Spain, Poland, Romania, Greece, and Turkey), approved between 1995 and 1999 for a total loan amount of over 1 billion euros. Seven projects were in response to flooding and landslides, one of which included environmental protection, i.e., the supply of mobile laboratories to monitor air and water quality and the installation of Doppler weather radars. One project aimed at the removal of toxic mud and restoration of environmental conditions after the breaching of a mining reservoir. The three other projects were in response to earthquakes. The flooding-related projects aimed mainly at the construction or rehabilitation of infrastructure to restore living conditions and reduce the impact of future new disasters. The earthquake projects aimed at reconstruction of individual or collective housing according to antiseismic standards.

Ex-post evaluations analyze project relevance, effectiveness, efficiency, impact and sustainability. Also specific issues are assessed: CEB value added, beneficiary participation and windfall opportunities. Evaluations are carried out not only from an institutional and socioeconomic (beneficiary surveys/interviews) perspective, but also from a technical perspective (quality and sustainability of civil works, housing and related infrastructure): socioeconomic experts work alongside engineers and academics.

Projects Related to Flood Prevention

The evaluation of a flood related project in Northeast Europe included an assessment of the technical quality of infrastructure (deviation channels, retaining reservoirs, dams, dykes, drop structures, etc.). All available project documentation was analyzed by the engineers contracted by the CEB; conformity of the infrastructure with relevant building codes and with international best practice was assessed. On-site visits were conducted for visual inspection of the works and interviews with representatives of relevant authorities. Additionally, land use planning was analyzed. These evaluations were performed by teams composed of task managers, civil engineers with urban and regional planning specialty and social scientists in charge of local teams for beneficiary survey.

Figure 6.1
Examples of Civil Works Financed by the CEB—Northeast Europe



When a pure engineering fix was chosen, the evaluation strongly underlined the need to consider alternative sustainable flood prevention measures taking into account land use planning considerations and using cost benefit analysis to compare alternatives. This would lead to the most appropriate solution—an engineering solution but maybe also a socioeconomic or environmental one, often less costly. For instance, deforestation is known to increase the risk of flooding, therefore an adequate response to flooding may be a reforestation project rather than a dyke.

Another example for the need of a multi-disciplinary approach in flood prevention was found in one of the Southeast Europe projects evaluated where a retaining wall and the riverbed of a regularly overflowing river were reinforced with concrete. Although the overall design and construction conform to national standards, the initial design had not anticipated the future increase in surface water due to the rapid increase of the built area. This hampers the rapid elimination of water through natural waterways, thereby increasing the risk of new floods. Better involvement of urban planners, demographers, sociologists on the one hand, and maybe forestry experts to analyze the situation upstream—both literally and figuratively—may have led to a more relevant overall design.

The preparation of an overall design requires community involvement in understanding the causes of flooding and commitment to engage with alternative solutions—these may not always be straightforwardly acceptable for the local population if only short term effects are considered (e.g., moving people out of risky areas). Yet the UK example shows the feasibility and value of community involvement. In 2001, the United Kingdom Government has elaborated a policy on development and flood risk (PPS25) to ensure that flood risk is taken into account at all stages in the urban planning process to avoid inappropriate developments in areas at risk, and to direct development away from high risk areas. Since this policy was introduced, the number of applications permitted by local planning authorities against the advice of the Environment Agency advice has halved, and currently only 8 percent of decisions are not in line with Environment Agency, testifying that alternative approaches are actually taken into account.

It is important to note that these evaluation findings were made possible by having multi-disciplinary evaluation teams in which engineers, environmental experts and socioeconomists dialogued with each other on the different solutions to be adopted. However, such a combined approach should not have to wait for an ex post evaluation to exist, but be applied since the initial project design.

Environmental Protection Projects

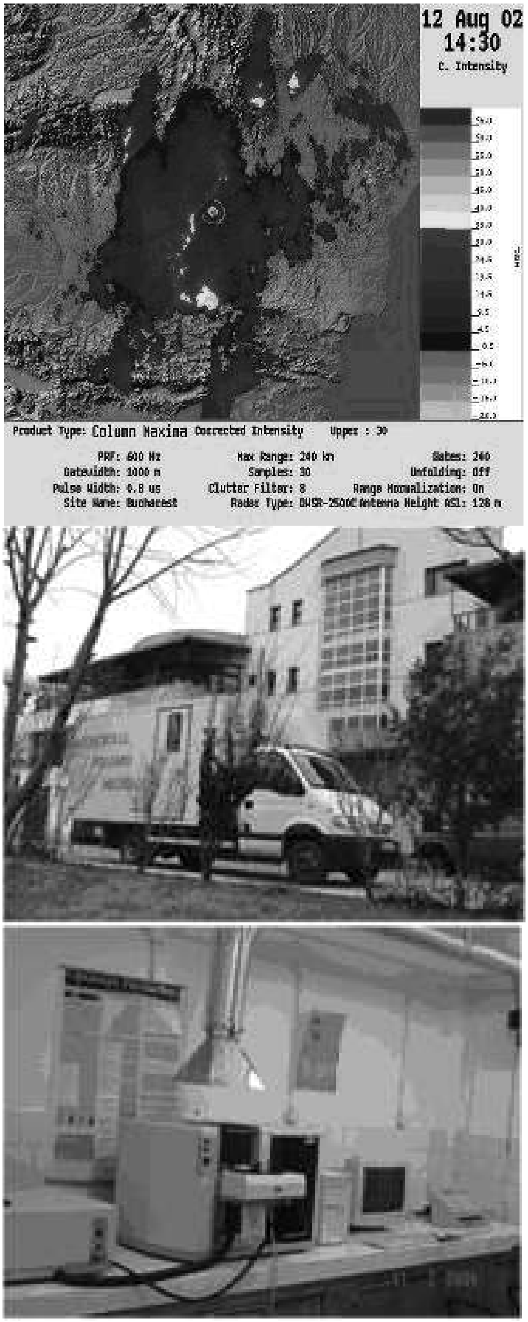
The evaluation of two projects more specifically related to environmental protection was particularly challenging because of the broad range of expertise required. The first project aimed at the rehabilitation and restoration of land and rivers following the breaching of a mining dam. They consisted of removing 10 million tons of contaminated mud and water from river catchments and agricultural land. In addition to standard evaluation approaches, environmental sampling was performed by an environmental expert specialized in mining issues: he carried out a spoil and groundwater contaminant investigation and environmental impact assessment. Hence not only interviews with stakeholders, farmers affected by the disaster and NGOs were made, but water and soil samples in remedied and non-remedied areas were taken. This combined multi-disciplinary approach provided noteworthy findings including the recommendation of a comprehensive risk management strategy in the mining sector of the region.

The second evaluation concerned a project with four different components: (i) protection against floods in high risk zones, (ii) reforestation and rehabilitation of torrents, (iii) supply of environmental protection laboratories to measure air and water quality, and (iv) replacement of outdated meteorological radar equipment with weather Doppler radars and related equipment. The evaluation team was composed of a task manager, a civil engineer, a university professor in geography and environmental studies (with expertise in GIS and environmental information systems) and a social scientist in charge of local teams for beneficiary surveys. An evaluation matrix was developed to assess the technical quality of laboratories and radars and their compliance with the EU directives for air and water quality control. Recommendations for the laboratories point to the need to acquire additional equipment to detect natural gas leaks from pipelines and biological hazards, and for the radars, the need to upgrade the system of which some components had become obsolete, and to purchase GIS hardware and accompanying consulting services for spatial data management, modeling and scenario design.

Earthquake-Related Projects

For earthquake-related projects, the structural quality of the buildings was analyzed. Two different techniques were used: in the first evaluation related to earthquakes, core drilling was used to assess concrete strength. As this technique was found too invasive, for the two remaining proj-

Figure 6.2
Radar and Environmental Equipment to Prevent Natural Disasters



ects non-destructive tests were applied using a concrete test hammer to measure compressive strength and an electronic scanner to identify the layout of constructions or reinforcements. Such tests are common in engineering, but, as argued below, not often used in evaluation.

Figure 6.3
Core Drilling (left) and Concrete Test Hammer (right)

Evaluation Outcomes and Recommendations

Derived from socioeconomic and technical analyses, the overall evaluation results of the 11 CEB projects were satisfactory. Most projects fulfilled priority needs and achieved their objectives. They produced a variety of economic, social, environmental and cultural effects, such as the restoration and improvement of the livelihoods of disaster victims, the improvement of transport infrastructure, improved productivity, reduced soil erosion, better forest exploitation and restoration, and preservation of cultural heritage.

Shortcomings were due to insufficient preparation and weakness of feasibility studies, lack of consultation between relevant parties (central and local authorities, and beneficiaries), poor quality, poor maintenance, and sometimes deviation from standards (seismic norms in particular). Five sets of factors emerge as being vital and instrumental to project success: (1) setting clear objectives, defining target groups and priority setting; (2) sound and flexible project design; (3) good governance, strong institutions and well-coordinated, flexible project management; (4) timeliness, but without harming the quality of project preparation; (5) the inclusion of disaster reduction and mitigation plans and the development of preventive measures. Box 6.1 summarizes the main success factors identified.

Despite their overall positive results, projects can be improved to increase the impact and value added of CEB projects. The focus should be on longer-term reconstruction and risk prevention rather than on emergency relief. Beneficiary participation should be sought when meaningful, consultation in most cases, and communication of quality information in all cases. It would be useful for the CEB to define a communication strategy in the disaster area, and cooperation between the Bank, Borrowers and lending institutions can still be improved. Finally, broader risk prevention and management programs should be actively promoted.

Multi Disciplinary Involvement: A Technical, Environmental, Social, and Economic Task

The foregoing discussion leads us to consider the importance of involving multi-disciplinary teams in natural disaster related projects, combining engineers, environmental experts, socioeconomists and maybe other types of experts. Given its mandate and social vocation, CEB projects are first of all "social projects," and should benefit populations affected by a natural disaster. Yet projects have necessarily a strong engineering com-

Box 6.1
Main Success Factors Identified

Setting and meeting objectives; defining targets and target groups; prioritization; monitoring

- Overall objectives met, producing significant benefits for target beneficiaries, including communities, schoolchildren, road users and the general public
- Relevant prioritization of sub-projects
- Demonstrated effectiveness, when tested in actual hazard events (renewed flooding avoided for example) and good value for money

Design

- Excellent design, including the incorporation of preventive measures, based on, where appropriate, a "build back better" principle, and relying on consultation with the scientific and technical communities
- Excellent project management efficiency, from assessment and design, to completion
- Design which implied minimal future maintenance, appropriate maintenance measures and records, and adequate allocations for maintenance budget support
- Innovative solutions, including the establishment of ecologically friendly 'green zones' where contaminated land was deemed no longer usable
- Compliance with national and EU (EC8) building codes

Governance

- Strong implementing institutions, capable of coordinating and managing recovery, and eventually initiating future prevention and mitigation activities, with a sharp definition of all responsibilities at central, provincial and local levels
- Development of links between the relevant authorities and the academic community, leading to a better understanding of risks and design options; this included the contracting of universities to conduct risk assessments of key infrastructure
- The benefit of a "champion" (an enthusiastic, committed leader or manager for the project) was also noted.

Speed, flexibility, project management

- Speed of response by the Bank and flexibility
- Speed of completion, especially before a worsening of conditions, such as the case of flood prevention works before the onset of seasonal rains
- Flexible and pragmatic approaches

Elaboration of disaster response and reduction plans

- Additional, or "spin-off" benefits, such as the elaboration of disaster response plans, and a shared knowledge system for disaster response throughout the country
- Learning generated from the project leading to revised disaster reduction standards
- Follow-up projects were defined, focusing on preventive measures

ponent, and civil and geotechnical engineers are involved in preparation and implementation. The emphasis on engineering sometimes resulted in loosing sight of social, economic or environmental aspects, ignoring for instance kinship relations or cultural similarities, deemed important in relation to maintenance in rehabilitated areas, as well as urban or regional planning. In other cases, an "engineering fix" overshadowed an economic solution: for instance costly anti-flood structures were implemented instead of a more cost-effective relocation of inhabitants, letting the river simply overflow from time to time. Examples were also found where the project design had not taken into account the possible future evolution of an area (e.g., increased urbanization reducing the capacity of rehabilitated waterways) or where the use of poor quality materials resulted in insufficiently strong concrete for instance.

Most of the deficiencies found could be explained by an unbalanced combination of socioeconomic, political, and engineering issues: it happens that engineers overlook sociological aspects, that political considerations prevail over economic ones, that contractors are too much under cost and time pressure resulting in poor quality. This is why the CEB evaluations draw the lesson that the optimal long-term solution that should be delivered to the final beneficiaries needs to take into account all economic, social, environmental and technical perspectives.

3. The Role and Activities of International Financial Institutions (IFIs)

An Increased Attention to Natural Disaster Mitigation and Rehabilitation

Not only the CEB, but other International Financial Institutions (IFIs) as well have been involved in disaster mitigation and rehabilitation since quite a long while. Recently, due to a series of major disasters—and particularly triggered by the Indian Ocean Tsunami of 26 December 2004, killing 200 000 people in a couple of minutes—the attention to natural disasters and their impacts suddenly increased. Like the CEB, several other major IFIs recently completed evaluations of their disaster assistance performance.

The World Bank (WB) has assessed its experience in disaster response over the past 20 years (2006). This assessment aimed to analyze the implementation and impact of 528 disaster-related projects. It showed that more attention is needed for disasters in relation to development: one single disaster can literally wipe out years of development effort. The report cites that the 2000 floods in Mozambique damaged or destroyed around the same amount of schools (500) that the Bank had built over the 20 previous years. The 5 billion dollars of losses due to the Kashmir earthquake were roughly equivalent to the total official development assistance to Pakistan in the 3 years preceding the disaster and equivalent to the amount the World Bank had lent to the country over the preceding 10 years. Disasters should no longer be treated as one-off, random events, but as events that strike with regularity, in known places, with a real risk to a country's development.

The WB evaluation came up with lessons similar to CEB's e.g., that advance preparation and priority setting is crucial and that a quick reaction may not lead to the most relevant response. The WB also observed that disaster management, preparedness and mitigation are not sufficiently addressed, that maintenance is crucial and that in urgent situations simple project design is important. As concerns donor-coordination, it judges co-financing to be preferred above parallel financing as this generally leads to more coherent projects.

The Inter-American Development Bank (IADB) and the Asian Development Bank (ADB) evaluations in 2004 came up with comparable results: disasters have significant bearing on development prospects, but countries are not addressing adequately the risk to development that disasters pose. The IADB's investment portfolio reflected the reactive approach of the countries, favoring post-disaster response over ex ante risk prevention and mitigation. ADB's evaluation highlighted the need for planning, training of staff, the inclusion of poverty reduction issues and the inclusion of maintenance, and flexibility. As a consequence of its evaluation results, the IADB designed a new policy that includes a country oriented portfolio management; adapted policies, procedures, training and financial instruments; and an organizational approach focusing on ex-ante risk reduction. It also established an action plan and defined incentives for staff. The ADB designed a new Disaster and Emergency Assistance Policy (2004) that shifts the emphasis from disaster response to disaster mitigation.

Several smaller developments banks have also been sharpening their policies with regard to post-disaster interventions. The Andean and the Caribbean Development Banks for instance emphasize as well the important role of disaster prevention, mostly absent from—reactive—national policies and procedures. They underline the importance of strengthening institutional capacity, coordination between stakeholders and development of proactive prevention policies, to deal appropriately with disaster mitigation.

Strong Convergence in Evaluation Results

The observations of the IFI evaluations of natural disaster related projects strongly converge. At the end of 2006, the IFIs gathered to discuss evaluation outcomes more in detail and shared their experiences. Also several NGOs were present at this event. There was a striking resemblance between the results of the IFIs' evaluations especially with regard to the lack of pro-activeness, risk prevention and strategy; and with regard to issues of institutional capacity building, staffing and training. Also, interesting complementarities were discovered between the action of the NGOs (better at short term, emergency interventions) and the IFIs (longer term reconstruction efforts).

While project design and preparation emphasize engineering aspects, and are often short of social and environmental insights, thereby overseeing risk prevention and pro-active approaches, ex post evaluations of IFIs do not seem to benefit systematically from specialized engineering competence. They do not test the technical quality and sustainability of the constructions they financed. Once the works are completed, the IFIs' evaluators take the lead without the participation of specialist engineers assuming that technical supervisors did their work during project implementation. In our view, a multi-disciplinary approach is recommendable throughout the entire project cycle, from initial project design to ex post evaluation.

4. Toward Multi-Disciplinary Approaches in Project Assessment of International Donors

Multidisciplinary approaches contribute to a better performance of international donor organizations in natural disaster mitigation. Involving engineers, environmental experts and socioeconomists simultaneously for quality and sustainability assessments increased the value and legitimacy of CEB ex-post evaluations. Evaluation results of the IFIs underline the importance of risk prevention, without which development itself is threatened. Risk prevention requires the investigation of alternative approaches and hence requires "alternative" experts and expertise. Depending on the issue at stake, these could come from areas as diverse as environmental sciences, sociology and socioeconomics, geology, water management, spatial planning, and so forth. Engineers' involvement in natural disaster management and mitigation within development projects is essential, but becomes even more valuable when complemented by other disciplines. Based upon the evaluation experience summarized in this chapter, three main types of involvement of multi-disciplinary teams can be envisaged:

- Involvement at appropriate moments in the project cycle, i.e.:
  - o In project preparation (e.g., with vulnerability & loss analyses; site safety assessments, land use planning with regard to risk), design (concrete proposals for infrastructures; ex ante evaluation of different options) and implementation (supervision & monitoring of works); in risk prevention and mitigation component, where they are expected to deliver innovative approaches;
  - o In project monitoring and ex post evaluations of international donor programs to assess conformity of works with plan, with norms and standards, and to assess sustainability.
- Further development of technologies related to the previous three issues, and in particular for risk prevention (field, visual, material testing; use of GIS; satellite and air-born techniques; in combination for instance with "soft" approaches).
- Increased dialogue between representatives of different disciplines and of different academic and engineering communities in project preparation and impact analysis of alternative engineering solutions—which are inherently socio-technical—is expected to lead to greater project effectiveness.

Note

1. Earthquakes are generally not included as a potential effect of climate change. In recent years, however, the relationship between the two phenomena increasingly has become a subject of scientific study—in particular the potential effect of melting glaciers and changing volumes/weights of water masses on geological properties, studied, inter alia, by the NASA. Hence it was decided to include this item in the discussion.

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7

Using Impact Evaluation to Increase the Efficacy of Climate Change Interventions

Howard White

1. Introduction

Climate change is high on the policy agenda. A growing pool of resources is available to finance climate change interventions. The selection and design of such interventions should be based on existing evidence of what works and what does not, why, and at what cost. This chapter argues that such analysis has been ignored, resulting in misallocation of resources at both the global and national level.

This chapter first introduces the issue of climate change, and then how the cost effectiveness of climate change interventions should be assessed. However, it is argued that a full cost-benefit analysis, rooted in a quality impact evaluation, is necessary to capture all costs and benefits and understand why interventions do or do not work.

2. Measuring the Impact of Climate Change and Climate Change Interventions

"Climate change" or "global warming" refers to the phenomenon of the observed steady increase in the global average temperature (most parts of the world are experiencing this increase, but it varies and some places are actually experiencing declines). That climate change is occurring is a matter of record. What is somewhat, though increasingly less, debated is the extent to which human activity plays a part in these changes, and how serious the consequences will be (e.g., Lindzen, 2008). Despite continuing debate, there is a growing consensus that human activity is indeed responsible for at least some of the increase, and that if action is not taken to halt global warming then the socio-economic consequences will be severe indeed. Deciding what action to take, if any, needs an assessment of what these socio-economic impacts are, and the countervailing impact of steps taken to mitigate or adapt to these changes. The estimated benefits of climate change interventions then need to be compared with their costs.

Hence recent years have seen a growth in models that estimate the impact of human-induced climate change on socio-economic outcomes, most notably the DICE model of William Nordhaus (Nordhaus and Boyer, 2000, and Nordhaus, 2008). There is a logical flow in these models from human activities which generate greenhouse gasses, to an increased concentration of these gases—most notably carbon dioxide, CO_2—in the earth's atmosphere, resulting in higher temperatures, which cause environmental changes ranging from drought and heat-waves to flooding and possibly increased hurricanes, ending up with socio-economic outcomes from displaced populations and reduced yields to heat-related deaths in the cities of Europe and North America. In modeling terms, these adverse effects are captured in a "damage function" linking higher temperatures to lower output.

This is a lengthy causal chain, so it is not surprising that there is debate over the various links in this chain. But, again, there is an emerging consensus, which is that we are already headed toward a temperature increase of 2-3°C even if carbon emissions were stabilized at current levels. With no interventions—the business as usual (BAU) scenario—the increase will be 5-6°C by the middle of the century.

As to the consequences of these increases, temperate countries would actually benefit from a temperature increase of 2-3°C as a result of higher yields, though poorer regions, in particular Africa, would be worse off. The overall loss would be around 0-3 percent of global GDP.

However, at higher temperature increases everyone loses, with the loss of global GDP reaching 5-10 percent of GDP, and far more in some of the poorest countries. These estimates are higher if value is attached to "non-market" effects, and become stronger still if more recent evidence suggesting that feedback loops in environmental effects will make them more severe than previously thought and distributional considerations are included. The Stern report, which is toward the pessimistic end of the spectrum, suggests that maintaining "business as usual" would reduce per capita consumption by 20 percent compared to current levels.

This factual analysis of what is happening is the basis for counterfactual analysis of the effect of climate change interventions. The policy intervention most usually captured in the global models is that of a carbon emissions tax. However, in practice there is a far broader range of climate change interventions than a simple tax on carbon emissions. Rather there are a variety of interventions encouraging reducing carbon emissions in developing countries, partly financed by the possibility to trade these reductions with developed countries.

3. Cost Effectiveness and Cost Benefit Analysis

Substantial and growing amounts of money are available for countries to undertake climate change interventions, both adaptation and mitigation. The benefit of mitigation projects arises from reduced carbon emissions or the creation of carbon sinks. For example, in Egypt the US$5.9 million Energy Efficiency Improvement and Greenhouse Gas Reduction project is financed by the Global Environment Facility (GEF), the United Nations Development Program (UNDP) and the Government of Egypt. Main components of this project are the reduction of electricity network losses (from 6.6 percent to 3.7 percent between 1999 and 2007), increasing use of CFLs (from sales of close to zero at the start of the decade to 4.4 million in 2007), and the promotion of energy efficiency standards and labeling. The majority (70 percent) of these projects are directly related to climate change, such as energy efficiency, green buildings, sustainable transport and agricultural waste recycling.

If a county is preparing a program to submit to GEF to access such funds, which sort of projects should it favor? Indeed, in allocating its funds so as to maximize its impact on CO_2 emissions, what sort of projects should GEF encourage, or restrict its finance to? The answer to these questions should be provided by cost effectiveness analysis: the cost of averting one ton of CO_2 emissions; that is the cost effectiveness of achieving the Carbon Emission Reduction (CER). The calculation is straightforward. If a project's outputs are known then the cost per averted ton of CO_2 is readily calculated. This figure can be used in two ways. First, is the cost of reducing a ton of CO_2 emissions greater than the value of achieving that reduction? The answer to this question requires a figure for the value of CER, which I return to below. Second, the figure can be used to rank interventions. Choosing the most cost effective approach allows a greater volume of CER for any given budget (or, alternatively, it minimizes the cost of achieving a level of CER).

Given the large number of projects already undertaken one would expect there to be a systematic inventory of existing climate change projects, describing the intervention, its costs and cost effectiveness.

Such an inventory would be an invaluable tool in improving resource allocation. However, not only does such an inventory not exist, attempts to make one would be stymied by lack of information on CER for many projects. This lack is particularly surprising for the Clean Development Mechanism, since these projects are paid according to the CER achieved against some baseline. But Gupta (2008) looked in detail at five projects, and could only give an estimate for cost effectiveness for three of these. For these three the range of estimates is striking—ranging from a low of €1.7 per tCO_2 to €27.5 per ton, suggesting very strongly that these funds are not being allocated in a globally optimal manner.

And of course, to know if these investments are worthwhile at all, then we need an idea of the value of one ton of reduced carbon emissions. There is not agreement here, partly as the right methodology is not always used, and partly as there are arguments over the parameters to use in that methodology, and further complications even were there to be agreement.

The correct approach is to calculate the social cost of carbon, which is the cost (lost output) resulting from *not* reducing emissions. However, the social cost approach is not universally followed. A recent review by the World Bank's evaluation department examined the way in which CO_2 emissions are valued in the Bank's project appraisal and evaluation reports. The review found that the valuation is done in one of four ways, the first two, based on GEF's financial support for the project, being the most common:

1. GEF's funding for the project is taken as the "willingness to pay" (WTP) of the international community for reduction in global CO_2 emissions, that is, the total value of reduced emissions equals the value of the GEF contribution to the project. Hence the value per ton of CO_2 avoided is based on an estimate of the amount of CO_2 avoided divided by the amount of GEF funding. However, as explained below, GEF financing is *not* linked in any way to CO_2 emissions, so this approach gives a wide range of values.

2. As an alternative approach, global environmental benefits are estimated using the incremental costs to the project of the GEF-supported component, which would usually be greater than the GEF financing alone. For example, in the Nicaragua Off-Grid Project GEF incremental costs for the mini-grids components gives a figure of \$7 per ton of CO_2.

3. Emissions are valued at carbon prices prevailing in the carbon market at the time of writing. Using this approach the appraisal document for

the Senegal Electricity Services for Rural Areas Project valued one ton of avoided CO_2 emissions at $4.5 per ton.

4. Calculate the emission factor from the project (which for the Mexico Carbon Fund Project is 0.584 tons of CO_2 emissions/MWh) and then the value of CO_2 reductions at the price of energy sales to the grid ($0.057 per kilowatt hour), giving US$33 per tCO_2.

The most common methods are thus based on GEF's decision on how much to allocate to the project. These country allocations are based on a two-part formula: the country's potential for reducing CO_2 emissions—which is calculated as the product of the baseline emissions and the rate of reduction over the previous decade—and an institutional quality measure of the capacity to implement environmental programs. How much money a project gets from GEF depends on the country allocation and the number of projects. Hence, the GEF-based estimation of environmental benefits is *not* project-specific, and so bears no relation to the actual level of carbon emissions averted. Application of the method results in different valuations of the worth of averting CO_2 emissions from project to project, and this figure also varies since other documents use different approaches. Since the benefit is a global one, it should be expected that a ton of CO_2 emissions saved carries the same value regardless of the source. Furthermore, these figures are not related to the social cost of carbon in any way.

The social cost of carbon should be calculated as the marginal impact of an extra ton of CO_2 emissions. There have been over 200 estimates of this social cost (Tol, 2007) which vary according to both assumptions about how emissions affect climate, how climate effects physical conditions and the economic valuation of changing physical conditions. The figure also depends on assumptions regarding the actions of others since the social cost increases as carbon concentration increases—if everyone cuts emissions then the marginal value of one ton of carbon reduction is less. Reviewing the range of available studies Stern put the figure at US$85 per ton, which is toward the upper end of existing estimates (Tol identifies it as an outlier). The UK Guidelines for the use of the social cost of carbon in appraising projects in the UK gives a lower figure of US$50 (UK£25) per ton. Both these figures are higher than the average price of carbon on the carbon exchanges; for example the price on the European Carbon Exchange has averaged in the range 20-25 per ton, and far greater than the price paid through the clean development mechanism which is less than €10 per ton.

A critical issue in these discussions is the discount rate to be used. A higher discount rate places less value on future costs. And since the costs of not doing anything about climate change are some way in the future: the higher the discount rate, the lower the estimated social cost of carbon. Hence variations in the assumed discount rate can make a great difference to the apparent desirability of climate change interventions. It is differences in assumptions about the discount rate that divide those, like Stern who used a discount rate of zero, who urge immediate and sizeable action, and those, like Nordhaus and Lomborg who use discount rates of 3-5 percent, argue for a more moderate approach.

But calculation of the social benefit of CER is further complicated by threshold effects and uncertainty. As already mentioned, if there are a large number of climate change projects so emissions remain low then the marginal benefit from a further project can be negligible. But if there are insufficient projects so the world moves toward the 2°C threshold, above which severe effects are expected, then the marginal benefits from the project which prevents crossing that threshold are very high indeed. But there is a lot of uncertainty, both in the feed through from human activity to climate change, and from changes in climate to socio-economic impacts. There is also uncertainty as to how future technological developments may alter these relationships: a single technologically innovation could, potentially, render all current climate change interventions worthless. Another element of uncertainty regards how well interventions work, which is an issue I return to below.

For countries wishing to select investments the picture is further complicated by the fact that climate change interventions have other impacts aside from that on climate change. Indeed, the distinction between "environment" and "development" projects is a rather artificial one. Many interventions in the climate change portfolio—such as reducing system losses in electricity distribution systems, better infrastructure, and improved natural resource management—have other developmental benefits which need also to be taken into account. These calculations should also take into account any negative impacts, such as the impact on food prices of diverting land to biofuel production, lost markets from "air mile" labeling of food products and the sight and sound negative externalities of wind farms.

Cost effectiveness analysis relies on having a common numeraire across interventions, such as CO_2 emissions. This approach is no longer applicable once the full range of costs and benefits is taken into account. It seems there is a problem of adding apples and oranges. But this is not a big problem. Indeed, it is one we solve every time we go the grocery store. How do we add a kilo of apples to a half kilo of oranges? By assigning a value to each of them. In the same way a value should be assigned to *all* costs and benefits from climate change interventions, thus making a cost-benefit analysis of these projects possible.

Just as we should include all costs and benefits, it is important to ensure that environmental benefits are included on a systematic basis for interventions mainly justified on the grounds of their immediate development benefits. World Bank rural electrification (RE) programs provide an example where there is not such a level playing field, calculations being tilted in favor of off-grid schemes using renewable technologies. Over the last decade an increasing proportion of World Bank rural electrification projects have included off-grid components. In the period 1980-95 less than 5 percent of Bank RE projects had an off-grid component, whereas in 1996-06 60 percent did so (World Bank, 2007: Table B.11). These components, most of which finance Solar Home Systems, are partly justified by reference to the global environmental benefits which follow from averted CO_2 emissions from displacing kerosene lamps. However, kerosene consumption is reduced on a much larger scale by grid extension programs, which reach many more people. Nevertheless, these environmental benefits are not taken into account in calculating the return to grid extension, hence biasing the comparison of the return from the two investments.[1]

We also need to keep in mind the bigger picture in two ways. First, is to acknowledge that using cost-benefit analysis allows us to rank interventions from different sectors, and so assess if climate change interventions are worth undertaking at all. This position, stated by Lomborg (2001) created great controversy, but is a long accepted approach to policy analysis. Second, the approach should be extended to policies also, in both the developed and developing worlds.

4. The Role of Impact Evaluation

To summarize the argument so far: climate change interventions should be subject to cost-benefit analysis which takes into account all costs and benefits. Doing this analysis requires information on the difference an intervention makes to CO_2 emissions and other outcomes—that is a counterfactual statement of CO_2 emissions with versus without the project.

A good project or program evaluation is a theory-based one, which documents the causal chain from inputs through to outcome and impact. Ideally this analysis produces a statement about the volume of carbon reduction achieved. Different pieces of information are needed for different parts of the analysis. Partly it can rely on technical coefficients. If we know the reduction in kerosene consumption or air travel, then calculation of carbon reduction is a simple multiplication.[2] However, achieving reductions in kerosene consumption and air travel require changes in human behavior, and this is harder to estimate, usually requiring data from impact evaluations. For example, a project may promote solar panels, but what will the take up be? And will they be well maintained (and what incentive systems best encourage good maintenance)? If they are not, they can provide much less electricity than anticipated, so dependence on other fuels remains. Knowing how interventions affect these outcomes requires a body of evidence from impact evaluations.

Impact evaluations are studies that attribute the change in the outcome of interest to the intervention under examination. There are a variety of means of conducting such studies, and I will not go into these debates in detail (see Bamberger and White, 2007). The important point is that we require a numerical estimate of behavior change, and achieving such an estimate requires a quantitative approach to impact evaluation. I would be the first to qualify this statement by pointing to the need for mixed methods (see White, 2008), and to recognize the limits when quantitative methods cannot be used (e.g., Bamberger and White, 2007). However, these caveats do not escape the need in this case for quantification, and the sorts of projects being discussed are amenable to it.

It is important to remember that impact evaluations, like any other studies, are not ends in themselves. The point of doing them is to improve development outcomes—that is to direct resources to their most cost-effective use. For this to happen there have to be effective feedback loops, from studies to policy-makers and back again to researchers. Ensuring policy relevance, the duty of the activist researcher, involves several steps in both study design and the process of conducting the study. It means publication of study findings are the start of influence, not the end of it.

5. Some Concluding Comments

This chapter has argued for a more systematic approach to the allocation of funds for climate change interventions. Given the primacy of CER for these projects, concerted efforts should be made to establish a database of the cost effectiveness of different interventions. The wide range of existing estimates suggests that country-based allocation models for climate change assistance undermine the potential total impact. There is a strong case for allocations at the global level reflecting relative efficiencies, rather than a country-based allocation model.

However, the developmental impacts—both positive and negative—of climate change interventions cannot be ignored. These should be taken into account by cost-benefit analyses derived from quality impact evaluations.

Notes

1. It might be thought that the benefit per household is greater from off-grid, since kerosene is being displaced by a clean source (solar power). But grid extension may also come from a clean source such as hydro-power, it depends on how the marginal wattage is generated. Moreover, off-gird programs provided limited power, especially if there are technical problems, and so may not fully displace kerosene, which grid extension undoubtedly does (unless there are outages owing to technical problems or load shedding). So the benefits per household could go either way.
2. This is something of an overstatement, since these are not homogenous. The efficiency and carbon emissions of different lamps and aircraft vary.

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8

Challenges for Evaluating Adaptation to Climate Change within the Context of Africa

Fatima Denton

1. Introduction

Climate change continues to make headline news. It is widely accepted fact that human activities are increasingly altering the climate system. The impact of climate change on poor people and their livelihoods is not a scenario that should just be conjugated in the future tense. Poor people are faced with climate variability on a daily basis. Climate extremes and variability threaten the lives of poor people more than any other social groups (Hellmuth et al., 2007). Climate change will undoubtedly come with huge social and economic costs that most fragile economies in Africa will not be able to support. Indeed, climate change has been dubbed the greatest market failure of all times (*Stern Review*, 2007). Poor communities may also be affected by climate change through changes in common property resources such as fisheries, degrading river basins, forests etc. on which they rely for their livelihoods. In short, ecosystems, which provide essential services for many resource dependent communities, are themselves threatened by climate variability and change. Poor people's resilience is greatly reduced when they are without such crucial services that are associated with functional ecosystems—water, food, fodder, and how these in turn can be translated into revenue earning activities.

However, whilst the climate debate is rallying scientists, policy makers and vulnerable communities together, there is still a discernible leadership gap in Africa. African leaders and policy makers have not quite made it to the agenda setting debate where they can build regional and continental efforts and discuss cost sharing mechanisms as well as measures to pool resources as a strategy for bearing the huge costs related to climate change adaptation. Climate change and variability are increasingly impacting on economies, livelihoods and assets in Africa. Adaptation remains a viable option and response strategy in the face of the climate change challenge (*Stern Review*, 2007). It is clear that building adaptive capacity will require piloting micro-initiatives at local level, but more importantly the pooling of resources from public agencies to go beyond micro-level adaptation to more impactful outcomes that will benefit the millions of people whose lives are conditioned by climate extremes and variability. Given the strong correlation between adaptive capacity, wealth and capabilities, it is obvious that lasting adaptation will help poorer communities increase their resilience and will need support from African governments and private companies.

The adaptation imperative is widely recognized in key African policy spaces and initiatives. However, the evaluation challenges are increased when one adds reduced capacity, weak institutions, and a poor evaluation culture. Yet, the situation is far from dire. Adaptation projects are fast growing in Africa. The potential for learning is considerable. It is important to incorporate locally developed knowledge that communities have crafted over time and to use this knowledge as a foundation to building resilience in climate change. The adaptation research community is fast growing and the large body of scientific research is a testimony that adaptation is rapidly emerging as a discipline in its own rights. African researchers and other change agents can not only become part of this research community, but could also substantively contribute to the research on adaptation that is developed and generated in different regions of the continent. The sustainability of adaptation projects depends on the degree of success or failure that is associated with these initiatives. Evaluation and monitoring adaptation projects will add greater value to current findings and provide strong foundations for scientists and communities to measure results.

The key messages from this chapter are as follows:

- Evaluative approaches are changing from purely accountability purposes to learning, seeking ownership and assessing impacts
- Evaluating vulnerability is fraught with difficulties most of which are associated with adaptive capacity and vulnerability.
- Evaluation in an African context presents additional problems in a context of paucity of data, weak dysfunctional institutions, limited capacity, poor evaluative culture and the existence of current multiple stressors and vulnerabilities

- The challenges of monitoring become reinforced when one adds specific difficulties relating to adaptation—calibration, uncertainty, and especially the difficulty of measuring something that has not happened
- The Climate Change Adaptation in Africa (CCAA) uses a combination of training, mentoring, peer learning, and participatory action research to create evaluative reflexes in the minds of its research partners and, through an active community of practice. It is this building and enhancing of capacity that will greatly contribute to strengthening and expanding coping ranges.

2. Evaluation—A Changing Landscape

The practice of evaluation is rapidly changing. What do we mean by "evaluation"? Why evaluate? Evaluation is a quintessential step in managing progress and change. As the age old management adage goes: "that which is not measured is not managed." Evaluation is essential for several reasons:

- Provision of Information—evaluation allows for access of critical and timely information for stakeholders involved in adaptive management
- Accountability—monitoring and evaluation provides project managers opportunity to verify that funds are used efficiently against stated objectives and goals
- Learning—evaluation can facilitate the process of learning and provide opportunities for feedback that would allow managers to make necessary adjustments
- Impact Assessment—evaluation can allow project managers to verify impacts based on objectives that are set.

Evaluation is important in assessing progress and making changes vis-à-vis the targets, objects and impacts of the assigned project. As such, it is an effective tool in adaptive management. Evaluation can provide information at crucial times in the process. The full loop of evaluation must include monitoring—taking the time to observe changes and making necessary adjustments vis-à-vis the stated objectives. Evaluation needs to be done against a baseline. In recent times, the practice of evaluation is gradually changing from ensuring donor accountability to ensuring that change agents form a fundamental part of the evaluation process. In short, the stimulus for evaluation is driven by the capacity and ability of key stakeholders to participate, assess and even set the parameters of evaluation.

The concept of participatory evaluation is not radically new—however, it re-emphasizes the need for learning as a central tenet of evaluation and a necessary pre-condition to drive change. Evaluation is not only results-oriented, but also process-oriented. In short, whilst it is important to assess the quality of work against strategic plans and objectives, doing this in a robotized manner where results are tracked against objectives is no longer sufficient. A high premium is placed on participation and the ownership that is generated through this process is now widely perceived as a much-treasured commodity. This process based character of evaluation underlines why it is increasingly seen as an on-going activity—and not the must do activity that takes place at the end of a project. A good policy environment is central to facilitating change in the environment. Thus, part of evaluating change must be premised on providing critical information that would serve policy makers. However, evaluating the reduction of vulnerability, especially in African societies, is fraught with challenges that are themselves predicated on poverty, limited capacity, inadequate institutional responses as well as other existing vulnerabilities.

Complexities Associated to Vulnerability Evaluation

Africa is vulnerable with the least capacity to adapt (IPCC, 2004, 2007). Its natural environment is sensitive and fragile, yet most of the continent's sectors are highly dependent on ecological goods and services (Ikeme, 2003). Its capacity to resist perturbation and withstand hazards is low (Vincent, 2004). The climate is diverse and poorly understood. (Hellmuth, 2007). The continent has one of the lowest human development indicators. Yet, vulnerability remains a contested term. (Vincent, 2004) Who should decide?

Definitions of vulnerability vary. Perhaps one of the easiest definitions is one offered by Blaikie, which refers to the "ability to anticipate, resist, cope with and respond to a hazard" (Blaikie et al., 1994). Understanding climate change vulnerability means understanding the physical conditions as well as the social, economic, institutional and political conditions that mediate the human context. Thus, if physical conditions tend to dictate and drive natural hazard, for these conditions to magnify into risk and potential disaster depends on the level of exposure of systems and human beings and the lack of capacity of human beings within that given locality (Pelling, 2000).

Thus, vulnerability assessment is not a straightforward matter, especially vis-à-vis environmental change as vulnerable people may not necessarily be in vulnerable places. In short, poor people can live in very resilient biophysical habitats and rich and affluent people can live in fragile physical surroundings. (Vincent, 2004; Liverman, 1994). Thus, to properly understand the impacts of climate change one would also need to refer to underlying human conditions that create enables vulnerability or resilience (Parry and Carter, 1998). Thus, social vulnerability is largely perceived as an outcome, the state of human societies and the way in which they undergo and experience natural hazards (Adger, 1999). Societies least able to resist perturbations and hazards are deemed to be the most vulnerable (Bohle et al., 1994). The ability to recover from shocks and climate related stresses is a key attribute to resilience. Hence, vulnerability is further defined by economic, political, environmental, and social assets. The physical forces which shape the allocation of these assets in a given society tend to determine who is vulnerable, the given locality and the timing of vulnerability (Vincent, 2004 and Pelling and Uitto, 2001). Thus, social and biophysical vulnerability or resilience are difficult to consider discretely as one impacts on the other, particularly with regard to climate dynamics and impacts. One way to consider this is through the lens of the "socio-ecological system," (Flint, 2008) that sees socio-ecological resilience as a product of biophysical and socio-economic inputs processes and outputs (adaptation being fed back in as an input, in an open system. In this way, vulnerability to climate change is immediately viewed as a historical construction of social and biophysical change in the ecosystem.

Vulnerability is starker in most African societies due to limited adaptive capacity and fragile economies that rely on climate sensitive sectors such as agriculture. Economies are highly dependent on rainfed agriculture, which remains susceptible to climate variation and change (Desanker and Magadza, 2001). Hence evaluation lies in recognizing how ecosystems will respond (biophysical vulnerability) but also to be able to measure how the social exposure unit responds to changes in the climate system and whether these changes reduce or strengthen its resilience (social vulnerability). The evaluation challenge lies in understanding the multifaceted and multidimensional concept of vulnerability. In short, vulnerability presents huge complexities and it is not a static entity (E. P. Dalziell, S. T. McManus). These challenges are further complicated by the very elusiveness of what is now regularly called "adaptive capacity."

3. Evaluating a "Moving Target"—The Elusiveness of "Adaptive Capacity"

Successful adaptation must rest on regular monitoring and evaluation to monitor progress and performance. Adaptive capacity is still a youthful concept though growing. Measuring and evaluating such a varying concept remains a huge challenge. There is also very little guidance on how adaptive capacity can be measured. The difficulty of measuring adaptive capacity arises from a number of challenges.

Definitional Maze

Definitions of adaptive capacity abound (Burton et al., 2002; Adger et al., 2003). More precisely, adaptive capacity refers to the ability or capacity of a system to modify its characteristics to cope with existing or anticipated external hazards and stresses (Adger et al., 2004). Hence in the definition of adaptive capacity certain key words are essential. "Capacity" denotes agency and ability of the system to face, resist and recover from external shocks and hazards. "Recovery" is also a key in the adaptive continuum—the ability to withstand and exploit the negative impacts of external shocks and stresses. The ability to take advantages of "opportunities" is equally embedded in the word "recovery." Hence, there are strong correlations between the concept of adaptive capacity, vulnerability, sensitivity, exposure and adaptation (Smit, 2006). In short, adaptive capacity is a function of the vulnerability of society. The essence of adaptation is to minimize exposure or increase adaptive capacity.

Attribution gap. Even with good information, it is difficult to assess impacts that are based on specific interventions or produced as a result of other external factors or political influences. (World Bank, 2008). Climate change is one of the many global environmental changes. Climate related risks may simply exacerbate other existing risks and stressors that may be associated with climate variability and other forms of environmental degradation. In addition, it is often difficult to differentiate impacts and risks that are related to climate change and those that emanating from other drivers and stressors. Equally, and not dissimilar to many other development issues, efforts by adaptation managers to enhance capacity and reduce the vulnerability of affected communities cannot be entirely attributed to interventions relating to climate change and anticipating inherent risks.

Climate uncertainty. There is a growing scientific consensus that climate change is a reality. However, in spite of this, there is still uncertainty at local, national and regional level. Also, the complexity of the climate system does mean that the feedback loops often produce unreliable data over long horizons and smaller geographical scales even when these are calibrated by powerful computers (Uitto and Shaw). Modelists often say that uncertainty in projections is integral to the adaptation challenge.

Hence, it is impossible to wait for accurate information as a first step toward taking action.

This uncertainty has created a paradigm shift among modelists and within the adaptation research community who perceive that the need for perfect data needs to be traded off with a learning-by-doing approach. Uncertainty is implicit in the climate framework and could lead to apathy from policy makers. The immediacy of other development priorities such as health, water, and energy might be a disincentive for policy makers to spend considerable sums of money on defensive infrastructures that may prove to be white elephants. However, uncertainty is a real challenge in climate policy and taking a no-regrets policy option has more advantages than adopting a business as usual scenario.

Calibration. It is important to recognize that adaptation strategies will be developed against changing climate hazards. One of the fundamental challenges of measuring adaptive capacity is the difficulty of measuring against a set of baseline indicators. From an adaptation perspective, baseline must include climate variability and hazards. This hazard is often not a fixed state; it is always changing in the light of climatic conditions. This change means that evaluators would need to constantly evaluate against a moving target. Assessing and evaluating adaptation projects needs to be done against changing hazard profiles. Assessing baseline conditions against actual outcome i.e., once the adaptation intervention is done remains a considerable feat given the above reasons. Equally important on the list of baseline indicators are the vulnerability of people and place, current coping strategies and how these translate to adaptive capacity and policy relevant constraints that may reduce the potential for adaptation efforts to take root.

Knowledge deficit. All societies have inherent abilities to adapt to changing circumstances. Adaptation to climate change as a formal discipline is relatively new. There is still a growing demand for new knowledge that would better inform adaptation managers of different conditions and climate scenarios and implications for adaptation strategies. Community knowledge of adaptation practices and how they fit into today's changing climate scenarios remains low. Adaptive managers are still grappling with ways to valorize community knowledge on environmental water resource management, forestry, agricultural practices in order that this knowledge can be used as foundational resource base to guide adaptation practices and serve as a baseline to weigh against institutional capacity needs and knowledge for adaptation. This knowledge deficit poses a huge challenge and tension for adaptative managers mainly because it is difficult to evaluate what you don't know and equally challenging to evaluate what has not happened yet.

Long-Term versus Short-Term Gains

Climate change is a long-term problem. Evaluators have to accept that evaluating in the context of adaptation will mean using imprecise information and not waiting for the perfect data. Adaptation benefits are both immediate- and long-term. Monitoring and evaluation is normally perceived as a must-do activity that is often left to the end of the project. Evaluating against long-term benefits would necessarily mean using proxy markers to measure reduction in vulnerability.

4. Evaluation in an African Context—One of Many Challenges

These challenges that are inherent to evaluating adaptation become doubled when transposed to an African context. African communities are no strangers to climate extremes and variability. Climate extremes and variability are very much part of the African fabric of life. The challenges though are reinforced because there are already existing stressors that make evaluation even more problematic. Climate change is just one other complex development problem that many African people, especially affected communities, have to contend with. It is important to say that Africa is not a homogenous continent and the nature of the climate system is very complex and poorly understood.

Availability and access. Information flow, dissemination, and usability of information are critical in climate change adaptation and institutional strengthening. Climate information is relevant input for climate decision-making, yet it tends to stay at the level of meteorological agents and researchers. Information exchange has enabled local farmers in Southern Africa to switch to drought resistant species of rice, maize and cassava (Thomas et al., 2005). The importance of good climate data, information and services is not lost in many African initiatives. Indeed, the African Union Commission, by endorsing the climate strategy of NEPAD, recognizes the importance of good credible information as part of building resilience (GCOS, 2006). African decision makers do not often get to be in a position where they can access and exploit such information in decision-making processes (Hellmuth, 2007). In spite of the disagreement between scholars who agree and those who disagree on the availability of data, data do exist (Hellmuth, 2007). However, data tends often to be not credible, unreliable, and not integrated into climate policy and practice. Some researchers argue that the dearth of climate information is not the real challenge. Accessing and communicating relevant information for seasonal forecasting that will allow key stakeholders to act is the key challenge (Sperling et al., 2005). Institutional processes that will facilitate the translation of such relevant data and encourage a two-way communication that will wed scientific research into local indigenous knowledge and hence bridge the gap between scientists and communities are often absent.

Adaptation to climate change, especially in sectors like water needs both functioning institutions and robust policies. Climate relevant data in Africa presents difficulties that relate both to quantity and quality. This is mainly because stations collecting data are often under-resourced and very sparsely distributed. Information on climate is thus often inadequate because they tend to be a microcosmic extension of some of the many resource problems and challenges that Africa faces. In addition, in Africa, one tends to see a "proprietorial" culture to information and the sharing of information. Meteorological agents and agencies are often not willing to share information. (Hellmuth et al., 2007, p. 40). In addition, data tends to be dispersed in different meteorological agencies and also tends to sit within various donor agencies. These make the availability and usability of data problematic.

However, perhaps more critical to evaluation is the way information is utilized, integrated into critical development sectors and mainstreamed in key policies in ways that would create impactful outcomes. For instance, one of the first things to note about rainfall patterns in West Africa is its increased variability in time, space and volume, partly due to its convective origins and partly due to anthropogenic activity. This is compounded by a lack of available ground-based observations due to low-density networks of measuring stations (Afouda, 2002).[1] Reducing the uncertainty that farmers feel, especially during periods they deem "risky" by providing them with critical, relevant information could reduce their vulnerability, increase their confidence and boost productivity (Hansen et al., 2004). Thus, accurate data for predictive and discursive analysis of inputs to the hydrology of the region remain insufficient at the present time. Adaptation measures and actions are critical in the context of many developing countries especially those within the Sahel.[2]

Poor governance. Governance structures in many African countries tend to be opaque. In short, what you see is not what you get. The political environment and governance structure need to support the basis for good adaptation work as a precursor to understanding the need for planning measures and building such plans across development sectors.

In the same manner that good governance is often hailed as essential for sustainable development, functioning institutions are also an attribute of good governance necessary to support political, economic processes of adaptation.

Institutional inertia. Institutions are essential to development processes in that they define "rules and patterns of behaviour that shape social interaction." By facilitating collective action, institutions are able to transcend beyond lone individual actions. In short, they represent sources of knowledge and innovation that can drive the process of adaptation (Thomas et al., 2005). The quality of institutions that would promote economic growth and maintain good leadership is a fundamental criterion of development (Kayizzi-Mugerwa, 2003). Economic growth is largely predicated on sound and effective policies, but most importantly the quality of information that should accompany the process of growth. The current environmental challenge is such that it would need a strong foundation to take on the imperatives of climate change and adaptation. This foundation needs to be strengthened in many of Africa's institutions to better prepare governments to anticipate and plan for the myriad risks associated with climate change adaptation. Climate change is yet another layer of complexity that compounds the severity of impacts on key economic sensitive sectors such as health, water, and agriculture. In some African countries, evaluation is often a precondition of donor involvement. The aid dependency culture that is now so inherent to development tends to mean that many African governments do not willingly evaluate progress of development initiatives but often take it on as part of the prescribed route. The weakness of many African institutions means the greater onus of climate change adaptation is left to communities to do—where adaptation is very much part of societal resource that can be drawn on during moments of scarcity and heightened vulnerability. Yet it is certain that institutions need to provide the glue to catalyze adaptation work.

Public sector institutions do not need to be the actual doers of adaptation work but their ability to provide incentives and to back processes is a strong enough incentive for change. Given the fact that evaluation is often conducted as part of donor precondition it does mean that the reflexes adopted to conduct this exercise needs to be questioned—the fundamentals of evaluation is not properly exercised as it operates on a level where learning is not necessarily the stated objective. One needs to ask what is driving the evaluation process, what hypotheses are conditioned by the evaluation processes and how do these hypotheses facilitate a culture and an environment for learning. In addition, the lack of institutional coordination in managing adaptation does make vulnerability monitoring difficult. Often several ministries will oversee adaptation projects and working on different levels but often in a fragmented way which does not help policy coherence, capacity development or data analysis (GCOS, 2006). Knowing and recognizing change will mean being flexible and also a never ending evaluation process of evaluation and re-evaluating risks and making necessary adjustments (Sperling et al., 2005).

Capacity constraint—limited pool of expertise. The capacity to adapt to climate change takes manifest forms in Africa. There is growing research and knowledge on climate change issues in Africa. African researchers are gradually putting their own slant on climate related issues. However, in spite of growing knowledge that is witnessed vis-à-vis a burgeoning research agenda on adaptation, there are still huge capacity problems relating to analysis and conceptualization of climate change not just from a scientific perspective but also in policy relevant terms. This limited capacity is reinforced especially when it comes to evaluation where baseline progress markers on specific scenarios are needed as a precondition for measuring change and enhanced adaptive capacity.

Institutional capacity is relevant to a supportive framework for effective climate policy action. Yet the nature of the institution and its mode of functionality are often poorly understood. Decisions makers in Africa are not sufficiently exposed to critical information on climate change and this is affecting climate leadership in Africa as the bulk of the analyses and providers of information are outside the African continent. Information is essential in order to facilitate decision-making processes and build an enabling, conducive environment where climate actions can work in tandem with development priorities. Projects on climate change adaptation and or mitigation are often conducted within a limited timeframe. Invariably, African researchers and institutions are under-funded and under-capacitated and are not able to exploit the relevant secondary and empirical research on climate change.

Limited participation. Evaluation is increasingly premised on ownership. Although accountability is a main driver for evaluating the progress of adaptation interventions and other development initiatives, ensuring that communities are integral to the process of adaptation remains a key challenge for growing number of evaluators and researchers. Yet, vulnerable communities in a number of African countries are still far removed from the processes of decision-making. They remain invisible and voiceless in many African communities. This creates an added challenge for evaluators as their participation in evaluation processes is often omitted and ignored. Vulnerable communities tend to act as alibi—groups whose consultation is often sought but often consultation does not translate to agency and participation.

Evaluation—the "Other Job"—"the rather you than me attitude"! The perception of evaluation is usually one that some researchers approach with great reluctance. Evaluation is often under-studied in many projects and overlooked. Most development projects are externally funded. This tends to mean that evaluation is often seen as a mechanized, robotized activity that is done as a must do rather than willingly as an exercise that will help project managers gain more insight into what went right and what could be done differently. This does not mean that many researchers do not approach with a willingness to learn—it means that when the parameters of the projects are set elsewhere in Africa, the natural reflex to make evaluation more appealing tends to be lost.

Complexity of factors. Factors affecting climate change tend to differ. What is worth noting is that existing drivers and stressors tend to make evaluation in Africa a complex issue. There are competing development priorities. Climate scenarios vary from one region to another, are spoken about in different languages with different meanings and nuances. Extreme events are also dealt with differently. Institutional responses differ from one country to another. All of this underscores the heterogeneity of the continent as a whole and the difficulty in comparing evaluation processes and results.

Poor evaluative culture. Adaptation practices have been part of societal response to dealing with climate hazards. In the Sahel, nomadic communities have sought to deal with drought and desertification by drawing on their own indigenous knowledge and cultures. Social culture and social and organizational vulnerability have been instrumental drivers in coping with climate related stresses and shocks. However, the culture of drawing on such practices as a foundational knowledge base is quite poor.

In Africa, to date, there are few efforts to capture existing knowledge on water management strategies and pool this important resource in the form of an adaptation knowledge bank that would inform and improve policy both nationally and regionally. Little is known on adaptation best practices as much of this information is dispersed between centers and is often lost at the end of a project. The value of local traditional knowledge with regard to water management and environmental degradation is often hailed as inherent to societal coping mechanisms and avoidance of risks and conflicts. However, the importance of such knowledge is not often translated into reality—even though most protagonists recognize that such knowledge can affect efforts to reduce vulnerability and negatively shape the complexion of policies, which are often as good as the information they rely upon.

Coping strategies such as traditional water-management and water conservation systems and other traditional irrigation techniques could help our understanding of climate change seen from the eyes of vulnerable communities. Knowledge could be banked and help to bridge the gap between empiricism, as in research and scientific evidence and policy.

However, it would be naïve to equate local traditional knowledge with environmental protection. Indeed, practices such as over-grazing or over-cultivation, slash and burn etc. can take a harmful toll on the environment. On the other hand the fact that this knowledge is slowly disappearing particularly with migration, modern economic and other societal processes dictate that it is important to keep a record of them and find ways of ensuring that some of this knowledge can be used to enhance adaptation options and strategies. Sahelian farmers and vulnerable communities have demonstrated quite well their abilities to cope under changing climate scenarios and especially during long periods of droughts. Their coping strategies include agricultural diversity, migration, good conservation techniques—soil and water especially, adopting animal fertilizers instead of artificial ones (Mortimer and Adams, 2001). Equally, in Southern Africa, in Mantsie and Khomele, when cropping ceases as a result of reduced precipitation, communities tend to adopt livestock and market gardening as alternative livelihood options (Thomas et al., 2005) These techniques and strategies can help throw more light on how to evaluate adaptive capacity using current strategies as benchmark indicators.

Also, institutions such as CILSS—the Permanent *Inter-State Committee for Drought Control in the Sahel* have been working on early warning systems and efforts to provide African farmers with relevant data and information to inform their agricultural practices. CILSS was established in 1973 in the aftermath of the large-scale droughts that struck the region in the 1970s. Its membership today is made up of nine States: The Gambia, Guinea-Bissau, Mauritania, Senegal, Burkina Faso, Mali, Niger, Chad, and Cap Vert. CILSS' mandate is to invest in the search for food security and the struggle against the effects of drought and desertification. CILSS has had a food security early warning and monitoring system since the 1980s. It holds consultations every year in March, June, September and November. The Food Crisis Prevention Network (FCPN) has met every

December (since 1984) at the end of the crop year to assess the agricultural and food situation and furnish political actors with the relevant information they need for appropriate decision-making. The network is formed by all actors involved in the food security sectors: representatives of the Sahelian countries, donating agencies, researchers, experts, CILSS, producers' organizations. In the Horn of Africa, ICPAC (IGAD Climate Prediction and Application Centre) has worked regularly with national meteorological and hydrological institutions in generating and disseminating climatic products to the different sectors of the economy (including agriculture, water, energy and healthcare). These products are shared with the governments of member countries of IGAD (The Intergovernmental Authority on Development in Eastern Africa) namely Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Somalia, Tanzania and Uganda.

SADC (Southern Africa Development Community) established in 1999 a Regional Vulnerability Assessment Committee (RVAC) placed under the aegis of the food, agriculture and natural resource (FANR) department of SADC. RVAC's mission is to "reinforce at the regional and national levels the vulnerability analysis systems designed to document policy, development program and emergency response formulation so as to reduce vulnerability in the SADC region". RVAC's members include the SADC Secretariat, World Food Program (WFP), FAO, FEWS NET, OCHA, and UNICEF. RVAC has developed offshoots at the national levels, NVACs, which have been created at the national level under governments' leadership. A Drought Monitoring Center (DMC) was established in 1998 and many other early warning mechanisms have been developed: the regional early warning system, the regional food reserve facility.

These methods and rich data can be exploited by many other institutions in the continent of a repository of knowledge to build on. However, the culture of externally funded projects is so strong that new initiatives are started and little is done to pool resources together and take advantage of such development gains.

Tools deficit. There is a general tendency that new tools will need to be invented to evaluate adaptation interventions. However, many evaluators and adaptive managers are gradually coming to the realization that what is needed are new entry points, refining our objectives and repositioning ourselves as co-learners in the overall evaluative framework. It is also becoming increasingly clear that the emphasis is not necessarily on the tool but how tool is used to capture results.

5. The Climate Change Adaptation in Africa Program—Building Capacity Development as a Basis for Adaptive Capacity

The Climate Change Adaptation in Africa (CCAA) Program, a joint initiative of Canada's International Development Research Centre (IDRC) and the United Kingdom's Department for International Development (DFID), aims to *significantly improve the capacity of African people and organizations to adapt to climate change in ways that benefit the most vulnerable members of society.*

This main objectives are:

1. To strengthen the capacity of African scientists, organizations, decision-makers and others to contribute to adaptation to climate change.
2. To support adaptation by rural and urban people, particularly the most vulnerable, through action research.
3. To generate a better shared understanding of the findings of scientists and research institutes on climate variability and change.
4. To inform policy processes with good quality science-based knowledge.

Building on existing initiatives and past experience, the CCAA program will work to establish a self-sustaining, skilled body of expertise in Africa. CCAA seeks to promote African leadership in finding solutions to support both the science and practice of climate change adaptation.

CCAA starting point is in the realization that lack of capacity is affecting the potential of African researchers, policy makers and vulnerable groups to properly address challenges posed by climate change adaptation. Capacity development is the process of building and enhancing adaptive capacity, which is a precondition for successful adaptation and expanding the coping range of vulnerable systems and people. Capacity development is generally perceived as a change management process (UNDP-GEF 2003).

What are the distinctive attributes of CCAA in building capacity and fostering an evaluative culture among its researchers? *First*, CCAA's is a strong believer that Participatory Action Research is an important tool to implanting change. Thus, CCAA has deliberately set about to creating a participatory action research framework in its research programming as a basis for building capacity of multiple local actors for adaptation, research and policy change, while testing innovative practices. The challenge of CCAA is considerable experience given the fact PAR experience and culture is limited in Africa. Also, PAR capacity building is not skills that can be transferred in a conventional 3-day workshop. They require field training, using relevant tools and techniques to convey experiential methods. Perhaps, the greatest challenge that the program faces is strengthening values and attitudes that would serve as working principles to guide PAR adaptation work customizing the tools according to the context. Using mentors to gradually build and reinforce PAR principles in the context of climate change adaptation research, the mentoring group participate in documenting increased capacity of partners to engage in PAR, as a contribution to CCAA M&E strategies as well as by way of documenting and publishing cases and outcomes of the capacity-building strategy. In addition, CCAA will use reflection workshops to document successes, challenge and decision taken by target beneficiaries and lessons learnt both at the level of researchers and their beneficiaries. Undoubtedly, some actions may not lead to observable changes. Reflections will explore whether this is a result of the temporal scale of change or whether adjustments are needed to facilitate change.

Second, from a growing recognition that evaluation is the lifeblood of vulnerability assessment and reduction, one of CCAA's immediate task is to instill an evaluative culture as part of the thought processes and reflexes that researchers need to cultivate. This strategy stems from several observations gained through examination of projects that are submitted to the program. The evaluation section in many CCAA's are often under-budgeted and the implications on the outcomes of research results poorly framed and not properly understood. Hence, the program has sought to create "safe spaces" where researchers tend to explore ideas on M&E and share experiences relating to the challenges of measuring adaptive capacity. The recognition is that an emerging community of practice through which project partners network and identify potential solutions would only serve to cement a stronger sense of evaluative culture that needs to be gradually cultivated in many researchers. Indeed, whilst CCAA's encourages partners to use the Outcome Mapping methodology (OM) as a credible tool to map behavioral change, it also recognizes that this behavioral change needs to be sought closer to home—using current research partners as key protagonists of change.

This change is itself drawing on a series of overlapping changes. First, CCAA operates from a principle that researchers need to gradually move away from extractive research and embrace participatory action research given its ability to bring problem holders together with other agents of change. Secondly that the magnitude of climate change and the imperative for adaptation in Africa would require a new type of research and a new brand of researcher. Research results need to offer scientific insights and most importantly these results when conducted within an action research methodology will gradually result in social transformation. In short, when research is able to drive society in ways that will address environmental challenges in a participatory and integrated way, then its reach takes on optimal value.

Third, CCAA structured pedagogy, peer support and learning has sought to assist current researchers in developing good communications skills as a precondition for fostering learning and measuring change. Part of bringing about change and working with CCAA research partners, is ensuring that researchers are able to communicate the value of their research in ways that is relevant and translatable to policy makers and vulnerable communities. Thus, as a result, researchers are encourage to explore the use of narrative, videos and other communication tools as ways of enhancing their research and repackaging and translating scientific knowledge in layman's terms. The need to "socialize" the researchers comes from a genuine concern that participatory M&E is about co-learning and co-apprenticeship that goes beyond the assumption that the researcher is sole holder of knowledge. Researchers are able to learn individually and also to share their knowledge in a wider context that facilitates knowledge sharing and transfer. This form of both individual and collective learning is gratifying for many researchers who are more accustomed to working within their immediate research fraternity.

Fourth, the program places high premium on processes and a culture of learning by doing. The emphasis for CCAA in developing evaluative culture through mentoring, "d" groups and capacity training courses is heavily premised on the learning by doing approach. Providing incentives through training and mentoring has shown good results in engaging African researchers and creating evaluative reflexes. Indeed the Outcome mapping methodology is indicative of a continuous documenting and tracking of activities, outcome journals and the outcomes as a result of specific intervention. Thus, the focus is not solely on the tool but the ability of the tool to effect changes. CCAA's perception is to focus on cultivating evaluative culture as part of a process based approach. In short, evaluation is rooted in a series of short and long-term process based actions. The outcome mapping methodology symbolizes this strategy that process is as important as outcome.

There are still many challenges that the program is trying to address i.e., using participatory M&E to evaluation an inclusive process. Cultivating the belief amongst its partners that evaluating vulnerabilities will ultimately lead to action. However, this global consciousness of the power of evaluation will bring greater demand especially from demand side stakeholders mainly policy makers and vulnerable groups. There are still tremendous challenges associated with understanding vulnerability as a concept and a reality. However, through carefully structured training courses on integrated risk management, gender-related vulnerabilities, exploiting research to policy-making, the program is gradually getting partners to go beyond conceptual definitions of these complex overlapping factors to demonstrating how together within their projects they could identify such trends.

6. Conclusion

Exploiting social capital will undoubtedly give new insights to climate change evaluation particularly from an adaptation perspective. There is a need to understand vulnerability as a holistic factor beyond just a mere concept. Most importantly, African institutions are important agents in changing the evaluation culture especially vis-à-vis adaptation. Institutions need to be able to measure change and to do so credibly. To do this, it will mean that the premise for this type of learning is not externally imposed but sown within the consciousness of key change agents and institution that measuring change is a critical step towards assessing vulnerability reduction. Thus, in exploring how this is done and the degree of success or failure, it is important to measure current evaluation practices against current initiatives that seek to reduce vulnerability and enhance adaptive capacity. There are a number of institutions sub-regional level that have made huge strides in managing climate variability and instituting mechanisms that have helped African farmers to foresee and anticipate climate risks in ways that encourage and facilitate planned adaptation.

The poor have always responded to crisis to reduce the vulnerabilities they face with their own coping strategies. Evaluating their capacity is important as a way of building on their foundational knowledge base. However, the evaluation challenge needs to be seen in a new context—a context of opportunity that will lend new skills to vulnerable communities and adaptive managers. More importantly, the evaluation challenge is critical to understanding the process of adaptation and embracing the many capacity related opportunities that are inherently linked to implementing adaptation strategies. For policy makers, researchers and communities, evaluating adaptation provides a good opportunity for bridging the gaps between different stakeholders. The reduction of vulnerability is inherently linked to scientific research, planning and anticipating climate related hazards and not least good monitoring and evaluation practices In short, bridging the evaluation gap is a challenge that all stakeholders cannot afford to ignore—if they do they not only do so at their own peril but more importantly reduce the potential for measuring real change in the face of climate impacts and risks.

Vulnerable communities remain key agents in evaluating adaptive capacity. Their participation in evaluative processes is fundamental to measuring change. Thus, establishing good relationships with communities at the planning phase of projects is essential in keeping them in the loop through the project development phase. Encouraging the sharing of knowledge as a two way process is essential to making development and evaluation more participatory. Supporting vulnerable groups in their adaptation strategies would mean understanding their demands for new knowledge, their ways of coping with current stressors and valorizing knowledge that they use as part of natural resource management. When evaluation is conducted based on such parameters—it gives us a unique opportunity to shape development initiatives in a truly participatory fashion.

Notes

1. Afouda, A et al., (2002) "Evidence of scaling properties in West African rainfall," paper from Proceedings of Fourth International FRIEND Conference, Cape Town, March 2002.
2. Denton, F, Sokona, Y, and Thomas J.P. "Climate Change and Sustainable Development Strategies in the Making: What Should African Countries Expect?" OECD and Environnement et Développement du Tiers Monde (ENDA T.M), 2002.

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Part III

Mitigation of Climate Change

9

The Mitigation of Climate Change

John Soussan

Whilst there may be a few resisters left, the overwhelming scientific and political consensus is that climate change is a reality that will progressively increase in its impacts over the coming decades. The debate now focuses on what to do about it rather than whether it will occur. The science is unequivocal: higher concentrations of greenhouse gases will lead to cumulative impacts and progressive structural changes to ecological processes until the viability of many ecosystems will be compromised. The impacts of these changes in terms of human welfare will likely be devastating: food security will be threatened, millions will lose their homes and land from sea level rises, natural disasters will be more frequent and severe, diseases will spread and health will be affected, and many parts of the world will face acute water shortages as rainfall patterns change.

International negotiations have focused on steps to mitigate climate change through the sustained reduction in the emission levels of greenhouse gases, especially carbon dioxide. Targets have been set, not least in the Kyoto Protocol, and new targets are currently being negotiated based on the "Plan of Action" agreed at the Bali COP meeting in 2007. But what is not clear is the identification and evaluation of the most effective actions that countries and communities can take to realize these targets: in other words, what are effective climate change mitigation policies and actions? The chapters in this section of the book, and the papers presented in the mitigation sessions at the Alexandria Conference, focused on this issue through considering the impacts and effectiveness of a wide range of mitigation actions.

The range of mitigation measures being proposed globally, and in many cases being tried out on a pilot basis, is truly staggering; but what is not clear is whether any of them work well enough, and are cost-effective enough, to be the basis for the hopes of humankind to stabilize and even reduce the concentrations of greenhouse gases in the atmosphere. The chapters in this section of the book represent a stimulating and wide variety of methods and styles, and provide an overview of some of the most important types of approaches to mitigation. The section by Tokle and Uitto, based primarily on the evaluation of the Global Environment Facility climate change mitigation portfolio, illustrates this issue extremely well.

The GEF has funded 317 mitigation activities in numerous countries around the world. This includes many focused on alternative energy sources such as off-grid solar photovoltaics that can provide the world's poor with electricity without adding to greenhouse gas emissions. There were also numerous projects aiming to enhance energy efficiency in different ways, projects focused on the transport sector and many other types of activities. The paper also looks at the performance of other donors as reported in 224 evaluation reports, to reveal a mixed track record overall on mitigation activities, with challenges to successful implementation frequently reflecting institutional and policy weaknesses as well as perverse financial incentives. Overall, the chapter demonstrates both the potential of mitigation activities and the numerous barriers to successful mitigation that exist in the contemporary world.

The chapter by Stewart, Uitto and Wells looks at the activities of one major global organization, the United Nations Development Programme, and is unique to this section of the book as a report based on a comprehensive evaluation of UNDP strategies and programs in the mitigation field. It considers the key relationship between achieving global climate change mitigation benefits through supporting local sustainable development efforts. This idea of "co-benefits," where actions that produce immediate development benefits are also intended to have long-term secondary benefits for climate change mitigation, is a crucial piece of the mitigation jigsaw. The goal is for "win-win" approaches, where investments and reforms are both viable and affordable now and are also effective in mitigation terms.

Overall, the chapter on UNDP's mitigation activities provides a key message for the mitigation field: these activities need to be approached in a way that integrates them into overall national development planning, rather than treating them as separate and stand-alone activities. This is too often not the case and adjustments need to be made to the way that the mitigation issue is addressed to ensure that these activities are more effectively "mainstreamed" into national planning. The chapter also demonstrates the extent to which the perspective of developing countries on the mitigation issue differs to that of the developed world and the value of organizations such as UNDP, which are more closely aligned to a developing country perspective, being key actors on the mitigation stage.

The chapter by Timilsina takes out scale of analysis down to a country level, with a consideration of the macroeconomic and sectoral impacts of climate change mitigation in Thailand. Using a comprehensive analysis based on a computable general equilibrium model, the chapter looks at the likely impacts of one of the most important potential mitigation approaches: taxation instruments that are intended to reduce carbon emissions. The effectiveness and political acceptability of taxation as a key mitigation instrument is a highly contentious issue. The Thailand study shows that, where such a tax is an integral part of a balanced taxation policy, it can be neutral or beneficial in economic development terms and extremely effective in terms of reducing greenhouse gas emissions.

Schroeder takes the discussions to a sub-national level with an assessment of the impact of provincial clean development mechanism (CDM) centers on local market development in China, one of the world leaders in the creation of internal CDM markets. The use of CDM processes as a key element of mitigation approaches has been widely advocated and globally it is one of the most widely used (and heavily financed) aspects of mitigation strategies. The study found that although there are, in some cases, institutional capacity limitations and some lack of clarity over the rules governing and responsibilities of the CDM centers, in general, the creation of this system of provincial CDM centers is likely to play a key part in advancing CDM development in China, one of the most important countries in the world in terms of mitigation activities.

The final chapter on mitigation in this section, by Khudadad and Shah, takes the scale even lower, to a household and community level. Ultimately, this is where many decisions on mitigation actions will be taken, as these actions involve changes in technology choice and consumption patterns. This fact is often lost in the rarified atmosphere of international negotiations and discourse on climate change mitigation. The Khudadad and Shah chapter looks at the impact of a range of household energy efficiency products on domestic fuel use levels in a remote and mountainous area in northern Pakistan. With extremely cold winter temperatures, domestic fuel use can be extremely high in this region, leading to substantial per capita greenhouse gas emissions with conventional construction materials and energy use technologies.

The study showed that the introduction of more efficient house insulation materials and more efficient stoves can result in fuel savings of up to 60 percent: reducing carbon dioxide emissions considerably and providing considerable cost savings for the families involved. These results demonstrate the potential mitigation impacts of what are often immediately affordable, modest and straightforward investments. Mitigation does not have to take place at a huge level and cost billions: indeed, it is the small scale efforts that are sensible and viable now that can produce the greatest impact if and where they take place at a sufficient level. In many ways, such interventions also bridge the adaptation and mitigation gap: they are a necessity to adapt to changing fuel prices, climates and/or resource availability and they also, through fuel or other savings, produce substantial mitigation benefits.

The chapters in this section of the book illustrate the range and complexity of the climate change mitigation issue. They also illustrate that actions need to be taken and can work at all levels, from the global to the local. Such actions need not be complex or expensive and can produce "co-benefits" in addition to their mitigation impacts. Indeed, the papers show that mitigation effects should themselves be seen as a co-benefit of interventions whose primary purpose and economic justification is measured in more immediate terms such as improving energy efficiency or generating more sustainable patterns of development in poor countries. Mitigation is consequently not just something that humankind cannot afford not to do: it is also in many cases something that people can afford to do in an immediate time horizon.

10

Overview of Climate Change Mitigation Evaluations: What Do We Know?

Siv Tokle and Juha I. Uitto

1. Introduction

Although climate change evaluation is still a relatively new field, a fair amount of experience has already been gained especially in the context of evaluating mitigation projects and programs. Much of this has taken place within the context of the Global Environment Facility (GEF). In this chapter, we will provide an overview of the evaluations of the GEF climate change portfolio. We will also draw upon evaluations from other donor agencies to the extent that we have been able to identify relevant evaluations. Following this overview, we will present and discuss conceptual frameworks that have been utilized in these evaluations. Finally, we identify a number of challenges in evaluating climate change mitigation.

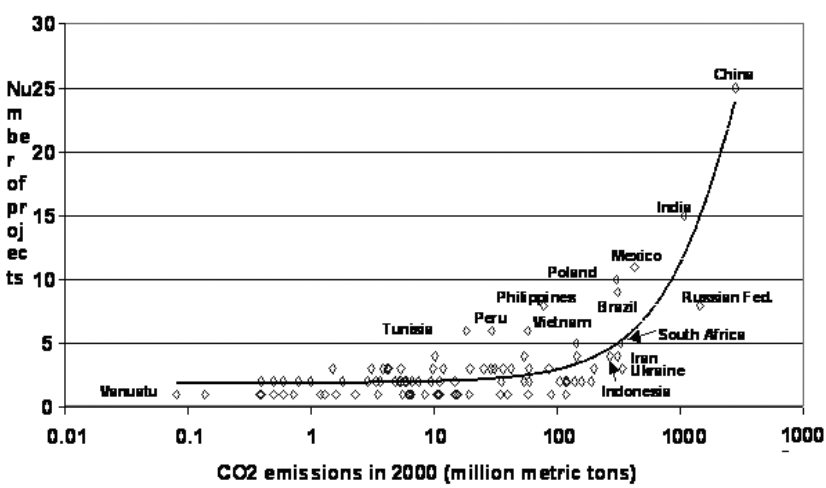
2. Evaluation of the GEF Climate Change Portfolio

The GEF is a partnership involving the majority of the world's countries, a number of international organizations, civil society, academia and the private sector set up to address global environmental issues while supporting national sustainable development efforts. Following the Rio de Janeiro Earth Summit in 1992, GEF emerged as the largest public source of financing on global environmental projects for the developing countries and countries with economies in transition. It was designated the financial mechanism for a number of global conventions and multilateral environmental agreements, including the UN Framework Convention on Climate Change (UNFCCC). Until today, the bulk of GEF's climate change work has focused on climate change mitigation. To date, GEF has provided $1.8 million in funding for projects that reduce or avoid greenhouse gas emissions in the areas of renewable energy, energy efficiency, and sustainable transport. In addition, it has raised some $10 billion in co-financing. This funding has been distributed in more than 900 projects in the developing and transitional countries.

The results allocation framework (RAF) approved in 2005 allocates GEF support to 161 countries based on their potential to generate global environmental benefits and their capacity, policies and practices to successfully implement GEF projects. Figure 10.1 presents the distribution of GEF projects by country in relation to their respective CO_2 emissions.

By the end of 2007, a total of 317 climate change projects have been completed and closed. However, only 56 terminal evaluation reports from these projects have been received by the GEF Evaluation Office, representing a quarter of all terminal evaluation reports in all GEF focal areas. Given the large number of completed projects, the relatively small number of evaluation reports suggests a rather serious underreporting. Out of the 56 evaluation reports, 45 were reviewed by the GEF Evaluation Office. The ones not reviewed were either old (from before 2002) or were among eight reports that attempted to assess the "impact" of the projects, rather than achievement of the "outcome."

Figure 10.1
Distribution of GEF Closed, Active, and Future Projects as of April 28, 2004



Overall, the review rated 37 (82 percent) of the 45 terminal evaluation reports to be of satisfactory quality. Consequently, eight (18 percent) of the reports were rated as less than satisfactory quality based on a number of identified weaknesses. These included factors such as:

- Evaluation reports did not adequately cover project outcomes;
- They were not internally consistent;
- The reports did not adequately cover risks to project sustainability;
- They did not adequately cover lessons learned;
- They did not adequately cover financial information or M&E.

Based on the 35 evaluation reports contained in the GEF Climate Change Portfolio Database that were found satisfactory, 83 percent (29) of the projects were rated satisfactory or higher with regard to achievement of their intended development outcomes.

The key achievements of the GEF climate change mitigation projects that were highlighted in the evaluation reports included positive changes in markets for energy efficient products as well as advances in finances and banking for energy efficiency. The projects also demonstrated improved policy frameworks when it comes to issues, such as codes and standards, awareness, market liberalization, and institutions. The evaluations of renewable energy projects reported benefits to the local populations pertaining to development of off-grid solar photovoltaics (see also GEF, 2004).

However, the evaluations also highlighted several challenges. Moving from a technological focus to market transformation has been challenging and not always smooth. Projects have not always been able to target the "right" market barriers within strategic country programming for energy efficiency and renewable energy. GEF projects are usually intended act as catalysts and to pave the way for replication of new approaches on a larger scale. However, the catalytic effects have not consistently been effective. Similarly, partnerships are critical for the success of GEF projects, but have not always been successful, especially with regard to working with the private sector. Given GEF's focus on the global environment and greenhouse gas emission reductions, there has often been inadequate attention paid to the local benefits of the projects, for instance through increased access to energy or reduced pressure for fuel wood (see also GEF, 2006).

In conclusion, while the evaluations reveal significant successes—and an 83 percent success rate is indeed impressive—there are still major challenges that need to be overcome. Overall, it would seem to be important to improve the strategic coherence of the entire climate change program.

3. Evaluations from Other Donors

The Climate Change Database contains 224 evaluation reports under the thematic area of “mitigation.” All of the non-GEF funded evaluations—a total of 104 evaluations—were assessed for this study. These were divided into the following mitigation clusters:

- Energy efficiency (21 evaluations);
- Renewable energy (20);
- Environment (30);
- Transport (7);
- Other (26).

Most of these evaluations were general in scope and only few of them dealt explicitly with mitigation efforts. The vast majority (69 percent) of the evaluations were conducted by bilateral donors. Almost half (45 percent) were conducted during the past five years. Most (83 percent) of the evaluations were ex-post or final evaluations. Out of the total, 47 percent were project evaluations (especially in the energy efficiency and environment clusters), while 37 percent were program evaluations.

Again, the evaluation reports were examined critically for quality. Significant deficiencies were found. Only two-thirds (64 percent) of the evaluations contained any recommendations, while just 45 percent identified lessons learned. Surprisingly, a mere 38 percent included the terms-of-reference of the evaluation and more than a third (42 percent) did not even specify the objectives of the evaluation.

With regard to the conduct of the evaluations, more than a half (59 percent) had no information about the duration of the evaluation itself. For the ones that did, the average length was 4-12 weeks per evaluation, which appears rather short even for individual project evaluations. The evaluation team composition was described in 60 percent of the reports revealing that most of the teams consisted of 2-4 persons. The expertise of the team members, when disclosed, consisted basically of environmental experts of various types, staff from evaluation offices, or a combination of the two.

Only 58 percent of the reports had any description of the evaluation methodology. Most of them used a combination of desk review, interviews with stakeholders and field visits. It was found that the evaluation methodologies used were not specific to climate change.

The review identified a number of issues and gaps. It was obvious that climate change is not sufficiently or systematically mainstreamed into development programming or the evaluations. The linkages between environmental issues and poverty continue to be established in an uncertain and non-specific manner. The projects are not designed with environment as a major objective but rather as an afterthought or a side consideration.

Programs could have more impact than just a collection of individual unconnected niche projects. They should take into consideration requirements from UNFCCC, the Inter-Governmental Panel on Climate Change (IPCC), the Kyoto Protocol, and other internationally agreed goals. However, a major gap exists between the policy priority accorded to environmental sustainability and the actual practice. While policy level declarations pay attention to the environment, the actions at the field level do so much less. There is a need to introduce concrete measures on the ground along with further policy level work.

In general, there is a lack of monitorable targets relating to the environment, which is further aggravated by the lack of environmental statistics in many countries.

The review nevertheless discovered a few good examples, all of which were from evaluations by bilateral agencies (CIDA, SIDA and DfID). These were from the mere 4 percent of evaluation reports that contained a prominent link to climate change. None of these good examples were derived from the transport, renewable energy or energy efficiency clusters. What defined these as good cases was that they included climate change explicitly in the evaluation terms-of-reference and objectives, as well as in the conclusions and recommendations. They also had a separate chapter focusing on climate change issues.

One evaluation from 2004 was conducted "from a climate change perspective," i.e., looking particularly at the program's approach in the context of the climate change requirements under UNFCCC and Kyoto Protocol (as quoted from the terms-of-reference). Another evaluation explored the linkages between the evaluated program and the international initiatives, including UNFCCC and IPCC.

There were numerous missed opportunities in the evaluations at all levels. At the policy level, when evaluating performance and effectiveness of "environmental policy," key elements such as greenhouse gas emissions and climate change considerations were not addressed. The same omissions were evident when looking at country programming or at sector level, e.g., with regard to analyzing the power sector in a specific country. At the project level, evaluations in the transport sector included "improved air quality" but did not make an explicit link to climate change.

Overall, thus, the climate change perspective was mostly not included in these evaluations and the link is generally missing between development and environment.

4. Conceptual Evaluation Frameworks

This study also analyzed the various conceptual frameworks used—or those that could be used—for evaluating climate change mitigation initiatives. Figure 10.2 presents a possible framework for evaluating a project or a program with the objective of reducing or avoiding greenhouse gas emissions. This program logic is based on the idea of market development for climate change mitigation. It thus assumes that such changes in the market that will favor increased energy savings or applications of renewable energy will result in lower greenhouse gas emissions. According to the logic model, market development relies on five key capacities. First, policy frameworks must be conducive and supportive for renewable energies as well as provide sufficient "comfort" to investors. Secondly, the technical capacities need to be available. Third, the market participants need to have the necessary management skills. Fourth, Financing must be available, both for businesses as well as the users. Fifth, the end-users must be aware and well informed of the technological options and future developments in the energy supply sector.

Normally, all these capacities must be in place in order to provide the enabling environment for sustainable development and growth of a market, with supply and demand infrastructure for renewable energy technologies. Market development and removal of barriers to adoption of climate friendly technologies are a continuous process. The question is how to address this in an evaluation.

One way of doing this is to translate this into an evaluative framework that distinguishes between the different levels of objectives and provides concrete and measurable indicators for each level (Figure 10.3).

Given the ultimate objective of the mitigation interventions at the highest level of the above evaluative framework, a central challenge for evaluations is calculating the actual greenhouse gas emissions reduced and/or avoided. This requires a technical assessment that is often not possible to do by an evaluation team, which may not have the time and resources or the technical means and competence required. Very often it is neither planned by those commissioning the evaluation. Consequently,

Figure 10.2
Evaluation Framework for a Market Transformation Intervention

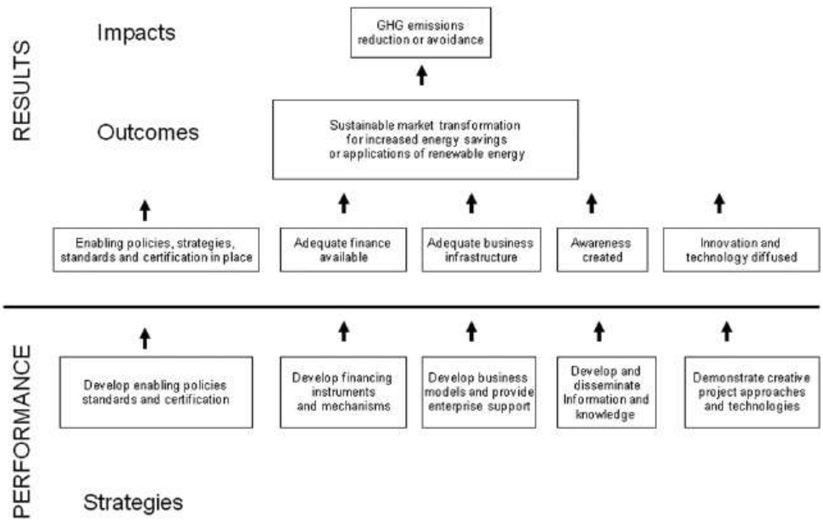


Figure 10.3
Evaluative Framework

Framework level	**Objective**	**Indicators and monitoring**
Global objective: Avoided GHG emissions	Reduce CO2 emissions from energy use and production	Direct and indirect CO2 and GHG emissions avoided
Development objective/ outcome	Build markets for energy efficiency and renewable energy	Market development indicators—measure indirect impacts
Project outputs	Technologies, capacities built in finance/business, new energy codes etc.	Market intervention indicators—measure direct impacts
Project inputs	Complete specific project activities	Project performance monitoring

evaluations often rely on monitoring data and assessments done by the project itself. These are not always available and, when they are, not always reliable. This poses a challenge to the evaluation.

A further complication is the frequent lack of targets or estimates with regard to greenhouse gas emissions. The review found that a third of the closed GEF climate change projects did not contain such targets or estimates. Where they do exist, the estimates are often of low quality, with inconsistent assumptions. Often the targets are too generous, representing wishful thinking—or excessive optimism in order to receive funding for the project. This is the frequent case especially when it comes to estimating emission reductions through replication. Consequently, project midterm evaluations tend to revise the original targets downward and the final evaluations tend to report shortfalls in meeting the targets.

5. Challenges in Evaluation of Climate Change Mitigation

We have here discussed the results of a review of a large sample of climate change mitigation evaluations of projects by the GEF as well as other donors. We have looked at the evaluations through a specific climate change angle. Obviously, an evaluation can be satisfactory, yet not address climate change and development adequately. Furthermore, regular weaknesses in M&E tend to be magnified in the case of climate change. The key challenges with regard to evaluating climate change mitigation identified can be categorized into four main categories:

1. Project or program design rarely facilitates evaluation of climate change issues;
2. Monitoring of many climate change issues is not undertaken;
3. Evaluation design does not take climate change into account;
4. Conduct of evaluation lacks technical expertise.

These challenges are elaborated further here below.

Climate change and development are rarely well integrated in project and program design. Regular development projects rarely take account of climate change issues. On the other hand, some climate change mitigation projects do take account of development (as in the case of promoting rural electrification through renewable energy), yet even this occurs more seldom than could be expected. The projects normally have intermediate goals other than climate change mitigation and these become the focus of M&E.

The program or strategy documents are often too overarching or pitched at a level that does not include climate change considerations.

More often than not, baselines related to climate change and greenhouse gas emissions are missing. All of the above leads to a lack of clear framework against which to evaluate.

As for monitoring, M&E budgets are often far too small to address elements outside of the project. However, it would be essential to monitor factors, such as the market for energy efficient products or renewable energy, energy consumption, demand from users, etc. Lack of easily available data (related, e.g., to private sector market share and practices) hinders monitoring. Greenhouse gas emissions and market change are frequently not monitored. Furthermore, targets and goals in the projects are often so ambitious that they are not captured by short-term monitoring. It is assumed that this will be done at the end of the project, when it in practice is often too late or impossible due to lack of baselines and data. Such lack of data hampers later evaluations.

Factors relating to evaluation design and conduct are equally important. Usually, evaluations are designed to look at the intended objectives and outcomes of interventions. If climate change dimensions are not included in the project design, they will not get analyzed in evaluations. Organizations commissioning evaluations frequently require environmental expertise in the evaluation, but rarely plan for the inclusion of technical expertise pertaining specifically to climate change. A frequent problem faced by evaluations is that their planned scope, duration and budget are not sufficient to cover aspects essential for evaluating climate change, such as validation methodology of market change. Evaluation designs therefore often are not conducive to allowing evaluators to address climate change considerations.

Finally, the conduct of evaluations poses limitations on how well they can address climate change. Importantly, impacts on climate change only become evident in the long term. However, very few ex-post evaluations address this issue. Terminal evaluations conducted soon after a project is closed do not fully capture the intended climate change impacts. Only few evaluations explicitly cover the unintended impacts of the project being evaluated.

As mentioned above, most evaluators lack the technical knowledge to assess climate change impacts and greenhouse gas emission reductions. The same goes for market transformation, which requires specific skills often not available amongst the professional evaluators. Even in cases where the technical expertise is available and used, a new challenge arises to present the findings so that they are accessible to the non-specialist reader. These include the policy makers and funders whose understanding of the evaluation findings is critical.

Furthermore, there are still methodological issues that need to be resolved. For instance, it is methodologically challenging to assess non-observable results, such as "avoided emissions." Good methodologies are still lacking for key issues, such as measuring sustainability or changes in behavior. None of this is facilitated by the usually inadequate data at all levels, including the project being evaluated, the government in the particular country, and the private sector.

It is thus obvious that evaluating climate change and development poses particular challenges—both related to the interventions intended to mitigate climate change as well as the evaluations themselves—that need to be overcome in order for the evaluations to become more credible and more useful to their intended audiences.

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11

Contributing to Global Benefits or Supporting Local Sustainable Development: Evidence from a Global Evaluation of UNDP's Program

Howard M. Stewart, Juha I. Uitto, and Michael P. Wells

1. Introduction

This chapter assesses the United Nations Development Programme's (UNDP) participation in global efforts to address causes and effects of climate change, how these efforts have evolved in the past and how they may evolve in the future. The chapter draws on a recent evaluation of the Role and Contributions of UNDP in Environment and Energy. The evaluation report was presented to UNDP's management and executive board in September 2008. The authors of the present chapter were all part of the core evaluation team.

Environment and energy in various guises have been central to UNDP's work for many years. Most recently, their 2004-2007 planning framework recognized "managing environment and energy for sustainable development" as one of UNDP's main areas of activity. Their plan for 2008-2011 includes "environment and sustainable development" as one of UNDP's four "focal areas." Within the energy area, in line with its global mandate, UNDP focuses on providing energy services for the poor and is not involved in large-scale energy infrastructure projects. The close linkages between energy and development have been well established in literature (e.g., Takada and Charles, 2007). While there is no Millennium Development Goal (MDG) specifically focusing on energy, it is implicitly important for the achievement of all MDGs (UNDP, 2005).

Climate change mitigation activities have been one of the key components of UNDP's work related to the environment. The Administrator of UNDP recently outlined the need for UNDP to support climate change mitigation activities while at the same time recognizing the developing world's legitimate right to increase their use of energy for development (Dervis, 2008). This challenge is fundamental for UNDP: How to help fight climate change while increasing access to energy services for the poorest countries and the poorest segments of society? A related issue is that it is the same poorest countries and their citizens who bear the brunt of climate change, though their own contributions to it have been negligible. Helping developing countries adapt to climate change is a new challenge and an increasingly important one for UNDP.

Since the establishment of the Global Environment Facility (GEF) in the early 1990s, UNDP together with the World Bank and the United Nations Environment Programme (UNEP) has been one of its three principal implementing agencies. In many ways UNDP's relationship with GEF makes much sense, in other ways it has been fraught with contradictions. UNDP has an unparalleled global presence, with UNDP country offices functioning in most developing and transitional countries around the world. This made it a natural partner for an initiative like the GEF, with its goal of helping these countries to address what the GEF defines as high priority global environmental problems. So it is not surprising that UNDP has disbursed roughly 40 percent of the GEF's project budget over the past fifteen years; roughly the same proportion of the GEF budget that was disbursed through the World Bank, an institution with a far higher level of overall disbursements than UNDP.

On the other hand, of all major international development cooperation organizations, UNDP is also the most aligned with the developing countries. These developing countries for the most part were not enthusiastic about the creation of the GEF in the 1990s, a decade when many mainstream development cooperation budgets declined significantly. The tension between local and national sustainable development priorities and the global environmental priorities features centrally in this paper, as it did in the evaluation it draws upon.

This paper is organized as follows. The first section below briefly outlines the objectives of the evaluation and how it was conducted. The sections that follow describe UNDP's corporate strategies on climate change, including key areas of relevance to this chapter, namely climate change mitigation, carbon finance, and adaptation to climate change. The next section analyzes how the organization's work on energy has evolved and intersected with the issue of climate change, including the tension between climate change mitigation and local-level sustainable development mentioned above. The final section summarizes the conclusions.

2. Evaluation of UNDP's Role and Contributions in Environment and Energy

The recently concluded evaluation of UNDP's role and contributions in environment and energy (Wells et al., 2008) took stock of the UNDP's overall performance and positioning in what the organization classifies as the field of "environment and energy." The objective of the evaluation was to assess UNDP's positioning and contributions to "managing environment and energy for sustainable development." The evaluation was objectives-based, that is to say it tried to ascertain whether UNDP's programs and actual outcomes were likely to achieve stated objectives. The organization's work was assessed against the evaluation criteria of relevance, effectiveness, efficiency and sustainability.

The evaluation focused mostly on the period between 2002 and 2007. However, in order to contextualize and situate the current program in its historical context, the evaluation also considered how events before 2002 have shaped UNDP's approach to environment and energy as well as how the organization has positioned itself to move forward. Evaluation enquiries primarily consisted of (a) an analysis of the policies and strategies and priorities adopted by UNDP in defining its role in managing environment and energy for sustainable development, (b) an overview of the programmatic and non-programmatic activities undertaken, and (c) assessment of performance of various activities at the global, regional and national levels.

The evaluation considered the effectiveness of the organizational architecture for environment and energy within UNDP since 2002, including the impacts of the UNDP's regionalization process. These enquiries looked into such areas as priority-setting for environment and energy within the organization, as well as organizational learning and how lessons from the past have been fed into policies and programmatic development. The evaluation analyzed UNDP's policy, praxis and performance along two principal axes. First, the entire environment and energy practice area was analyzed holistically at the three main levels of operations, i.e., global, regional, and national. Secondly, the evaluation assessed a selection of the most important technical areas, namely climate change, energy, and biodiversity at all of the above levels. Important crosscutting issues, mainly mainstreaming and partnerships (notably with GEF and UNEP) merited specific attention in the evaluation.

Information sources *within* UNDP consisted mainly of staff working on environment and energy at global, regional and national levels, as well as Resident Representatives/Coordinators. Information sources *outside* UNDP included major partner organizations and other stakeholders with an informed view of UNDP operations, including individuals from government departments, donor agencies, research organizations and civil society. Consultations with external stakeholders were undertaken at national, global (i.e., multilateral) and, where feasible, regional levels.

A significant body of project and program evaluations already carried out by UNDP was relevant to this evaluation. These included evaluations of UNDP's national, regional and global level programming. In the countries selected for evaluation case studies, individual project evaluations and project implementation reviews were also reviewed.

The country-level case studies were a key source of evaluation information. Most of UNDP's programming resources are allocated at the country level and this is the level where one can determine how much of headquarters' policy and rhetoric is being translated into concrete action. Eight countries were visited (Table 11.1), including Fiji and Samoa where UNDP has multi-country offices covering a total of 14 countries (ten from Fiji, four from Samoa). Two UNDP regional service centers as well as the Pacific sub-regional center were also visited. In addition, a more cursory study of the UNDP's Thailand country program was undertaken in conjunction with the evaluation team's visit to the Bangkok regional center.

Global consultations focused on senior technical and management staff at UNDP headquarters. The evaluation team also visited organizations whose environmental interests and goals overlap with those of UNDP:

Table 11.1
Case Study Countries and Regional Service Centers/SURFs

UNDP Region	Case Studies	Regional Centers/ SURFs
Africa	Burkina Faso, Kenya, Malawi	-
Asia & the Pacific	China, Fiji, Samoa	Bangkok, Suva
Latin America & the Caribbean	Ecuador	-
Europe & the CIS	FYR Macedonia	Bratislava

UNEP headquarters and its Bangkok Regional Office, GEF's Secretariat and Evaluation Office, the World Bank, the World Conservation Union (IUCN), the International Institute for Environment and Development and the World Resources Institute.

Evaluating UNDP's role in environment and energy was complex and challenging. A sample of eight countries could not capture the diversity of roles played by the organization in environment and energy in over 160 countries. Fragmented and sometimes incoherent financial information hampered efforts to obtain insights into trends over time or analyze national project portfolios. While individual project inputs and outputs had been monitored, performance monitoring systems were found to provide little usable information on goals, results or outcomes. To address these limitations, extra care was taken in identifying the different stakeholders and in conducting semi-structured interviews with them.

3. UNDP's Corporate Response to Climate Change

Climate change has been a primary area of focus for UNDP's environment and energy work for the past 15 years. Since 1992 UNDP has mobilized roughly US$3 billion to fund over 400 large-scale and 1,000 small-scale climate and energy related projects. These have been financed almost entirely with GEF funding and associated co-financing. Climate change now figures prominently in UNDP's strategic plan for the period 2008-2011.

Most of UNDP's activities related to climate change activities at the country level have been aimed at mitigating greenhouse gas (GHG) emissions. Mitigating GHG emissions is a global concern but it is hardly a priority of many developing countries, especially for the least developed countries (LDC). Climate change mitigation projects are often seen as being of marginal relevance to developing countries' development agendas. The climate change mitigation projects of UNDP have included support for renewable energy, energy efficiency, sustainable transportation and new low-GHG energy technologies. A shift from "technology-based" towards "market-based" approaches in recent years has meant a greater focus on creating "enabling environments" for "improved" energy policies and practices, and tackling those barriers that inhibit countries' progress towards more "climate-friendly" energy policies. Many countries have also received help to fulfill their reporting obligations under the UN Framework Convention on Climate Change (UNFCCC). Far less funding has been available to help developing countries prepare for and respond to the impacts of climate change.

Climate Change Mitigation

The direct impacts of UNDP's work related to climate change mitigation can be measured in reduced GHG emissions. As reported by UNDP GEF's global "project implementation review" for 2007, about 89 million metric tons of CO_2 emissions were avoided during 2007, with the projects in the portfolio having cumulatively avoided emissions of about 386 million metric tons over the lifetimes of the projects. Energy efficiency projects accounted for virtually all these avoided emissions. While these results are impressive and significant from the perspective of global environmental benefits, they were generally of limited interest to most of the countries concerned.

Only six projects accounted for 98 percent of the emissions reductions of the entire global portfolio (Table 11.2). Five of these are in the Asia-Pacific region, three in China. The other 58 projects in the global portfolio contributed just over 1 percent of the total emissions avoided.

Table 11.2
Projects with Greatest Amount of CO_2 Emissions Reductions, in PIR 2007 Period

Country	Project Title	Emissions avoided (Mt CO_2/year) during 2007	Cumulative CO_2 Reduction (Mt CO_2)
Egypt	Energy Efficiency Improvements and Greenhouse Gas Reduction	2.97	11.79
China	Energy Conservation and GHG Emissions Reduction in Township and Village Enterprise Industries in China Phase II	2.05	2.24
China	Barrier Removal for the Widespread Commercialization of Energy-Efficient CFC-free Refrigerators in China	75.00	347.90
China	End Use Energy Efficiency Project (EUEEP)	3.84	5.84
Malaysia	Industrial Energy Efficiency and Improvement Project	2.04	7.57
Philippines	Capacity Building to Remove Barriers to RE Development Project	2.01	6.55
TOTAL		**87.91**	**381.89**

Source: UNDP, 2007a.

The emissions reductions caused by "market transformation" are proving significantly more difficult to quantify and have to be assessed on a project-by-project basis. Renewable energy projects have been demonstrated in some cases to have positive socio-economic impacts, as well, by providing households with energy.

Reviews of the performance of UNDP's climate change projects by GEF have been generally favorable. However, the selection of projects and allocations of resources between countries for all GEF climate change projects was described by the GEF's independent program study in 2004 as "not revealing any evidence of strategic choice" (GEF, 2004).

UNDP has built up an impressive body of expertise and experience in this area, although this expertise is located mostly at headquarters and the regional centers, and there is relatively limited expertise in most UNDP country offices. There are concerns that the stream of projects coming online may be beyond the capacity of many country offices to implement effectively,[1] raising the prospect of "resource mobilization successes" of the headquarters and regional centers becoming "implementation liabilities" for the country offices.

Climate change mitigation has been an uncomfortable fit with the rest of UNDP's agenda, especially with regard to the LDC, reflecting the differing objectives of UNDP and GEF. Among the countries where UNDP is active, the major opportunities for emission reductions can be found in the more industrialized, middle-income countries. Carbon emission reductions from investments in sub-Saharan Africa or in the small-island developing states (SIDS) are currently almost non-existent. Recently the GEF's new Resource Allocation Framework has begun to further concentrate support for mitigation activities in the countries that are the main GHG emitters. This means that the poorest countries are among those least likely to benefit from international investments in reducing carbon emissions.

Carbon Finance

The rapid growth of carbon trading, that is to say the buying and selling of carbon emission permits, has been a notable feature of the global response to climate change in recent years. This is an area of activity that the GEF has not supported. The so-called Clean Development Mechanism (CDM) has been of particular interest to UNDP and its mission. The CDM has allowed wealthy industrialized countries to invest in projects that reduce emissions in developing countries as an alternative to making larger investments to achieve similar levels of carbon emission reductions in their own countries.

CDM benefits have so far been limited to a small group of countries (especially China, India, Brazil, and Mexico). Very few LDC or SIDS are ready to participate in carbon markets on a significant scale, though their perceived carbon sequestration potential may increase significantly if credits for sustainable land management or avoided deforestation are approved during the negotiations of a successor to the Kyoto Protocol expiring in 2012.

In response to this emerging source of funds, UNDP has recently established the MDG Carbon Facility, which aims to realize "development benefits" from the sales of carbon credits. The target market is countries that have not benefited significantly from the CDM, due to their lack of capacities and opportunities, as well as regions within countries (notably China) that have not benefited so far. UNDP has managed to attract bids from major banks to underwrite their MDG Carbon Facility. One bank has committed to guaranteeing an attractive carbon price for carbon offset projects around the developing world for 15 million carbon credits. This is an innovative initiative for UNDP offering a model for collaboration with private banks and with those who invest in activities that can generate carbon credits, as well as with concerned governments. It also promises full cost recovery and does not rely on GEF funding.

It is too early to assess how UNDP's entry into this arena is likely to turn out and whether the agency has found a unique niche. This market has already attracted other institutions with considerably more carbon finance experience than UNDP, though few others have UNDP's experience in working with developing countries.

UNDP is not an early starter in this area and the MDG Carbon Facility is small. The World Bank, for example, has 10 funds managing US$2 billion and a decade of experience in the field. Despite this, even the World Bank is no longer a significant player in the rapidly expanding carbon market. The World Bank has a community fund, a forestry fund and a bio-carbon fund, all financed with proceeds from the carbon market. All these areas are also of interest to UNDP and all may eventually prove to be appropriate areas of focus for UNDP carbon funds as well.

The World Bank's experience with projects that do not readily attract private sector investments—exactly the type of project UNDP is looking for—is that such deals are hard to close. This corresponds with the early UNDP experience, showing that considerable hands-on work by highly capable and knowledgeable staff is often likely to be required to close deals with project promoters, investors and governments.

However, UNDP has started to assemble a promising pipeline of projects following high-quality preparation work, mainly led by their Bratislava and Bangkok regional centers. UNDP has made considerable progress in building carbon finance capacity within the agency as well as certain partner governments, while deepening staff understanding of the carbon markets and gaining valuable experience in collaborating with the private sector.

The main rationale for UNDP's participation in carbon markets is to access a new source of finance for poverty reduction. They aim to use carbon funds to generate local and national development benefits in areas such as of food security, education, biodiversity protection, community benefits, water purification, watershed protection, gender equality, health care, secure land tenure, improved sanitation, poverty alleviation, and human rights. But the mechanisms for transferring resources to support these areas need to be negotiated and established separately as part of each carbon "deal." This will be a complex institutional challenge, especially given the lack of capacity and relevant experience in the countries that UNDP is targeting. How and on what scale these "development dividends" can be realized in practice remains to be seen. But unless these dividends can be realized on a significant scale and used to realize clear welfare gains, UNDP may appear to be ignoring the interests of the countries, as well as the constituents within these countries, that are most in need of UNDP support.

Adaptation to Climate Change

Very modest levels of international funding have so far been provided for climate change adaptation. GEF administers three small funds and on an interim basis will administer a new Adaptation Fund to be governed directly by the UNFCCC.[2] This fund will receive funding generated by CDM projects, plus direct contributions, although the scale of financial resources likely to be available is unlikely to be clear for some time.

Using GEF resources, UNDP has helped over a hundred countries prepare national climate change vulnerability assessments, national adaptation plans, and national communications to the UNFCCC. Based on this experience, UNDP expects to be in a position to help countries access resources for climate change adaptation through GEF and other sources. Furthermore, UNDP has initiated the development of strategies and approaches to tackling adaptation (Lim and Spanger-Siegfried, 2005), which has led to piloting of some field activities.

The recently launched UNDP-Spain MDG Achievement Fund is expected to provide direct support for climate change adaptation activities. Japan has also committed a large fund to UNDP for climate change adaptation work. UNDP has recently formed "climate change partnerships" with the World Bank, regional development banks, UNEP and other UN agencies, although it is still unclear how these arrangements will evolve. It is important to note, however, that the scale of financial and human resources dedicated to climate change adaptation within UNDP has so far been very modest in comparison with those devoted to mitigation.

A variety of studies indicate that the LDC and SIDS will be hardest hit by climate change. These are the countries most in need of adaptation support for awareness raising, capacity development and action on the ground. These sorts of climate change adaptation activities, with their focus on local benefits are a more natural fit with UNDP's core activities than climate change mitigation activities, where the benefits are largely global. The challenges cannot be overstated, however. The countries most in need of support for climate change adaptation also tend to be those with the most modest resources and capacities. UNDP country offices in these countries will also require significantly enhanced human and financial resources to be effective in this area.

While climate change is regarded within UNDP as a global environmental issue, adaptation to its impacts is primarily seen as a question of national and local level sustainable development and risk management. Climate change impacts will vary considerably from location to location. They are hard to predict and cover a very wide range of potential impacts from sea-level rise and more frequent and severe storms and floods, to changes in growing seasons, vegetation cover and water resources. National responses to climatic change will need to cover a huge range of issues. A common denominator, as usual, is that poor people living in marginal areas are the most vulnerable and have the least resources to cope and to recover from a short-term disaster or longer-term degradation. Enhanced capacities will play an important role in reducing people's vulnerability to climate change. Defining the capacities needed and UNDP's role in developing them in the context of adaptation to climate change poses new challenges.

So far UNDP has had a small team working on adaptation issues at headquarters. This team is helping raise awareness and train staff throughout the agency, and also working with some regional programs to incorporate adaptation into their planning and strategy development. Reviews of UNDP country programs are currently underway to assess their vulnerability to climate change as a prelude to "climate proofing" these programs. "Climate risk assessments" of new projects for example, are expected to become standard procedure in UNDP. This is a good start but the scale of the effort needs to increase dramatically.

UNDP's institutional arrangements for carrying out adaptation work need to adapt to the changing global context. Yet UNDP is uniquely positioned within the UN system to assume an important role in adaptation based on its broad range of responsibilities and competencies across a range of development sectors as well as its experience in supporting national development planning and strategy development. The UNDP's 2007 Human Development Report focuses on climate change (HDR 2007). This impressive document could help UNDP to bring together stakeholders and to promote mainstreaming of adaptation efforts, especially in poorer countries.

On the other hand a "business as usual" approach, treating adaptation as just one more new environment program, will not be effective. Resource mobilization, developing UNDP country office capacities and mainstreaming adaptation activities within the organization will all require major adjustments and realignment. Adaptation measures will certainly need to be integrated into national development plans and the programs of many sectors. This is unlikely to happen if adaptation continues to be perceived primarily as an environmental issue, which is still very much the case at the moment both within and outside UNDP. The need to mainstream adaptation activities into UNDP's work in crisis prevention and recovery is obvious and has begun in a few cases. UNDP will have little credibility however, unless it can demonstrate that its poverty reduction and democratic governance practice areas are also addressing adaptation issues. This would be a significant departure from past and current practice. If UNDP does not convincingly adopt adaptation to climate change as an agency-wide priority and start making some of the fundamental changes needed, then it is unlikely that the international community will recognize UNDP as a suitable agency for delivering the sort of large-scale funding for adaptation activities that may become available in coming years.

4. Energy

Financial Resources

UNDP's energy-related portfolio has increased significantly since the 1990s. Apart from quantity, there has also been a distinct qualitative change from conventional energy sources to a focus on more environmentally sustainable energy production and consumption. This shift has coincided with the global community's growing attention more generally to sustainable development and climate change. The increase in funding has been marked in all regions, but particularly so in the Asia-Pacific and Latin America-Caribbean regions (Figure 11.1).

A closer look at this positive trend (Figure 11.2) reveals an important feature of UNDP's support. Although UNDP's energy-related activities as a whole have increased substantially since the 1990s, most of this increase has been because of climate change mitigation projects funded through the GEF. In fact, the activities funded through UNDP's regular resources have actually declined during the past decade. The effects of this decline have been felt especially in LDC and Africa where energy is closely related to local benefits of poverty reduction and economic opportunities, but where the opportunities for achieving global environmental benefits through conventional greenhouse gas emission reductions activities have been minimal. One initiative that has addressed such local issues is the GEF Small Grants Programme, albeit on a small and local scale.

UNDP has established several Thematic Trust Funds in order to mobilize additional resources to address developing country demands. From their inception in 2001 until 2006 they attracted roughly US$27 million for energy related projects from a collection of bilateral donors

Figure 11.1
Regional Funding Growth for UNDP Energy Projects: 1986-2005

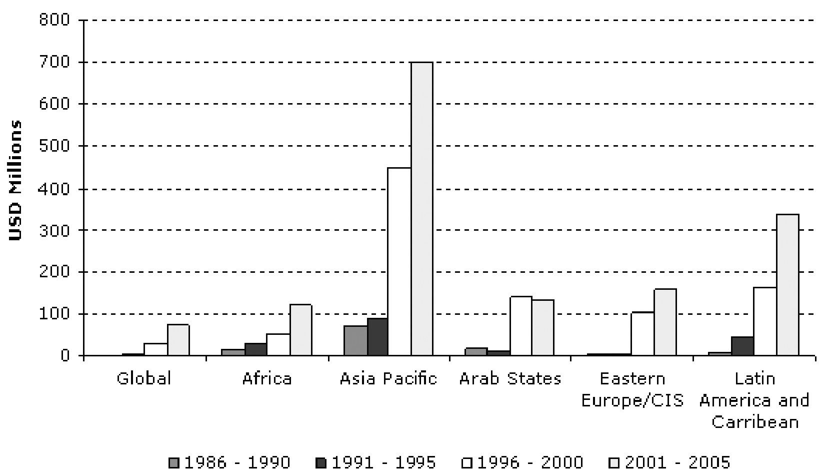
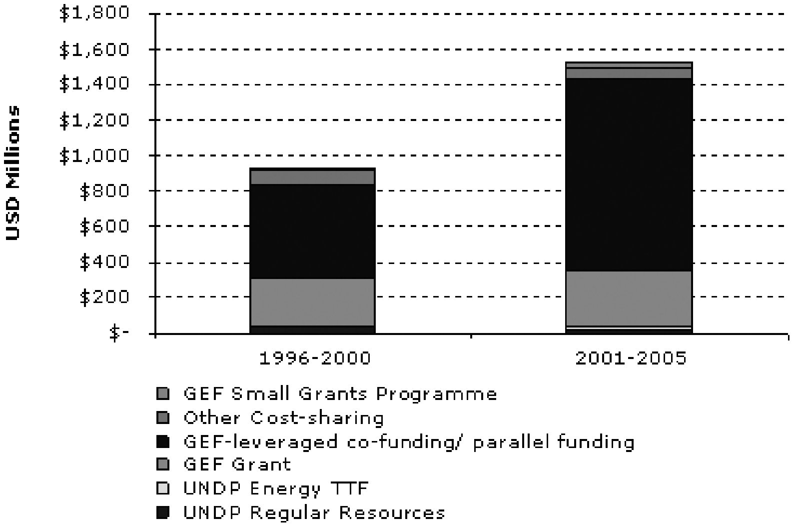


Figure 11.2
UNDP Energy Portfolio 1996-2005



(UNDP, 2007b). These funds pale in comparison to those mobilized from the GEF for various climate change projects—mostly mitigation activities—amounting to over US$300 million since 2002.

Energy Results

The evaluation found examples of significant and impressive country level work introducing clean renewable energy and energy efficiency, largely through GEF funding. Most of this work was in the larger middle-income countries. In China, a project entitled "Energy Conservation and Greenhouse Gas Emissions Reduction in Township and Village Enterprises" has achieved considerable success in promoting new technologies. It has led to a new project focusing on the housing sector (including brick industry) in small towns. The "Capacity Development for China Green Lights Programme" supported the country in setting the first efficiency standards for lighting products. Since then, the government has strategically expanded the program with significant success.

While over half of UNDP's energy-related projects include objectives related to expanding energy access to the poor, the evaluation did not find widespread evidence of these objectives being realized in the countries visited. As evident from Figure 11.1 above, the level of investment in

Africa—where lack of access to energy services among the poor is a key development challenge—is very low. There are a few apparently successful, albeit small scale, projects, such as the "Multifunctional Platforms" in Mali and Burkina Faso, which address local communities´ demand for affordable energy, using a diesel motor to produce a variety of energy services at the village level.

Regional energy programs have been designed by UNDP to facilitate the sharing of knowledge between national programs. A recent evaluation of the UNDP's Africa regional program (UNDP, 2007c) reported that the program had supported the development of an ECOWAS (Economic Community of West Africa States) Regional White Paper on increasing access to energy for rural and periurban populations. This was ratified by the member states and is now being used to attract financing. The member states also approved guidelines on the development of energy access strategies and costing methodologies that are now being piloted. Activities also included support for the Global Village Energy Partnership to help countries develop their national plans to expand access to energy services for the poor.

A UNDP renewable energy program concerned with promoting an understanding of the relationship between poverty, energy and gender was started in mid-2005 by their Regional Centre in Bangkok. This project aims to enable countries to formulate their responses to energy security concerns. An oil pricing study publicly launched in October 2007 (UNDP, 2007d) has been one of the main outputs of the project. This study proposes an innovative composite oil price vulnerability index. It offers a range of policy prescriptions and options to countries depending on their level of vulnerability to changing oil prices. This study attracted considerable attention from the press and the public as well as the governments of the region. A broad group of stakeholders in the SIDS of the Pacific Ocean region also recognize and appreciate UNDP's role in supporting their energy policies and programs.

Energy for Poverty Reduction or Mitigation of Climate Change?

UNDP recognizes that enhancing access to energy services remains a key element of poverty alleviation in developing countries. The organization has focused its non-climate related energy work on mainstreaming energy considerations into national development strategies and developing local capacities to expand energy service delivery. UNDP's new strategic plan for the period 2008-2011 describes "expanding access to environmental and energy services for the poor: developing national capacity for service delivery" as one of the agency's key results areas.

Yet in practice most of UNDP's work in energy consists of climate change mitigation projects funded by GEF. These projects are rarely consistent with UNDP's stated focus on the needs and priorities of LDCs and SIDS, where climate change mitigation is seldom a national priority and where the immediate potential for GHG reductions is minimal. Potential contradictions between UNDP and GEF priorities can be illustrated by the "Barrier Removal to Renewable Energy Project" in Malawi. This is a major component of UNDP's support to Malawi. It has aimed to mitigate GHG emissions by encouraging increased use of photovoltaic panels by households, institutions, commercial entities and agro-industries. While the project has moved more slowly than anticipated, it appears to have generated momentum in encouraging banks to offer loans to off-grid households wishing to invest in solar panels. It has boosted the emergence of a local industry devoted to the installation and maintenance of these panels. As a result, more households in poor communities are receiving enough power for lighting. There appears to have been a significant, if unmeasured, improvement in well-being and a potentially significant contribution to poverty alleviation that is environmentally benign. Yet the GEF mid-term evaluation of this project rated its performance as unsatisfactory, largely because the carbon emission reduction impacts were "miniscule" (UNDP, 2007e; UNDP, 2006).

This example from Malawi illustrates some of the difficulties in relying on GEF financing to expand the provision of affordable energy services to the poor. It is important to note as well that, had comparable funding been available for a project aimed principally at providing affordable energy services to the poor, consistent with UNDP's poverty reduction mission, then the activities undertaken would have been quite different from those in the GEF financed project.

Alleviating poverty through enhanced energy access is a fundamentally different issue from climate change mitigation and the two issues can seldom be addressed effectively through the same means and mechanisms. UNDP's ongoing dependence on GEF funding—or even the emerging MDG Carbon Facility—will not be conducive to an energy program focused principally on poverty and sustainable development issues. Climate change mitigation is most effectively advanced by assisting middle income countries to reduce GHG emissions from industry, traffic and the urban sector, while the greatest need for energy services for poverty reduction lies in LDC, especially in Africa. This discrepancy is clearly demonstrated by comparing the priority countries within the GEF resource allocation framework with those countries with the lowest access to electricity (Table 11.3).

In the future UNDP will need to secure substantially more funding to support enhanced penetration of energy services in those poor countries that are seldom eligible for significant funding from GEF. These countries are at the heart of UNDP's poverty reduction and human development mandate. There already exist promising plans for new programs to support enhanced energy services for the poor, notably in Africa. It is essential to ensure these programs secure adequate funding. It will also be important to ensure that similar programs be developed in the LDC of other regions and that they be well integrated with the overall country programs in the countries where they operate.

5. Conclusions

The relevance of environmental and energy goods and services to the principal UNDP mission of poverty reduction is very clear. The negative consequences of the deteriorating international environmental situation for the world's poorest countries and communities have been elaborated unequivocally by a variety of credible international bodies and studies, notably the International Panel on Climate Change and the Millennium Ecosystem Assessment.

Table 11.3
Top 10 Countries with (a) lowest Electrification Rates, and (b) highest GEF Resource Allocations for Climate Change

(a) Electrification Rate (% of households with domestic electricity supply) 2000-05*	(b) GEF-4 Resource Allocations for Climate Change (US$ million) +
1. Congo DRC (6 %)	1. China (US$150)
1. Mozambique (6 %)	2. India (US$74.9)
3. Burkina Faso (7 %)	3. Russian Federation (US$72.5)
3. Malawi (7 %)	4. Brazil (US$38.1)
5. Uganda (9 %)	4. Poland (US$38.1)
6. Lesotho (11 %)	6. Mexico (US$28.3)
6. Myanmar (11 %)	7. South Africa (US$23.9)
6. Tanzania (11 %)	8. Ukraine (US$18.9)
9. Kenya (14 %)	9. Turkey (US$17.5)
10. Ethiopia (15 %)	10. Iran, Islamic Rep. (US$16.5)

* HDR 2007

+ GEF Resource Allocation Framework

Climate change issues have only recently begun to gain greater recognition in the mainstream of UNDP as the likelihood of local and regional climates actually changing begins to gain broader currency. The prospect of helping lower income countries with their adaptation to such climate change, as well as the promise of substantial development financing generated through global carbon emissions trading, have also helped enhance UNDP's interest in climate change issues.

Direct impacts of UNDP's work in climate change mitigation, measured in reduced GHG emissions, have been impressive and significant from the perspective of global environmental benefits but have been of limited interest to most of the countries concerned. Only six mitigation projects, three of these in China, accounted for over 98 percent of these emissions reductions.

Similarly, carbon trading has thus far mostly benefited larger middle-income countries. Very few least-developed countries or small-island developing states are ready to participate in carbon markets though their potential for achieving carbon sequestration may be significant. If carbon credits are allowed in the future for sustainable land management or avoided deforestation, for example, then these countries stand to benefit from the carbon market substantially more than they have to date. It is still too early to assess how UNDP's entry into the developing market for carbon credits will turn out.

Modest levels of international funding have been provided in recent years for climate change adaptation activities and UNDP has a small team working on adaptation issues at headquarters. This is a good start but efforts need to be expanded dramatically. Adaptation to climate change seems likely to emerge as one of the most prominent issues in international development and thus attract substantial resources. Adaptation measures are likely to be needed across a broad spectrum of sectors, especially in the highly vulnerable countries, least developed countries, and small-island developing states. So far, UNDP has treated adaptation to climate change as an environmental issue, even though it is very closely linked with poverty, economic development, governance, and disaster management. It is important to treat adaptation as a multi-sectoral development issue, not simply an environmental one. This shift will require genuinely mainstreaming adaptation within the organization through effective integration with its poverty reduction, crisis management, and governance.

UNDP's energy-related activities as a whole have increased substantially since the 1990s and UNDP's now describes expanding access to environmental and energy services for the poor as one of its key results areas. Yet in practice UNDP's work in energy still consists mostly of climate change mitigation projects funded by GEF. These projects are seldom well aligned with the needs and priorities of least developed countries and small-island developing states, where climate change mitigation is rarely if ever a national priority and where the immediate potential for GHG reductions is minimal. Alleviating poverty through enhanced energy access is a fundamentally different issue from climate change mitigation and the two issues can seldom be addressed effectively through the same means and mechanisms.

UNDP responsiveness to national priorities in environment and energy has been varied and largely dependent upon the type of countries involved. UNDP should strengthen its policy dialogue with the countries where it operates, in particular in least developed countries and small-island developing states, in order to better identify national sustainable development priorities. It should also advocate and seek opportunities to incorporate environment and energy concerns into national development plans and programs and develop country-level capacities to work on these.

Advocating for integration of environmental thinking and considerations across the entire range of development sectors within governments will remain a "hard sell" for UNDP country offices until such mainstreaming becomes more visible within UNDP.

Notes

1. See, e.g., UNDP Environment Finance Group Regional Business Plan for 2007: Asia and the Pacific Region.
2. UNFCCC will approve Adaptation Fund projects on a one country, one vote basis, in contrast to GEF Council project approval voting on the size of donor contributions.

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12

Macroeconomic and Sectoral Impacts of Climate Change Mitigation in Thailand[1]

Govinda R. Timilsina

1. Introduction

Climate change is considered as the greatest threat to our planet. International efforts from both developing countries (DCs) and industrialized countries (ICs) are expected to mitigate climate change although United Nations Framework Convention on Climate Change (UNFCCC) has urged ICs to take a lead based on the common but differentiated responsibility principle (UNFCCC, 1992). Both ICs and DCs are undertaking various measures to reduce their greenhouse (GHG) emissions although ICs have mandatory obligation to do so, whereas DCs do not. The main reason for DCs not accepting any binding commitments to reduce their GHG emissions is that they fear of slowing their expected economic growth. However, the magnitudes of economic impacts of climate change mitigation have not been widely assessed in DCs. It is therefore of interest to DC policy makers and other stakeholders to understand the economy wide impacts of curtailing their GHG emissions.

A large number of studies have been carried out to assess the economic and environmental consequences of curtailing their CO_2 emissions (e.g., Jorgenson and Wilcoxen, 1993a,b; Goulder, 1995; Parry et al., 1999; Proost and van Rogemorter, 1992; Capros et al., 1997; Bohringer and Rutherford, 1997 and Aasness et al., 1996). These studies consider a carbon tax as a policy instrument to reduce CO_2 emissions and applied computable general equilibrium (CGE) model to assess the impacts of CO_2 mitigation. These studies are, however, focused on contexts in developed economies. A number of similar studies have also carried out for

DCs. These studies include Liang et al. (2007), Garbaccio et al. (1999) and Zhang (1997) for China; Van Heerden et al. (2006) for South Africa; Nwaobi (2004) for Nigeria; Dessus and O'Connor (2003) for Chile, Blitzer and Eckaus (1994) for Egypt. A few studies also exist for Thailand (e.g., Timilsina and Shrestha, 2002; Li, 2006). Li (2006) concentrates on ancillary benefits of a carbon tax; it does not present impacts of carbon tax on various macroeconomic and sectoral economic indicators, such as economic welfare, trade, sectoral value added. Timilsina and Shrestha (2002) present these impacts but the model considers only two schemes for recycling carbon tax revenue to the economy. The current study is significantly different from the existing ones in both model specifications and design of the policy instrument simulated. First, it employs an extensive nested structure for modeling the producers and consumers behaviors. Secondly, it disaggregates the electricity sector into seven sub-sectors to allow substitution between the various technologies used for electricity generation. Third, the model allows a direct substitution between capital and fuel inputs for electricity generation. Fourth, this study focuses on evaluating economic and environmental impacts at the both national and sectoral levels, whereas existing studies are focused more on impacts at the national level.

We consider a carbon tax to reduce CO_2 emissions to a specified level (9 to 10 percent from the base case). The carbon tax is designed with four alternative schemes to recycle the tax revenue to the economy. These schemes are: (i) recycling the revenue for public consumption; (ii) lump-sum transfer of the revenue to households and (iii) using it to finance cuts in labor tax, and (iv) using it to finance cuts in existing indirect taxes on non-energy goods. The chapter is organized as follows: Section 2 briefly highlights the model and data. This is followed by an analysis of national and sectoral level economic impacts in Sections 3 and 4, respectively. Environmental impacts are presented in Section 5. Finally, concluding remarks are presented.

2. Model and Data

We used a static, single period, multi-sectoral CGE model of the Thai economy to analyze macroeconomic and sectoral impacts of climate change mitigation. Please see Timilsina and Shrestha (2007) for the detailed description of the model. The economy is disaggregated into 21 production sectors of which 6 are energy sectors (see Table 12.2). Production behaviors are represented by nested constant elasticity of substitution (CES) production functions. This is along the lines of some existing studies (e.g., Bohringer and Rutherford, 1997 and Capros et al., 1997). The model, however, differs from most of the existing ones in representing the electricity sector. First, the electricity sector is divided into seven sub-sectors based on technologies used for electricity generation. This allows for substitutions between various technologies used for electricity generation. Secondly, the nested CES structure used for the electricity industry differs from those used in the rest of the industries to allow direct substitution between capital and fuel in electricity generation.

The model considers a representative household that follows a five-step hierarchical optimization process to maximize its utility. As in the case of the production sector, CES functional forms are mostly used. Similar to most existing general equilibrium models (e.g., Bohringer and Rutherford, 1997; Shoven and Whalley, 1992 and Ballard et al., 1985), Hicksian equivalent variation defined as "the additional income necessary to obtain a new utility level at old price" is used to measure welfare impact of the policy considered.

While modeling the government sector, it is assumed that government consumption does not provide any utility to private consumers. This approach is commonly employed in existing general equilibrium studies (e.g., Ballard et al., 1985; Capros et al., 1997; Zhang, 1997).[2] Government collects tax, consumes public goods, saves part of its income and receives transfers from the rest of the world.[3] Government income is allocated to public consumption and government savings. Total government consumption is maintained at the same fraction of GDP as that in the base case (i.e., before the introduction of the carbon tax and the sale of mitigated emissions as CERs).[4] Total government consumption is then distributed to various goods and services at the same proportion as in the base case.

The modeling of the foreign sector follows Armington (1969) and assumes that domestically produced and imported goods are considered to be imperfect substitutes. The total domestic demand for a good or service is assumed to be a CES composite of domestically produced and imported components. Following Dervis et al. (1982), we assume export demand to be downward sloping.[5]

The model follows the Walrasian approach to clear goods and factor markets (Shoven and Whalley, 1992). The model allows capital mobility across the production sectors, keeping the total capital stock in the economy fixed. Similar to a number of existing general equilibrium models, such as Dervis et al. (1982) and Benjamin (1994), nominal exchange rate is kept fixed; domestic prices fluctuate against the fixed foreign price level, which serves as the price numéraire in the model.

Emissions of CO_2, SO_2 and NO_x are calculated in each sector based on fuel consumption in the sector and corresponding emission coefficients. Although a carbon tax refers to a tax imposed on a fuel in proportion to its carbon content, fuel wood and crude oil are exempted from the carbon tax. This is because fuel wood is carbon neutral in the long run (i.e., assumption of sustainable use of fuelwood) and crude oil is not used for direct consumption, rather it is transformed into petroleum products. Thus, the carbon tax is imposed only on coal, petroleum products and natural gas.

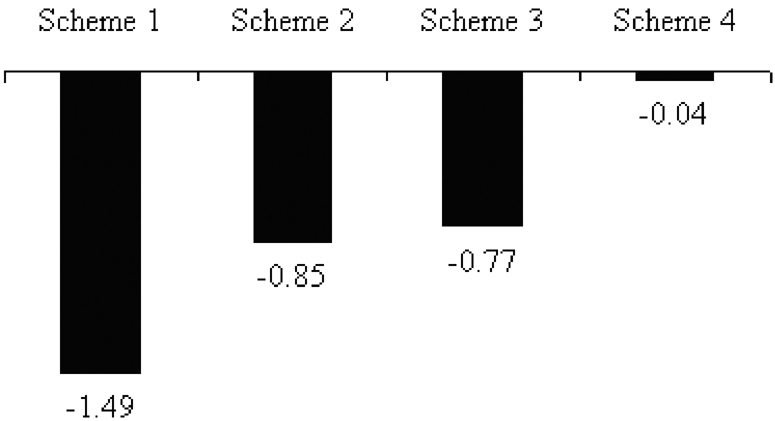
The data needed include a social accounting matrix (SAM) of Thailand and the values of the parameters. While the SAM is taken from Timilsina and Shrestha (2002), the values of the parameters are taken from Timilsina and Shrestha (2006).

3. Macroeconomic Impacts

Impacts on Economic Welfare

The welfare impacts of climate change mitigation through US$40/tC under alternative schemes of tax revenue recycling are presented in Figure 12.1. The economic costs of the carbon tax (i.e., welfare loss) are found significantly different across the alternative revenue recycling schemes. If the carbon tax revenue is used for government consumption (i.e., Scheme 1), the welfare loss would be 1.49 percent, on the other hand, it would be 0.04 percent if tax revenue is used to finance cuts in existing indirect tax rates of non-energy goods (Scheme 4). The welfare loss under the revenue recycling Scheme 2 (i.e., lump-sum transfer to household) and the Scheme 3 (i.e., revenue used to finance cuts in existing labor tax rate) would be lower than those in scheme 4 and higher than those in Scheme 1. The higher welfare cost when tax revenue is used for public consumption than when the revenue is either recycled to households through a lump-sum transfer or used to finance cuts in factor or indirect taxes is similar to the finding of Böhringer and Rutherford (1997).[6] Similarly, the smaller welfare cost when revenue is recycled to finance cuts in existing labor tax rates than when it is recycled to household through a lump-sum transfer is consistent with the findings of existing studies, such as Goulder et al. (1999), Parry et al. (1999), Bovenberg and Goulder (1995, 1996). A new finding of the study is that the cost of carbon tax with the tax revenue recycled to cut

Figure 12.1
Welfare Effects of Carbon Tax (% change from the base case)



indirect tax rates of non-energy goods would be the smallest among the revenue recycling schemes considered here.

This result would have an important policy implication while designing an environmental tax instrument for Thailand. The findings listed above clearly support the weak double dividend hypothesis, but not the strong double dividend hypothesis. However, note that when the tax revenue is recycled to finance cuts in indirect tax rates of non-energy goods, the welfare loss is very small (0.04 percent). In other words, it is very close to the strong double dividend hypothesis.

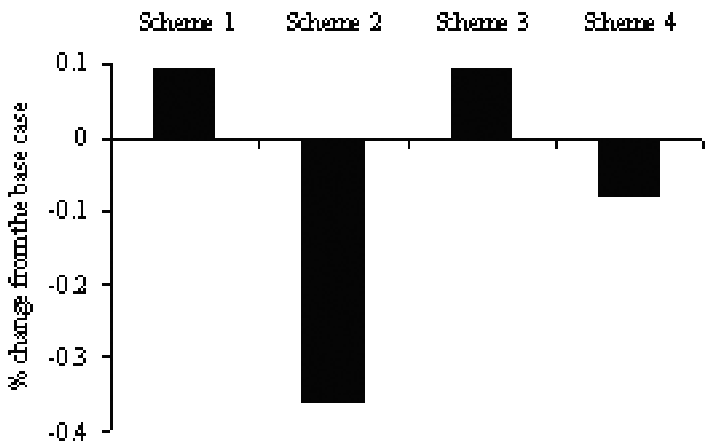
Impacts on Gross Domestic Product and Gross Output

The percentage changes in GDP and gross output with the carbon tax under alternative revenue recycling scheme are presented in Figures 12.2(a) and 12.5(b), respectively. As can be seen from the figure, the carbon tax would cause GDP to increase when tax revenue is used either for public consumption or for financing cuts in the existing labor tax rate. On the other hand, the carbon tax would cause GDP to fall when the tax revenue is either recycled to households through a lump-sum transfer or used to finance cuts in existing indirect taxes on non-energy goods.

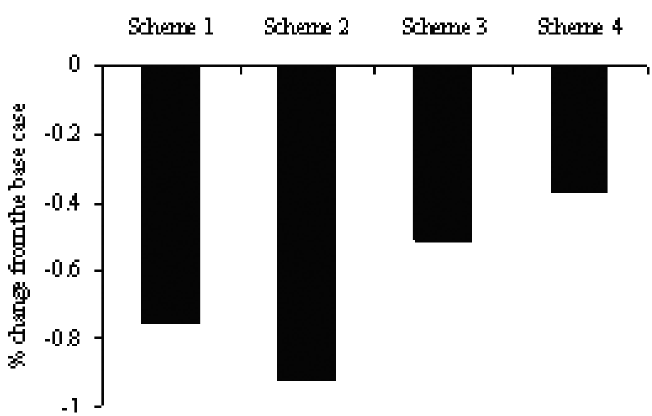
As the tax revenue is used for public (or government) consumption under the revenue recycling Scheme 1, public consumption would be higher than that in the base case (i.e., without the carbon tax). The increased public consumption would cause GDP to increase. Under the second scheme of revenue recycling, a decrease in gross fixed capital formation is mainly responsible for the decrease in GDP. Under revenue recycling Schemes 3 and 4, the changes in GDP are mainly influenced by changes in net export. Net export, which is negative in the base case, increases (i.e., become less negative with increase in export and decrease in import) under the revenue recycling Scheme 3 thereby increasing GDP, whereas net exports decreases under the revenue recycling Scheme 4 causing GDP to decrease.

As can be seen from the Figure 12.2(b), a carbon tax with the revenue recycling to households through lump-sum transfer would reduce gross

Figure 12.2
Impacts of Carbon Tax on GDP and Gross Output



(a) GDP



(b) Gross Output

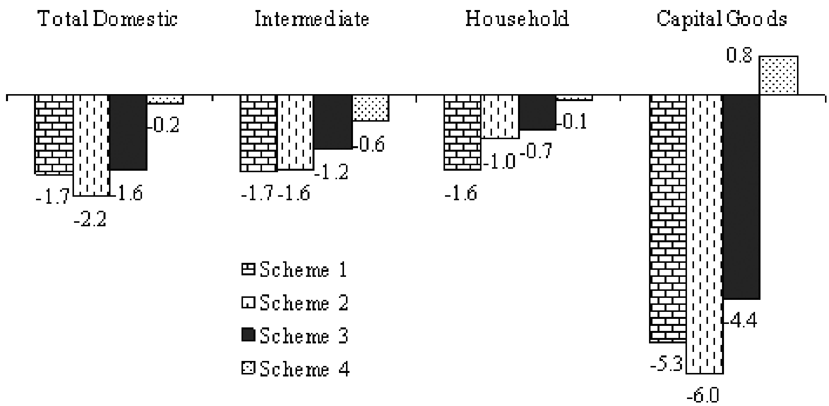
output to the highest level, followed by the carbon tax with revenue recycling for public consumption. On the other hand, the carbon tax with the revenue recycling to finance cuts in existing indirect taxes on material would cause the lowest reduction in gross output. If we compare impact of the carbon tax on gross output between the revenue recycling Schemes 1 and 2, where tax revenues are used in a lump-sum manner, we find that gross output under the revenue recycling Scheme 1 is higher than that under the Scheme 2. Under the revenue recycling Scheme 1, all transferred revenue is used for public consumption, whereas under the Scheme 2, only part of the revenue is used for household consumption, and part is saved by households. Because of this, total domestic demand for goods and services would be higher under the tax revenue-recycling Scheme 1 than that under Scheme 2. Since, the total domestic demand would be met through domestic production and imports, both gross outputs and imports would be higher under the revenue-recycling Scheme 1 than they would be under the Scheme 2. Similar explanations would hold for the higher gross output under the revenue recycling Schemes 4 than that under the Scheme 3.

Impacts on Demand for Goods and Services

Impacts of the carbon tax on demands for goods and services are presented in Figure 12.3. The carbon tax would cause reductions in demand for goods and services in each scheme of revenue recycling considered in the study. It is interesting to note here that with the carbon tax, the total domestic demand for goods and services are significantly higher when revenue is recycled to finance cuts in existing indirect taxes on materials than those with other revenue recycling schemes. This is because, recycling of tax revenue to cut indirect tax rates on materials, makes materials relatively cheaper than energy goods. It would encourage substitution of material for energy goods. Carbon tax with this revenue recycling scheme would even result in a higher demand for capital goods than that in the base case.

It is also interesting to note that household consumption of goods and services are higher when the tax revenue is used to finance cuts in existing labor or indirect taxes than those when tax revenue is recycled to households through a lump-sum transfer. The reason is: the higher disposable income in the former cases than that in the latter as labor and capital prices would be higher in the former cases than that in the latter.

Figure 12.3
Impacts of Carbon Tax on Demand for Goods and Services
(% change from the base case)

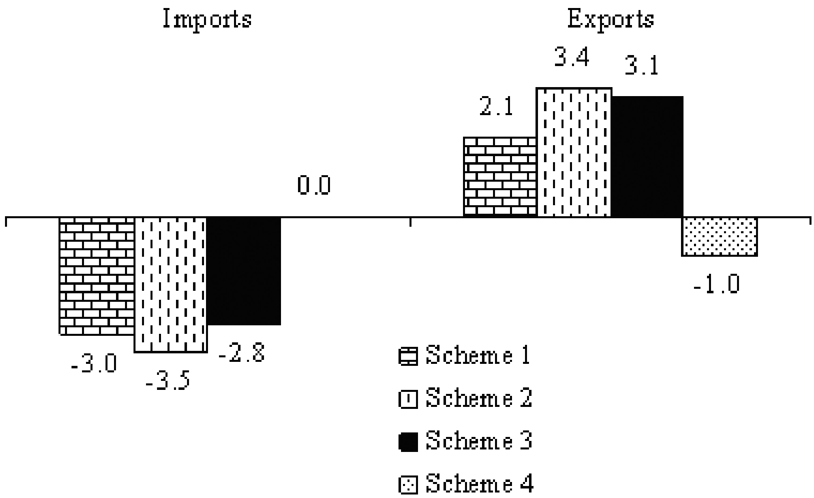


Impacts on Foreign Trades

Impacts of the carbon tax on imports, exports and trade balance are presented in Figure 12.4. Total imports of goods are found to decrease with the carbon tax under the revenue recycling Schemes 1, 2 and 3, whereas it is not found unaffected under the Scheme 4. Import is influenced mainly by total domestic demand for goods and services. As the total domestic demand is significantly higher under the revenue recycling Scheme 4 than those under other schemes, import is also higher under this scheme than those in others. Like total domestic demand, the carbon tax with revenue recycling Scheme 2 would cause the highest reductions of imports, followed by the carbon tax with revenue recycling Scheme 1.

One interesting finding of the study, which is different from most existing studies (e.g., Aasness et al., 1996; Gottinger, 1998 and Zhang, 1998), is that the carbon tax would cause total exports to increase in Thailand under all revenue recycling schemes except Scheme 4. In our model, the export demand for a good depends on the ratio of its export price (i.e., prices of sectoral outputs) to its world price and export price elasticity of the good. As export prices of goods, which have relatively higher shares in total volume of exports (e.g., foods, textile, commercial services, fabricated metals and electrical machinery), decreases due to the carbon tax, and their world prices remains unchanged, their export demand increase. The reasons for the decrease in export prices of major export goods with the carbon tax under the revenue recycling Schemes

Figure 12.4
Impacts of Carbon Tax on Foreign Trade (% change from the base case)



1, 2 and 3 are as follows. The carbon tax would cause capital and labor prices to fall. This results in decrease in production costs and output prices of less fossil fuel intensive industries (e.g., food, textile). This would not the case when tax revenue is recycled to finance cuts in existing indirect taxes on materials. In this case, the recycling of the tax revenue to finance cuts in existing indirect taxes on materials does not allow the capital and labor prices to fall to a level that would cause output prices to decrease. Hence, the total export is found to decrease with the carbon tax under the revenue recycling Scheme 4. Increase in total exports and decrease in total imports would cause trade balance to decrease under all revenue recycling schemes except Scheme 4. Under the Scheme 4, the total import does not change and the total exports increases, trade balance also decreases.

Revenue Implications of the Carbon Tax

A US$40/tC carbon tax generates about US$420 million. This would account for 8.2 percent to 8.7 percent of the total government revenue depending upon the tax revenue recycling schemes (please see Table 12.1).

The carbon tax revenues have important implications when they are recycled to finance cuts in the existing tax rates thereby keeping the total government revenue at the same level as before the introduction of the

Table 12.1
Revenues Generated from a US$40/tC Carbon Tax

New and Existing Taxes	Base Case	Tax Simulation Cases with Alternative Schemes of Revenue Recycling			
		Scheme 1	Scheme 2	Scheme 3	Scheme 4
New tax (i.e., carbon tax)	-	8.23	8.24	8.63	8.70
Existing indirect tax	72.40	67.11	67.25	70.53	63.75
Existing direct tax	26.45	24.66	24.51	19.67	26.40

carbon tax. When recycled to finance cuts in existing labor tax rates to keep the total government revenue constant, the revenue generated from a US$40/tC carbon tax would replace 6.8 percent of the revenues generated from the existing direct taxes (i.e., labor and capital taxes). Similarly if recycled to finance cuts in existing indirect tax rates of non-energy goods, the revenue generated from a US$40/tC would replace 8.6 percent of the revenues generated from the existing indirect taxes.

4. Sectoral Impacts

The study finds that the qualitative results of a carbon tax under each alternative revenue recycling scheme do not change with changes in tax levels. If the tax level is increased, the magnitude of impacts on welfare, GDP output, value added, demand for goods and services, import and export would increase and vise versa. Hence, for the sectoral level analysis, we present here the results corresponding to the US$40/tC carbon tax.

Impacts on Sectoral Outputs and Value Added

Changes in sectoral outputs and value added due to the carbon tax under alternative revenue recycling schemes are presented in Figures 12.5(a) and 12.5(b), respectively. As can be seen from Figure 12.5(a), out of the 21 sectors considered in the study, ten sectors (i.e., coal, crude oil, minerals, chemicals, petroleum, gas, non metals, metals, electricity and transport) exhibited reductions in sectoral outputs due to the carbon tax under each scheme of revenue recycling. The reason behind the decrease in sectoral outputs in these sectors is clear as these sectors are either fossil fuel sectors (e.g., coal, petroleum and gas) or fossil fuel intensive sectors (e.g., electricity, non-metals, transport). Of these, the coal industry is found to have the highest impact, whereas the chemicals industry has the lowest.

Sectoral outputs of eight sectors (i.e., agriculture, fuelwood, food, textile, electrical machinery, other manufacturing, commercial and services) are found to increase due to the carbon tax under each revenue recycling scheme. The reason is that these industries are less fossil fuel intensive as compared to others. For example, as the fuel wood sector is the least fossil fuel intensive sector among the 21 sectors considered in the study, it exhibits the highest percentage increase in sectoral output due to the carbon tax under each revenue recycling scheme.

In three sectors (i.e., construction, pulp and paper and fabricated metal), sectoral outputs are found to decrease due to the carbon tax under the revenue recycling Schemes 1, 2 and 3, but increase under the revenue recycling Scheme 4. These three sectors are the ones, which have relatively higher demand for capital goods. For example, in the construction sector, capital goods account for 97 percent of the total domestic demand for construction materials. Similarly in the fabricated metal sector, capital goods account for 40 percent of the total domestic demand for fabricated metals. The net capital and labor prices are higher when the tax revenue is recycled to finance cuts in indirect taxes on materials, than when they were in other revenue recycling schemes. Higher the capital price would cause higher demand for investment goods. Since, construction and fabricated metal sectors produce mainly capital goods, their output would increase if there is an increased demand for capital goods.

Impacts of the carbon tax on sectoral value added are presented in Figure 12.5(b). As can be seen from the figure, the impacts of carbon tax on sectoral value added are similar to those on sectoral outputs. Sectoral value added is found to increase in 8 sectors (i.e., agriculture, fuelwood, food, textile, electrical machinery, other manufacturing, commercial and service) due to the carbon tax under each scheme of carbon tax revenue recycling scheme. The reason is that these sectors exhibit an increase in sectoral outputs. Higher the sectoral output would cause higher demand of factors, thereby increasing sectoral value added. The carbon tax would cause reductions in sectoral value added in 7 sectors (coal, crude oil, minerals, petroleum, gas, non-metals and transport).

As in the case of gross output, fossil fuel industries (i.e., coal, petroleum and gas) exhibit higher reductions in their value added as compared to all other sectors. As in the case of sectoral outputs, value added of the sectors that mainly produce capital goods (e.g., construction, metal, fabricated metals) are found to be decreasing due to the carbon tax under the revenue recycling Scheme 1,2 and 3; and increased under the Scheme 4. In the case of the electricity sector, the sectoral output is assumed to be a function of the capital-fuel composite and the labor-material-electricity composite, and value added does not enter into the model. Hence, Figure 12.5(b) does not show changes in value added in the electricity sector.

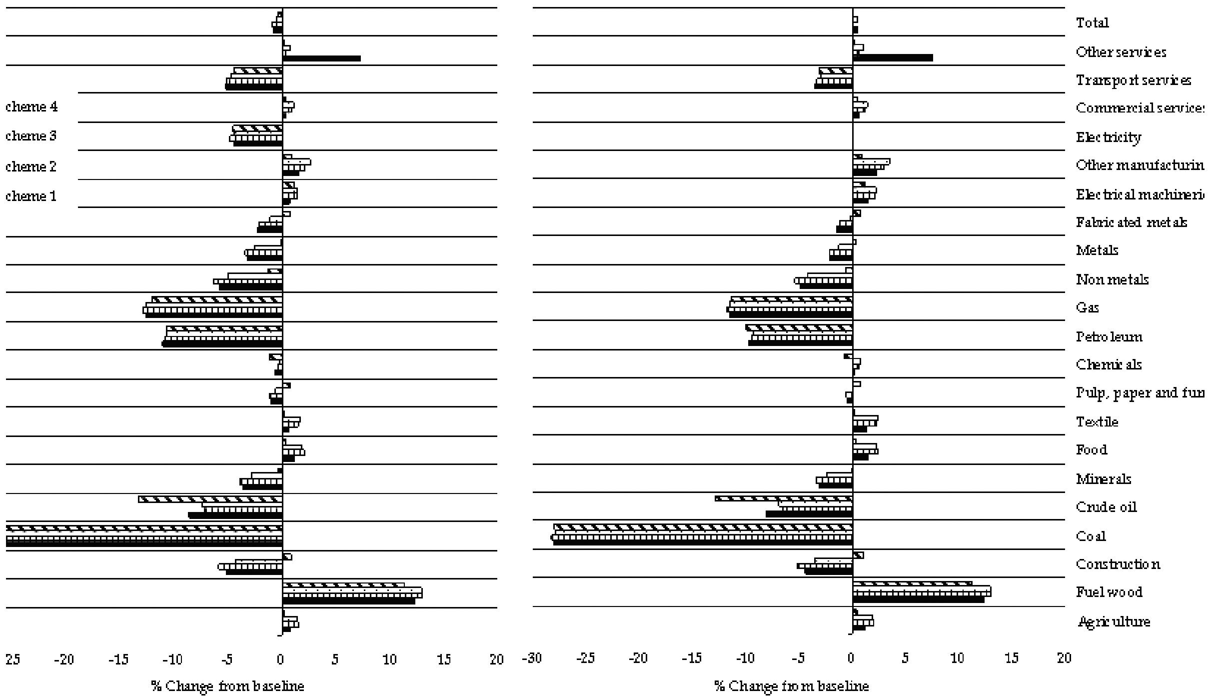
Impacts on Demand for Good and Services

The impacts of the carbon tax on demand for goods and services are presented in Table 12.2. As can be seen from the table, total domestic demand for coal, crude oil, minerals, chemicals, petroleum, gas, non-metals, electricity and transport services are found to decrease under each scheme of revenue recycling. On the other hand, total domestic demand for agricultural products, fuel wood and services would increase under each scheme of revenue recycling. Total domestic demand for goods which are mainly used for capital formation such as construction, pulp, paper and furniture, metals, fabricated metals and electrical machinery are found to increase under the revenue recycling Scheme 4, whereas they are found to decrease under the other revenue recycling schemes. Total domestic demand of goods and services such as food, textile and commercial services, which are relatively less energy intensive, are also found to decrease due to the carbon tax unless the tax revenue is recycled to households or used for financing cuts in existing factor or indirect taxes.

The percentage changes in total domestic demand depend on percentage changes in intermediate-, household- and capital good- demand, and their shares in total domestic demand. Since the share of the intermediate demand in the total domestic demand is significantly higher than that of the final demand, the changes in total domestic demand for goods and services are found to follow the corresponding changes in the intermediate demand. Intermediate demand for of all goods and services except agricultural products, fuel wood, food, textile, other manufactured goods, commercial and other services are found to decrease under each scheme of revenue recycling. As expected, the intermediate demand for coal was affected the most due to the carbon tax, followed by the intermediate demand for gas, crude oil, petroleum, non-metals and transport services.

The study shows that final demand for all goods and services, except for other services, would decrease due to the carbon tax under the revenue recycling Schemes 1, 2 and 3. Final demand for capital goods such as construction goods, metal, fabricated metals and electrical machinery would increase due to the carbon tax under the revenue recycling Scheme 4 as their investment demand increases under this scheme. The same would be the case for foods, textile, pulp, paper and furniture, other manufacturing

Figure 12.5
Impacts of Carbon Tax on Sectoral Output and Sectoral Value Added



(a) Sectoral Output

(b) Sectoral Value Added

goods and commercial services as household consumption of these goods and services would increase under the revenue recycling Scheme 4.

Impacts on Imports and Exports

Impacts of the carbon tax on foreign trade are also presented in Figures 12.6(a) and 12.6(b). Since overhauling (i.e., direct export of imported goods) is not allowed in the model, import demand for goods and services are mainly influenced by the corresponding total domestic demand. The changes in imports of all goods and services except food, textile, electricity and other services due to the carbon tax are in the same directions as those of the corresponding total domestic demand. Coal import is found to fall 72 percent below of its pre-carbon tax level. Import of electricity is found to be increased as domestic demand of electricity is predominantly supplied by domestic production, and the carbon tax would cause domestic price of electricity 14 percent-17 percent higher than its world price.

Exports of fossil fuels (e.g., petroleum) and fossil fuel intensive goods and services (electricity, transport, non-metals and metals) would decrease due to the carbon tax under each scheme of revenue recycling. On the other hand, exports of fuel wood, food, fabricated metals, electrical machinery, other manufacturing goods and other services would increase due to the carbon tax under each scheme of revenue recycling. Exports of agricultural products, minerals, textile, pulp and paper, and commercial services are found to increase due to the carbon tax under the revenue recycling Schemes 1, 2 and 3, but decreased under the revenue recycling Scheme 4.

As discussed earlier, export demand for goods and services is mainly influenced by export prices (or output prices as goods are exported at producers' prices). Increasing output price would lead to decrease in exports and vice versa. Changes in output prices differ across revenue recycling schemes and thus changes in export demand would be different across the alternative revenue recycling schemes.

5. National and Sectoral Impacts on CO_2, SO_2 and NO_x Emissions

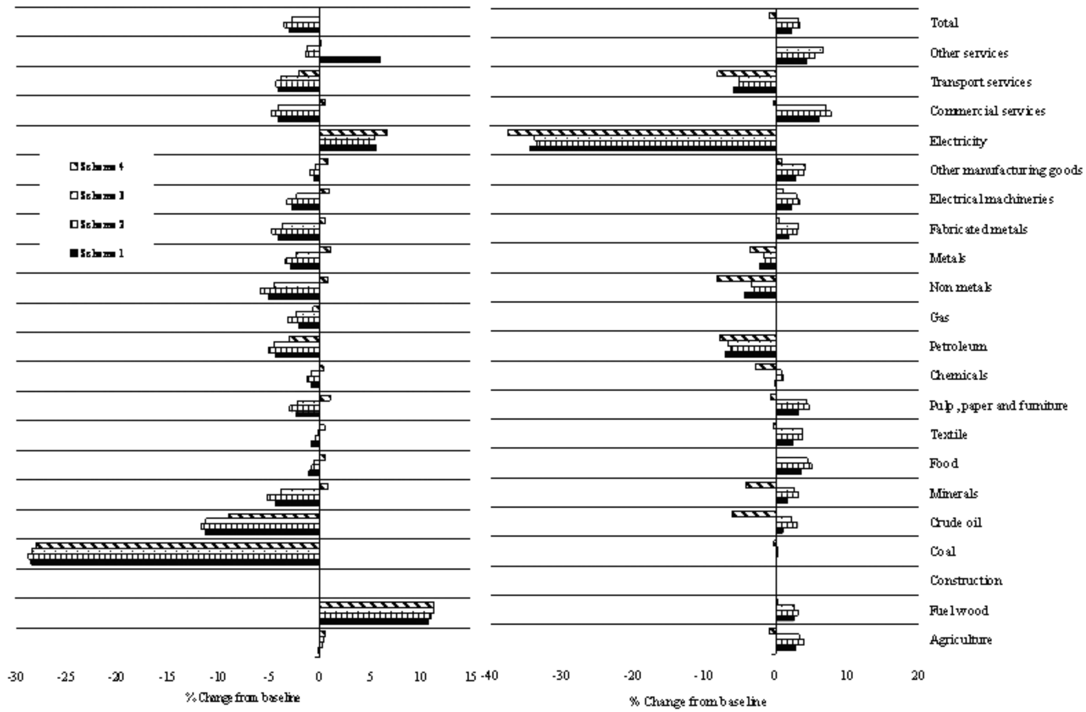
Impacts on Emissions at the National Level

Reductions in CO_2, SO_2 and NO_x emissions with the carbon tax under alternative revenue recycling schemes are presented in Table 12.3. An important side benefit of the carbon tax is that it also helps reduce harmful local air pollutants (e.g., SO_2 and NO_x). It is interesting to note

Table 12.2
Impacts of Carbon Tax on Demand for Goods and Services
(% change from the base case)

	Total Domestic Demand				Intermediate Demand				Final Demand			
	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Agriculture	1	1	1	0	1.05	1.77	1.63	0.32	-0.93	-0.34	-0.27	0.11
Fuel wood	12	13	13	11	27.71	28.43	28.19	25.1	-8.99	-8.36	-8.22	-7.8
Construction	-5	-6	-4	1	0.37	-0.82	-0.37	0.1	-5.25	-5.97	-4.37	0.81
Coal	-28	-29	-28	-28	-28.43	-28.63	-28.31	-28.26	-28.42	-28.62	-28.3	-28.27
Crude oil	-11	-11	-11	-10	-11.06	-11.01	-10.77	-10.46	-8.61	-7.08	-7.44	-13.26
Minerals	-4	-5	-3	0	-4.08	-4.61	-3.4	0.07	-3.61	-3.95	-2.89	-0.37
Food	0	0	0	1	0.65	1.12	1.13	0.64	-1.39	-0.81	-0.64	0.43
Textile	0	0	1	0	0.55	1.17	1.38	0.41	-1.62	-1.05	-0.73	0.42
Pulp, paper and furniture	-2	-2	-1	1	-1.48	-1.86	-1.1	1.07	-2.56	-2.87	-2.14	0.5
Chemicals	-1	-1	-1	0	-0.64	-0.92	-0.59	0.05	-1.67	-1.89	-1.6	0.13
Petroleum	-8	-8	-8	-7	-8.26	-8.3	-7.9	-7.16	-6.99	-8.62	-8.45	-7.93
Gas	-12	-13	-12	-12	-12.3	-12.59	-12.23	-11.72	0.00	0.00	0.00	0.00
Non metals	-6	-6	-5	-1	-5.88	-6.45	-5.11	-0.78	-2.82	-3.27	-2.63	-0.35
Metals	-3	-3	-2	1	-3.02	-3.44	-2.41	0.94	-3.63	-3.9	-2.88	0.05
Fabricated metals	-4	-4	-3	1	-2.36	-2.55	-1.73	0.52	-4.48	-4.97	-3.65	0.76
Electrical machineries	-2	-3	-2	1	-0.47	-0.74	-0.24	1.41	-4.51	-4.96	-3.67	0.77
Other manufacturing goods	0	-1	0	1	1.51	1.1	1.56	1.07	-1.7	-1.98	-1.32	0.7
Electricity	-4	-5	-4	-4	-3.56	-3.71	-3.34	-3.47	-7.02	-8.03	-7.88	-7.69
Commercial services	0	0	0	0	0.4	0.59	0.9	0.38	-0.99	-0.58	-0.25	0.46
Transport services	-5	-5	-5	-3	-5.53	-5.71	-5.06	-3.77	-4.5	-4.52	-4.1	-2.79
Other services	7	0	1	0	1.41	0.82	1.79	0.32	8.58	0.15	0.39	0.14
Total	-2	-2	-2	0	-1.66	-1.63	-1.18	-0.59	-1.82	-2.81	-2.06	0.25

Figure 12.6
Impacts of Carbon Tax on Imports and exports of Individual Good and Service



(a) Imports **(b) Exports**

here that the percentage reduction of SO_2 emission due to the carbon tax is significantly higher than the percentage reduction of CO_2 emission itself. This is mainly due to the greater difference in emission factors among the fossil fuels for SO_2 emission compared to that for CO_2 and NO_x emissions. There is only a small variation in reduction in each type of emission across different revenue recycling schemes. The emissions CO_2, SO_2 and NO_x are found to be the lowest under the revenue recycling Scheme 2, for which the regressive macro-economic impacts are the highest. The emissions are found to be the highest under the revenue recycling Scheme 4, for which the regressive macro-economic impacts are the lowest. This is expected because the level of emissions depends on level of total domestic demand for goods and services. Higher total domestic demand (i.e., lower reduction of total domestic demand or less regressive macro-economic impacts) would imply higher level of emissions and vice versa.

Impacts on Emissions at the Sectoral Level

Figure 12.7(a)-(c) present reductions in CO_2, SO_2 and NO_x emissions due to the carbon tax at the sectoral level. As can be seen from the figures, CO_2, SO_2 and NO_x emissions are found to decrease in all sectors except fuel wood due to the carbon tax under each scheme of revenue recycling. The study does not impose carbon tax on fuel wood considering that fuel wood is carbon neutral. The total domestic demand for fuel wood would increase due to relative decrease in its price after the introduction of the carbon tax. Increase in its total domestic demand would imply increase in atmospheric emissions from this sector.

The coal industry exhibits the highest percentage reduction of CO_2 emissions as a result of the carbon tax, followed by the electricity generation, non-metals, pulp and paper, and food industries. At a given level of

Table 12.3
Impacts of Carbon Tax on CO_2, SO_2 and NO_x (% Reductions from the Base Case)

Revenue Recycling Scheme	CO_2	SO_2	NOx
Scheme-1	-9.78	-13.19	-9.84
Scheme-2	-10.01	-13.42	-10.06
Scheme-3	-9.64	-13.06	-9.70
Scheme-4	-9.19	-12.79	-9.17

carbon tax, the emission reductions are not found to vary significantly across alternative schemes of recycling the tax revenue in all sectors except in construction, metals and fabricated metals. In these three sectors, CO_2, SO_2 and NO_x emissions are higher under the revenue recycling Scheme 4 than those in other revenue recycling schemes as these sectors produces mainly capital goods and demand for capital goods are higher under the revenue recycling Scheme 4 than that under other schemes.

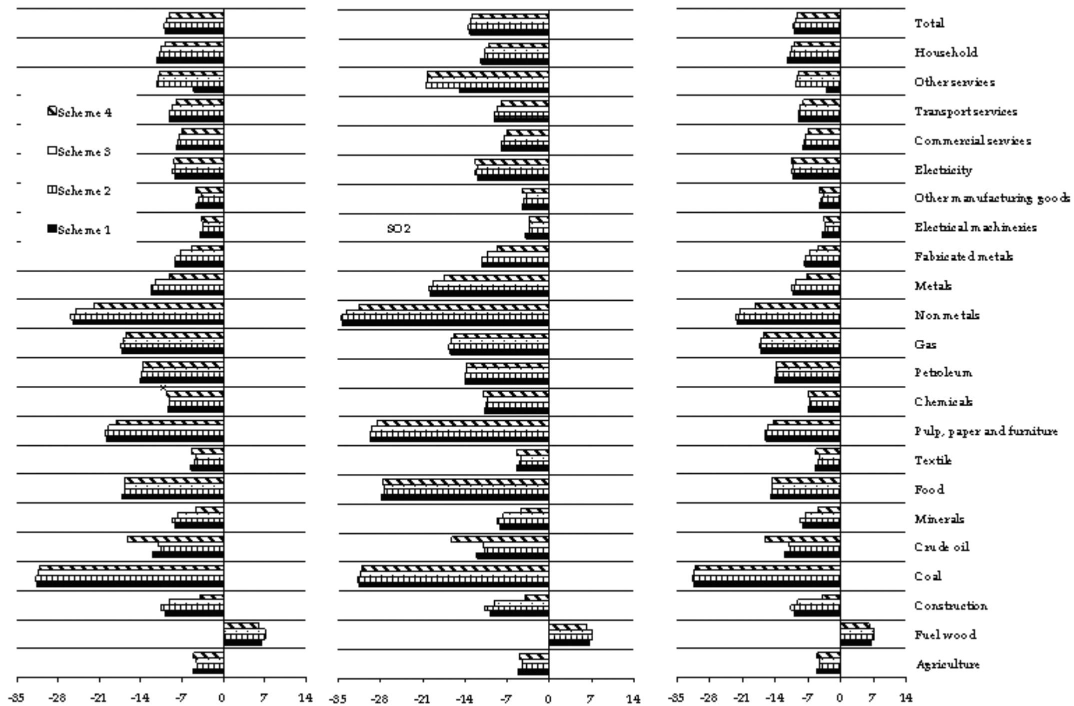
6. Conclusions

The study illustrates the economic and environmental impacts of reducing CO_2 emissions through carbon tax in Thailand. A carbon tax of US$40/tC would be needed to reduce CO_2 emissions by 9 percent to 10 percent from the base case depending upon the revenue recycling scheme. We find that the scheme of recycling the carbon tax revenue crucially influences the performance of a carbon tax. The welfare cost of a carbon tax would be smaller when the revenue is either transferred to households in a lump-sum manner or used to finance cuts in factor or indirect taxes than when the tax revenue is used for public consumption. Moreover, the welfare cost of the carbon tax with revenue recycling to finance cuts in existing labor tax rates would be smaller than that with tax revenue recycled to household through a lump-sum transfer. One of the most notable findings of the study is that the cost of carbon tax would be the smallest, when tax revenue is recycled to cut indirect tax rates of non-energy goods as the existing indirect taxes create more distortion in economy than the income taxes in Thailand. On the contrary, the carbon tax would create the highest welfare loss if the tax revenue were to be used for public consumption.

Another interesting finding of the study is that when the tax revenue is used for public consumption or recycled to finance cuts in the existing labor tax rate, the carbon tax would cause gross domestic product to increase. Moreover, the carbon tax would also cause exports to increase under all revenue recycling schemes considered here except the recycling of revenue to finance cuts in indirect tax rates of non-energy goods. Under each scheme of tax revenue recycling, total domestic demand for and total import of goods and services are found to decrease with the carbon tax.

Interestingly, the carbon tax is found to reduce SO_2 emission, even at higher proportion (i.e., about 13 percent) than the CO_2 emission itself and NO_x emissions almost at the same level of CO_2. Both SO_2 and NOx are the critical component of local air pollution in the country. We find that

Figure 12.7
Impacts of Carbon Tax on Sectoral Emissions (% change from baseline)



(a) CO_2 (b) SO_2 (c) NO_x

the percentage reductions in emissions do not vary significantly across alternative schemes for revenue recycling.

The sensitivity analyses on key parameters used in the study show that the qualitative results are robust. The quantitative results too are found not varying significantly for most parameters; they are, however, found to be sensitive to some parameters, particularly to the substitution elasticity between the primary factor composite and aggregate intermediate inputs.

Notes

1. The views expressed in this chapter are those of the authors only, and do not necessarily represent the World Bank and its affiliated organizations.
2. It is possible to account government consumption in private utility if its contribution in the private utility (i.e., share of government consumption in total household utility) is known.
3. On the contrary, existing studies particularly, Goulder et al. (1999) and Parry et al. (1999), assume that government neither consumes nor saves rather transfers all its income to households.
4. Some studies have treated government expenditure as exogenous (e.g., Xie, 1996; Zhang, 1997).
5. This is a popular approach for modeling export demand in the general equilibrium literature (e.g., Naqvi, 1999; Dufournaud et al., 1994).
6. Böhringer and Rutherford (1997) show the welfare cost of a carbon tax to be higher when the tax revenue is used for public consumption than when the revenue is recycled to finance cuts in factor taxes.

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13

Measuring the Impact of Chinese Provincial CDM Centers for Local Market Development

Miriam Schroeder

1. Introduction

Capacity building for the environment has been an issue for development cooperation since the UN Conference on Environment and Development in 1992. With regard to climate change, GEF and UNDP initiated the Capacity Building Initiative, and many donor organizations have been providing support for the set up of designated national authorities (DNAs). Experiences have been gathered about institutional capacity building for climate protection at the national level, but measures to extent countries' capacities for climate governance to the sub-national level have started only recently.

Even if China has a large potential for the clean development mechanism (CDM), capacity for development and implementation of CDM projects at the sub-national level was hardly existent when the Kyoto Protocol came into force in 2005. To tap the huge potential of CDM projects, especially in China's Western region, Annex I governments, international development organizations and the Chinese central government have launched several capacity building programs to enable public and private actors on the local level to participate in the international carbon market. The most prominent approach is to set up so-called "Provincial CDM Centers" as institutions for the facilitation of provincial markets for CDM projects. These provincial CDM centers differ in their effectiveness, as currently only ten out of the twenty-seven existing or planned CDM centers have generated CDM projects that made it into the international CDM pipeline (UNEP, 2008).

The objective of this chapter is to use the empirical case study on the establishment of provincial CDM centers in China to inquire into the following research question: What impacts do the CDM centers have on the CDM market development in their province?

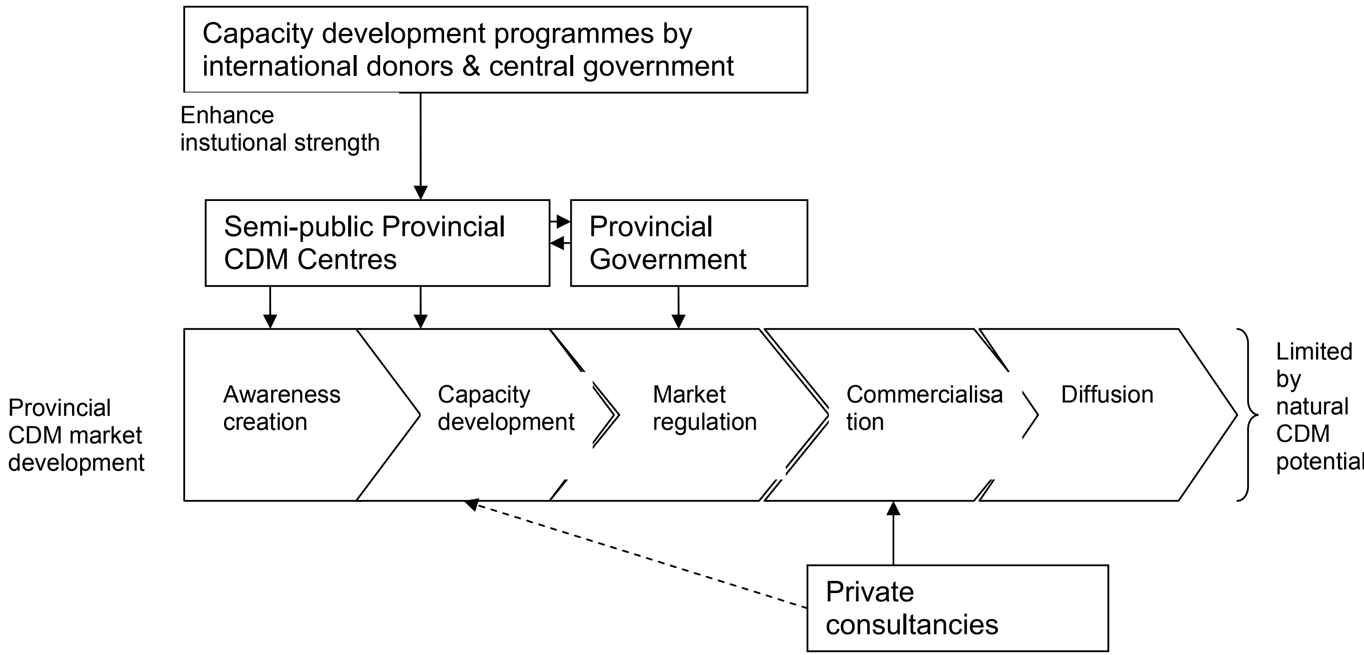
The chapter starts with a summary of the conceptual approach used in this study for measuring and assessing the impact of institutions on market development. The empirical part introduces briefly the situation of the Chinese CDM market at the national and provincial level and gives an overview of donors' capacity development projects for the CDM (CD4CDM) at the provincial level. The main part analyzes the activities of four CDM centers for their impact on provincial CDM market development. Special attention is given to the methodological issues of measuring impact of market intervention activities. The chapter closes with a discussion of the experiences gained in China and their transferability to other countries in need for CDM capacity development.

2. Facilitating New Markets

Similar to newly invented technologies, one can perceive "certified emission reductions" (CERs) to be a new politically invented good. Thus, in analogy to technology innovation, one can perceive the market development for CERs to go through similar stages of awareness creation, capacity building, market regulation, commercialization, and product diversification (Rogers, 1995; Carbon Trust, 2003). For initiating and steering new markets, so-called market facilitation institutions, like the Provincial CDM centers, can become crucial catalysts. They can help to overcome an emerging market's shortcomings such as lack of information, networks, finance and technical know-how. These institutions are successful when they decrease the risk of engagement for market participants. Once risks of market engagement have become limited, private actors will become the driving forces of further market progress (see Figure 13.1 as an illustration for CDM market development). Three fundamental dimensions shape the corridor for market development: 1. the timing of the intervention; 2. the choice of instruments; and 3. the interplay between public and private actors for market facilitation.

Concerning the time of intervention, the CDM centers differ in their time of establishment. The first Center had been initiated in 2004, while some are still in the planning stage in 2008. Similarly, the national Chinese CDM market started around 2005, but provinces show differences in timing in their local market start and market development pace. Assessing the impact of a center on different market phases has thus

Figure 13.1
Phases of Provincial CDM Market Development



Source: Adaptation from Carbon Trust, 2003:18

to consider at what point of time—in which market phase—the center started its operation. Even if market phases overlap in reality, a center that started late, e.g., at a time when local CDM capacity was already well developed, cannot have the same impact on early market phases as centers that were established early.

Concerning the choice of instruments, one can distinguish between direct market support instruments, which target business actors directly; and indirect market support instruments, which create a favorable environment (Lewis and Wiser, 2007: 1851). An appropriate choice of instruments depends on the present market phase, and on the ability and mandate of actors to use certain intervention instruments. For example, in the Chinese case study, the semi-governmental CDM centers have a no mandate for direct market regulation, but can influence the provincial government by policy advice indirectly on market regulation. Thus it can be assumed that CDM centers will mainly rely on indirect intervention instruments.

Concerning the interplay between public and private actors for market intervention, the chapter follows the assumption of innovation theory that public actors are needed to initiate a new market, to raise awareness, provide capacity development and set up a functioning market regulation, while it is mainly private actors that eventually bring the market to phases of commercialization and diffusion by their business operations (Carbon Trust, 2003). Ultimately, the scope of market development is limited by a province's CDM potential, which is determined by its natural resources and its industry structure. Small geographical regions like Ningxia can be considered having a well-developed CDM market even if they have only a small number of CDM projects because they are either small in size or do not have a good CDM potential.

3. Case Study China: Capacity Development Programs for CDM Market Development

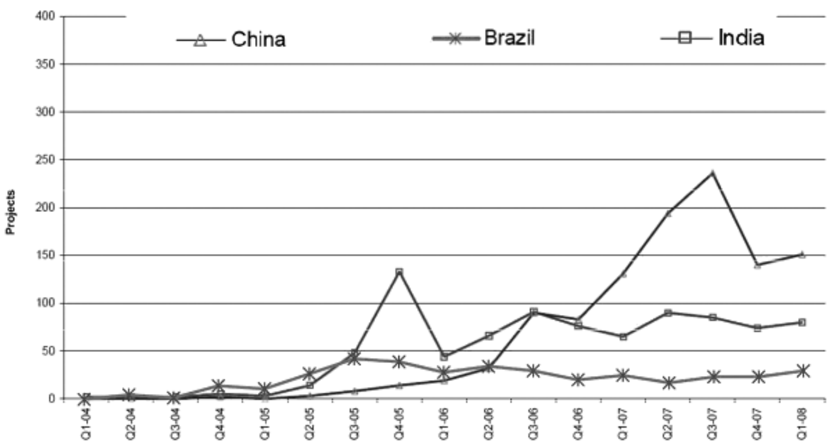
Overview of CDM Market in China

Despite its large potential, China had taken a slow start in the global CDM market when the Kyoto Protocol came into force in February 2005. After several CDM capacity development programs had assisted China to set up its institutional CDM structure and after positive CDM project examples from other countries had raised China's awareness of its own CDM potential, the country quickly caught up (see Figure 13.2) and soon became one of the top CDM host countries.

The CDM market in China has the following characteristics: 1. It is a politically created market by the parties to the Kyoto Protocol; 2. Political market regulation by the international state community, but especially by the Chinese government, were still in flux in 2005.s Now, national CDM regulation in China has reached predictability; 3. The tradable CERs—and also "Voluntary Emission Reductions" (VERs)—are newly created commodities on which potential market participants had neither knowledge nor trust in the beginning; 4. A high and increasing demand exists on the market from Annex I countries and companies for CERs; 5. Most of China's provinces have a high potential for CDM projects; 6. Political support by the Chinese central government existed for the CDM and its envisaged global effects, such as emission reduction and local effects such as increased foreign investment into clean energy infrastructure, technology transfer and benefits for the local environment or even sustainable development.

Despite such favorable framework conditions, there are still barriers at the national level for CDM project development that relate to general investment barriers in China, like the strong governmental intervention in the economy, inflated bureaucracy, and an insufficient protection of intellectual property (Bfai, 2007); and CDM-specific barriers like the 51 percent ownership rule which requires Chinese companies to hold control on CDM projects, thus limiting foreign companies' influence, and the set floor prices by the Chinese government (Gao and Li, 2007).

Figure 13.2
New CDM Projects in Pipeline per Quarter 2004-2008



Source: Based on UNEP Risoe CDM/JI Pipeline Analysis and Database, June 2008

The CDM market in China's provinces has developed at different paces. Despite their good energy resource allocation, Western provinces took a slow start in the CDM market, but caught up in 2007 at least in terms of numbers of CDM projects. In terms of CERs generated, large HFC and N_2O projects on the Eastern coast still account for a geographical gap. CDM markets tend to face a number of barriers (OECD, 2007), some of which were also listed by interviewees of this study. These include for example: a lack of CDM awareness among potential project owners, government officials and financial institutions, a lack of capacity to develop complex CDM projects, and a lack of capacity to actively participate in the international carbon market (e.g., lack of foreign language skills, experience to deal with foreign companies, lack of contacts).

Overview of Donor Programs for Provincial CDM Capacity Development

Once the CDM market came to life with the coming into force of the Kyoto Protocol in 2005, governments of Annex I countries started to get

Figure 13.3
Selection of Sino-Foreign CD4CDM Projects at the Provincial Level

involved in provincial CD4CDM programs in China. One popular type of CDM capacity development has become the support to provincial CDM centers (see Figure 13.3 for an overview).

A Sino-Canadian project was the first to support the setting up of China's first provincial-level CDM center in the Ningxia Autonomous Region. Due to the success of the project, Canada expanded this project to other provinces, and other Annex I countries took up the same approach. The donors' support for provincial CDM centers is very similar in their approach, and all projects are implemented via the Ministry of Science and Technology; thus different program designs are neither interesting nor feasible. In general, their main objective is to develop lists of possible CDM projects from the respective provinces, and to write PINs and PDDs. They are also granted the "first right of purchase" within a limited time for the CERs generated by projects from "their" provinces. A typical project for the support of provincial CDM centers includes training for the center's staff, but mainly training organized by the center for provincial project owners and government officials. Staff and experts from Beijing source projects and write PINs and PDDs. In addition, CDM information is disseminated by CDM handbooks for the trainees, a launch of a CDM center's website, and sometimes articles in local newspapers or documentaries on local TV channels.

Analysis of CDM Centers' Impact on Market Development

In order to determine the driving factors for provincial CDM market development and the role of the Provincial CDM centers, the study uses a comparative case study design. Four provinces have been selected as case studies based on the relative performance of their CDM center compared with private consultancies. The relative performance of the CDM centers is measured in the number of CDM project development versus total number of projects developed in the province, taking their activity in PDD development as a proxy for their institutional strength (Table 13.1).

The first challenge in assessing the impact of the CDM centers on provincial market development is the lack of baseline data on CDM awareness and capacity among market participants. This problem was tackled by two methods: First, the available data from the UNEP Risoe Center CDM pipeline was used to create a timeline for each provincial market; and second, qualitative interviews were conducted with 64 representatives of donor countries and organizations, the Chinese central and provincial governments, the CDM center staff, Beijing-based project developers and buyers, DOEs, and provincial project owners, develop-

Table 13.1
Development of CDM Projects by CDM Centers

	Total no. of projects in pipeline	No. of projects developed by CDM Center	Percentage
Ningxia	14	11	79%
Hunan	80	28	35%
Gansu	69	12	17%
Yunnan	144	1	0.6%

Source: Based on UNEP Risoe, June 2008

ers, NGOs and researchers. Interviews at the provincial level included a quantitative part that asked market participants to assess their peers' CDM awareness and CDM project development capacity for the time prior to donors' CD4CDM projects and for the end of 2007. For an orientation, Table 13.2 gives an overview about the four CDM centers' activities.

CDM Awareness Creation

The earlier a CDM center started operating in a market, the higher were its chances to have an impact on CDM awareness creation. As pointed out already, the methods of awareness creation used by the CDM centers are very similar, but differ in their timing and scope. All CDM centers are involved in organizing provincial CDM conferences for spreading CDM awareness among local political leaders, industry and media representatives, and all have published basic information material on CDM.

Using the method of peer assessment, an increase in CDM awareness was attested by the interviewees for the three groups inquired about a) potential project owners (Figure 13.4), b) government officials (Figure 13.5) and c) financial institutions (Figure 13.6). This increase in CDM awareness was given in all four provinces, but it varied in time and depth.

These quantitative results seem to testify that there is at least a correlation between the CDM centers' information dissemination activities and the increase of CDM awareness among market participants. However, these generalizations have also to be taken as a tendency only because of the small size of the sample.

Table 13.2
Overview of Activities by CDM Centers

	Ningxia	Gansu	Hunan	Yunnan
Established in	October 2003	October 2005	November 2005	January 2007
Staff	15	8	19	12
Website	2006	2006	2006	-
Publications	CDM handbook; 16 articles between May 05 – June06	CDM handbook	CDM handbook	CDM handbook
Trainings/conferences	6	9	9	3
International cooperation	Canada, UK, Italy, Japan	ADB	Canada	France
Policy advice	yes	Yes	Yes	yes
Other			Software for calculating emission reductions; QQ online CDM advisory	

Figure 13.4
Change in CDM Awareness among Potential Project Owners

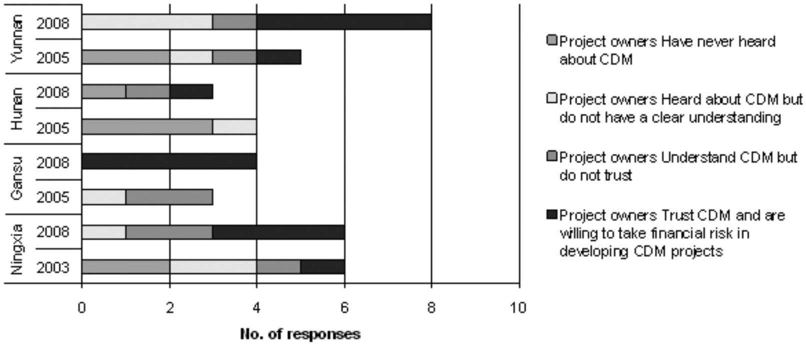


Figure 13.5
Change in CDM Awareness among Government Officials

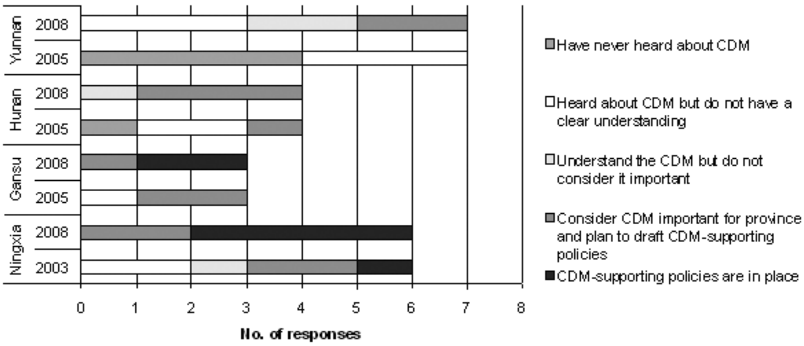
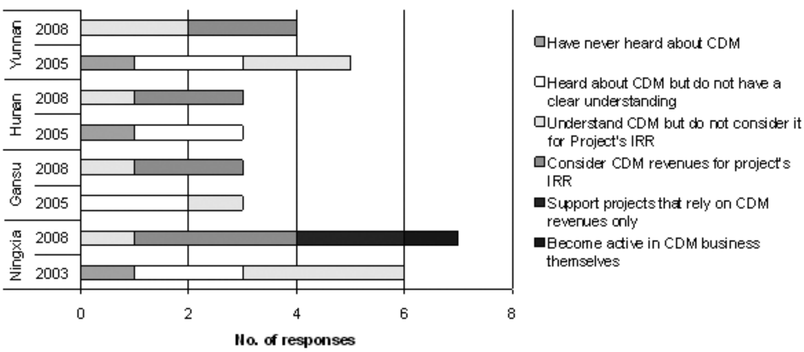


Figure 13.6
Change in CDM awareness among financial institutions



The qualitative parts of the interviews shed some light on possible underlying causal connections. The following explanations were given by the interviewed market participants and by experts such as researchers for the impact of the provincial CDM centers on CDM awareness rising:

- In the case of Ningxia, and to some extent also in Gansu, they simply were the first to approach project owners with CDM information.
- They are perceived as especially trustworthy, because they are attached to the provincial government (points raised in Ningxia, Gansu and Hunan). A governmental background makes them trustworthy, because "they will not just disappear tomorrow" and "they do not just want to make money."

- This situation is seen differently in Yunnan, where the majority of project owners rely on private consultancies for CDM-related information. Reasons given were: Information offered by private (mainly Beijing-based) consultancies was a) qualitatively better than the information provided by the CDM center, and was b) provided at an earlier stage. Departments of the provincial government did operate without coordination, not well informed and inefficiently.
- Concerning the use of the CDM publications of the CDM centers, interviewees had received publications only when they participated in the Centers' training. Websites of the centers are known, but the provincial market participants stated that they mainly used the websites of the Chinese DNA and of the UNFCCC as information sources, because these provide consolidated information.

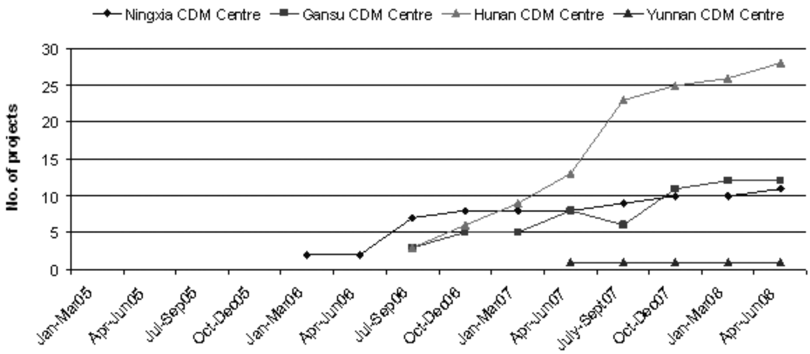
Alternative explanations for an increase in CDM awareness in the four provinces were the activities of industry associations and the headquarters of the project owners, which also provided their members and sub-branches with CDM information. For example, a Ningxia branch of one of China's five big power-producing companies received CDM information and training organized by his headquarter. Hydropower industry associations are also active in providing CDM information to their members. Training is not held, but members exchange information about project developers and their successfully developed CDM projects informally.

CDM Capacity Development

All CDM centers organize provincial CDM training, but these differ in frequency and scope. Some only do "must do" training in the framework of their Sino-foreign projects, others do self-financed training in order to get in touch with potential project owners and source projects. CDM centers also publicize CDM handbooks that complement the training. These handbooks have been similar in their content and include normally an introduction to climate change, the Kyoto Protocol and the CDM, an overview about the current Chinese CDM institutions, regulations and registration procedures, and outline CDM potential of sectors of the respective province.

The results of the study on this phase of market development show the greatest deviation from the original hypothesis. Instead of targeting all market participants, training was conducted mainly for project owners and governmental officials. Financial institutions were invited, but apparently showed no interest in attending. Other existing or potential CDM project developers were not invited, probably because they are

Figure 13.7
Increase in CDM Projects Developed by CDM Centers



Source: Based on UNEP Risoe, June 2008

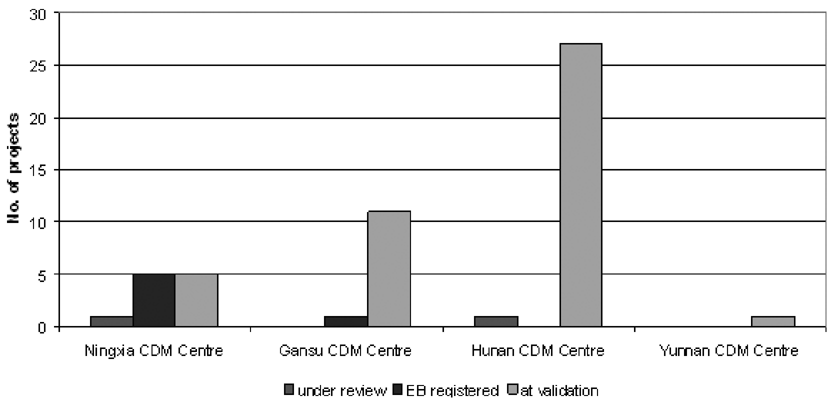
regarded as competitors. Instead, staff of the CDM centers often were participants of CDM training themselves, and thus were able to increase their own CDM project development capacity (Figure 13.7).

Not all interviewees were convinced by the CDM project development capacity of the CDM centers. These doubts were expressed by two categories of respondents: a) project owners from Yunnan and Hunan, who believed that the center experts could only apply well easy methodologies for e.g., hydropower projects, but would outsource more complicated project types to researchers; and b) local project developers, who raised this point as well and in addition questioned the efficiency of a semi-governmental institution. One way for having a quantifiable assessment of this issue is by checking CDM projects developed by CDM centers for their registration status (Figure 13.8). Although none of them have so far been selected for review by the EB, some projects from Hunan apparently have been selected for review by the Chinese DNA.

CDM Market Regulation

The CDM centers are actively advising the provincial government, which in some cases has initiated special political support for the CDM at provincial level. As a note of explanation on the possible scope of regulation, it has to be mentioned that the political mandate for CDM-related policy making and the whole CDM project approval process in China lies with the central government. The scope for influencing provincial CDM policies is thus limited by the mandate of the provincial government to

Figure 13.8
Comparison of CDM Projects under Review, EB Registered, and at Validation Stage



Source: Based on UNEP Risoe, June 2008

draft such policies. Possibilities at the provincial level for political support for the CDM include "soft" measures such as attendance of high-level officials at CDM conferences, statements and notes of government officials supporting CDM, and provincial-level CDM research projects. "Hard" measures for CDM support by the provincial government might be inclusion of CDM-related targets in the provincial planning documents like the Five-Year Plans or other forms of provincial level regulations.

In the four provinces included in the analysis, the observable political support for the CDM has mainly used "soft" measures, e.g., in Gansu three departments of the provincial government have issued a joint declaration for the support of CDM. However, interviews with market participants, and especially with the representatives of the provincial government and the CDM centers, revealed that these often assign a much broader influence to the CDM centers than is detectable from official documents. According to these qualitative statements, provincial government positions on general climate change-related or emission reduction-related statements can be traced back to the CDM centers' activities, which include personal talks and official reporting to the relevant departments.

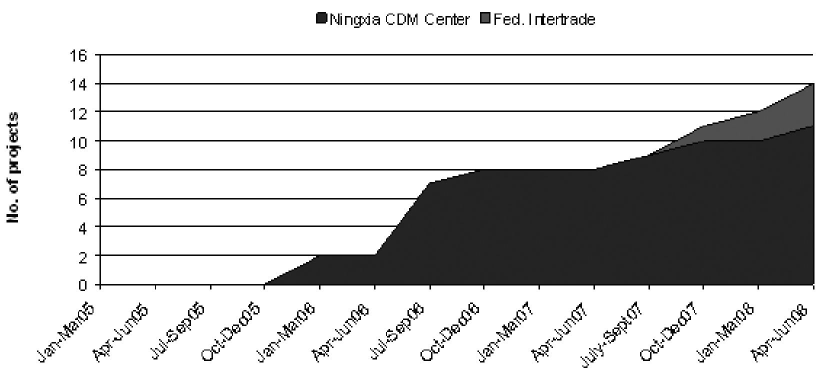
CDM Market Commercialization

Probably the greatest contribution of the CDM centers to CDM market development is the CDM project development that they themselves conduct. This is their core activity. The timeline based on the UNEP Risoe Centre CDM pipeline allows an assessment of market transformation in terms of the number and type of projects, which allows for a comparison of the centers' performance in CDM project development compared to private consultancies. The timelines of the four case studies reveals that the CDM centers differ greatly in their ability to source and develop CDM projects if compared to private actors (Figures 13.9 and 13.10).

There is a correlation between early market entry and the number of projects developed: Ningxia, the first CDM center which was already on the market in 2004, had full market monopoly until October 2007 and has since then only one local competitor in CDM project development. The Gansu and Hunan centers have a middle-sized market share, but show different tendencies: while the Hunan centre is quickly increasing its market share, due to an "aggressive marketing strategy" as stated by many interviewees, the Gansu center is losing its market grip, maybe because its competitors set up Gansu-based offices, which increased competition. In contrast, the Yunnan CDM center has only a marginal share in the market, and one interviewee stated that "potential hydropower projects are already under contract with other developers."

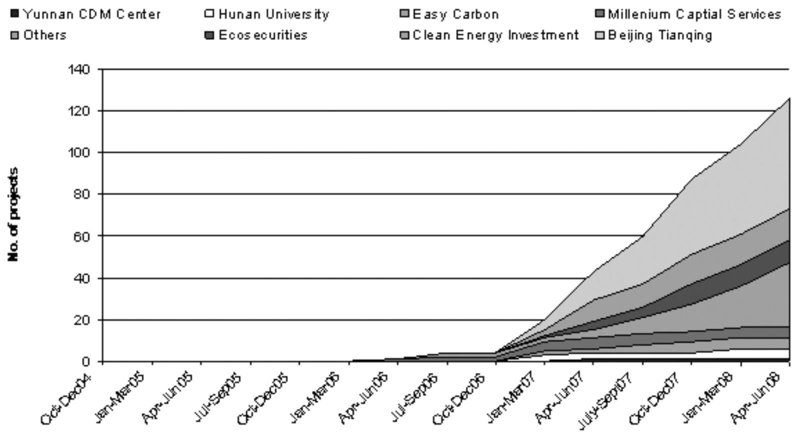
From the qualitative interviews, another explanation can be derived: the ability to trust seems to be fundamental to project owners when deciding with whom to cooperate. Because project owners tend to trust governmental institutions—CDM centers—more than private companies

Figure 13.9
Market Position of Ningxia CDM Center in Terms of Number of Developed Projects



Source: Based on UNEP Risoe, June 2008

Figure 13.10
Market Position of Yunnan CDM Center in Terms of Number of Developed Projects



Source: Based on UNEP Risoe, June 2008

(except not in Yunnan), this might be one more explanation for a better performance of the CDM centers with regard to project development in comparison with their private competitors. This might be because most of them felt relatively overburdened by the complex CDM requirements (this reason was always given as the first point when asked about the CDM's disadvantages), which is not their core business and in which they were not willing or able to invest much time and effort. Interpreting these responses one could say that project owners were not able and willing to make fully informed decision about the best choice of project developer and thus turned towards an emotional decision.

CDM centers do not directly lobby with financial institutions, although there would be a high need for more CDM awareness among financial institutions as these tend not to take CER revenues into loan considerations. Instead, project owners complain that they often have to explain the whole CDM procedure to the banks themselves.

CDM Market Diversification

The CDM centers are not very active when it comes to market diversification activities. There is no systematic approach to diversifying the market, and this seems also not to be seen as a mandate. All representatives of the CDM centers have heard about the emerging VER market, and modified CDM project types such as the Gold Standard or other voluntary project standards. The Gansu and Hunan Centers also include information about the VER market and its requirements in their training, but response from project owners has been limited so far. None of the centers has become active in own CDM methodology development. The reasons given were lack of time and finance, but also lack of capacity.

The CDM centers become active in two categories of research: First, research on how to implement the central government's "energy saving and emission reduction" policy at the provincial level. This kind of research seems to be a contribution of the CDM centers demanded by the provincial governments, e.g., the Hunan CDM center has set up an extra branch that only does research on this topic. Second, CDM centers become active in research which is financed by Sino-foreign donor projects, e.g., the Ningxia CDM center is already in phase three of a UK project assessing the effects of climate change on Ningxia's agriculture.

The CDM centers have some influence on the CER seller and purchaser demographics. Due to the current demand-driven CER market in China, the Centers have a relatively large choice of buyers for their CERs, and they increase their choice by attending international conferences (e.g., Carbon Expos) and by setting up sub-branches in Beijing, where they are closer to the buyers. In turn, they can also increase their choice of project owner, because some of them now turn to other provinces to source new CDM projects, e.g., the Hunan CDM center has a cooperation agreement with the Anhui CDM center to mutually develop projects in Anhui province.

4. Discussion of Results

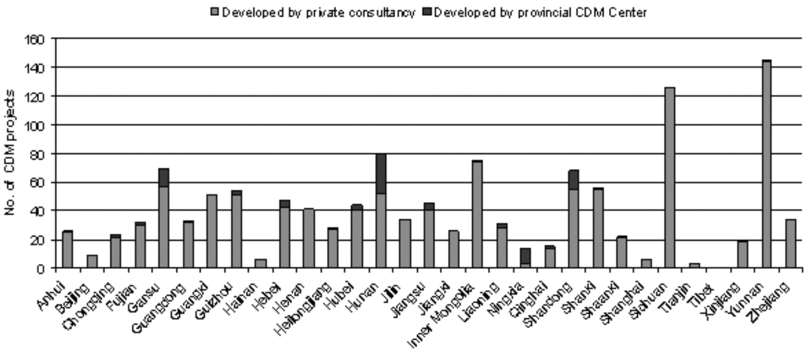
CDM Centers as Market Facilitation Organizations

The CDM centers had a verifiable impact on the first three phases of market development: Firstly, their information dissemination via publications and conferences contributed to the dissemination of information on the CDM. Secondly, the centers' training and their learning-by-developing-projects approach helped project owners to understand the CDM requirements, judge their project's CDM eligibility, increased their ability to use the CDM as a leverage in loan negotiations, and has—a surprisingly important issue—increased trust in an international mechanism which was first regarded as a "pie the sky" that nobody would dare to believe in. The training was however not able to reach representatives of financial institutions, which were invited but did not attend the events, assumedly due to a lack of CDM recognition by their banks. Most contrasting to the assumptions of this research, the training of the CDM centers was not at all targeting other project developers. While representatives of CDM centers always assured that other project developers in their provinces would be welcome, they also stated that these were eventually competitors. One fundamental conclusion is therefore that the CDM centers have had no impact on CDM capacity development for one important segment of the market: other project developers. Thirdly, training and conferences also helped to create awareness about CDM among local government officials. Most of the CDM centers also used their standing as sub-departments or government affiliated entities to use the official communication channels within a provincial government to provide CDM information and policy suggestions to their superiors. Besides personal interaction, this took the form of writing reports. Officials from the provincial governments thus often supported the Centers' work, lifted the CDM on the political agenda, and eventually drafted notes, reports, and policies supporting the CDM project development in their province. This in turn had a positive effect on project owners' trust in CDM, as these generally take a governmental backing of an issue as a sign of its trustworthiness.

The impact of the CDM centers on the market phases of commercialization and diffusion is only clearly verifiable for one indicator: the number of CDM projects developed. While a monopoly on the market by the center is only existent for Ningxia, there are some other CDM centers that established themselves as successful project developers (Figure 13.11).

Evidence of impacts on the commercialization and diffusion phase of market development remains weak: CDM centers do not engage in methodology development, but they start to include information on the VER market in their publications, websites, and training. When asked about their future strategy for business development, representatives of the CDM centers mainly want to expand their PDD services, e.g., by entering either new sectors in their own provinces or by sourcing projects in other provinces. One concern was also to go beyond PDD development and enter the international carbon market as CER traders or even of becoming buyers to their own projects by establishing joint ventures with foreign companies. Most of them regarded the time for CDM capacity development in their province as coming to a closure, instead focusing now on the CDM business. However, some of the CDM centers are offering CDM training to externals: the Hunan CDM center has a cooperation

Figure 13.11
CDM Project Development by All 27 CDM Centers



Source: Based on UNEP Risoe, June 2008

agreement to train staff of the Anhui CDM center; and the director of the Ningxia CDM center is even thinking about offering his training and PDD development services in Russia and in African countries.

Methodological Issues

This study faced several challenges on the methodological side. Probably the largest practical barrier for the empirical part of the project was getting access to interview partners in departments of the central and local governments, and at financial institutions. Project owners and consultancies, which tend to be small- to middle-sized enterprises, were easier to approach. An average of 8.5 interviews per province could be conducted which certainly limits the degree to which the findings can be generalized. Besides these general restrictions, the research experienced two main challenges: 1. the assessment of an ex-ante project situation without any baseline data; and 2. the general difficulty of measuring impacts of capacity development activities on market development.

In order to be able to do a comparison of CDM awareness and capacities, ideally a baseline prior and after intervention should be available. As no data was available for the case studies, an ex-post assessment of the CDM awareness and capacities of three groups—potential project owners, government officials and financial institutions—was tried by asking representatives of two of these groups—project owners and government officials—to assess the 2005 and 2008 situations of their peers and the other two groups. The degree of correctness of these subjective assessments is debatable, because a) memories of the timing of training, composition and contents tend to become shallow with time, and b) personnel within the CDM business has very high turnover so that current staff often has only recently started within the company/department or even in the CDM business itself.

The impact on capacity development by the CDM centers was measured directly by the number and size of training delivered and indirectly by a) an assessment by peers about their group's increase in CDM awareness, knowledge and capacity, and b) by an analysis of the increase of the groups' CDM-related outputs, like the number and quality of developed CDM projects or number of CDM-supporting policies by local government officials. Evidence of a causal connection between these groups' outputs and the training received from the provincial CDM centers remains however anecdotal.

Another difficulty has been the assessment of the explanatory power of alternative explanations for market development, e.g., how to weigh the relevance of CDM training conducted by the CDM centers versus training conducted by industry associations.

5. Conclusion

This study has shown that the provincial CDM centers have had an impact on launching and consolidating their provincial CDM markets, but their impact on maturing markets by diversifying these is low. The centers' focus on providing information to project owners, and the exclusion of project developers from CDM training, leads to the conclusion that the CDM centers act not as market facilitating institutions, but mainly as CDM project developers. This tendency is confirmed by statements of CDM centers' representatives, who see the expansion of their PDD development services as their future business development strategy. While these tendencies are not in line with theoretical concepts of market facilitation organizations, they respond to the objectives of the donors' capacity development projects, which are also mainly focused on the development of PDDs and the generation of CERs. On the other hand, private actors—such as project developers, buyers and even DOEs—have launched their own CDM training in the provinces. Although they do this with the goal of reaching out to more potential project owners, they do contribute to provincial capacity development. This observation contrasts the theoretical assumption that mainly public actors are responsible for capacity development in emerging markets.

What can thus be learned from the Chinese experiences by other countries that have local capacity development needs for their full participation in the CDM? Probably, this depends to some degree on the transferability to other countries of a very Chinese feature of the provincial CDM centers: they have been *Shiye danwei*, privately run companies that serve the government by providing public services. Government back up and the possibility to use government channels for information dissemination and contacts to project owners are their competitive advantages vis-à-vis private consultancies.

India has probably had similar experiences with a comparable approach: "Nodal agencies," which are also sub-branches of governmental departments at the state level, have been appointed for CDM promotion at the local level. Despite their different political systems, both countries have opted for a "top down" approach of setting up local level CDM market facilitation institutions. Interesting for future research would be a comparison of these "top down" approaches with countries or regions that pursue a "bottom up" approach, in which institutions can compete for the status of a "CDM center," which then is awarded with governmental support and donor financing. Actually, two Chinese provinces have taken such "bottom up" approaches of setting up CDM centers: in Sichuan, two independent CDM centers emerged as competitors; and in Guizhou, the CDM center was selected via a tender procedure initiated by the donor (UK) among several competing institutions. Although setting up centers for local CDM market facilitation is a replicable model, there is still scope for improving the approach.

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14

The Impact of BACIP Energy-Efficient Products on Domestic Fuel Savings in Northern Pakistan

Nahida Khudadad and Qayum Ali Shah***

1. Introduction

Building and Construction Improvement Program (BACIP) works under the patronage of Aga Khan Planning and Building Service, Pakistan. It was initiated in 1997 in partnership with the Canadian International Development Agency (CIDA) with a vision that "The visual, physical and emotional impact of a decent home can light the spirit of human endeavor. A proper home can provide the bridge across that terrible gulf between utter poverty the possibility of a better future." BACIP was subsequently funded by other donors including USAID, the UNDP under its Global Environment Facility-Small Grants Program (GEF-SGP) Austrian Development Agency (ADA), European Union, Climate Care Trust Limited United Kingdom, The United States Environmental Protection Agency (EPA), and, Japan Social Development Fund (administered by the World Bank). The funding has helped in scaling-up and replicating 124380 BACIP EE-HI products covering almost 10 percent of households in the northern areas and the Chitral region.

The goal of BACIP is to promote measures that will enable communities to manage the process of change and make sustainable improvements in their living conditions by providing solutions to their housing related problems, allowing them to optimize their investment in built environment related aspects and hence improve the quality of living environment, especially for women and children.

Through research, BACIP has determined that rural dwellings in the Northern Pakistan have many issues related to thermal efficiency, illumination and ventilation, indoor air pollution and space management. These issues were addressed by BACIP by developing, through a participatory process, Energy-Efficient and House Improvement Techniques (EE-HI). Till date more then 60 products have been developed, of which 12 products are highly energy-efficient. These products have multi-level benefits to the beneficiaries/householders, including, improved thermal efficiency, increased illumination, high level ventilation, earthquake resistance, and appropriate domestic space management. To ensure sustainability and easy accessibility, BACIP trains local artisans and crafts persons in manufacturing, stocking, selling and installing the energy-efficient house improvement products. For effective marketing and diffusion of its products, BACIP has successfully been encouraging local women to work as sales persons within the villages thereby generating employment opportunities and mobility for village women.

BACIP's efforts in promoting low-cost and energy-efficient products have been recognized by the UN-HABITAT by it presenting BACIP with the World Habitat Award 2006 (www.bshf.org). Moreover, for the sustainability approach it has been taking to improve the living conditions of rural people in northern Pakistan, BACIP has been awarded the ALCAN Award for Sustainability 2005 (www.alcanprizeforsustainability.com). The ALCAN Award was won both by BACIP along with its sister program, the Water and Sanitation Extension Program (WASEP). Furthermore, BACIP program was also recognized by GEF (SGP) for its success and effectiveness by picking it up as a case study among all the small grant projects developed world wide from 1992 to 2003 (www.sgp.net.pk/docs/BACIPevaluation.pdf).

"Improving Energy Efficiency in Northern Pakistan" of BACIP was funded by Climate Care Trust Limited UK with the overall goal to improving the energy efficiency of building technologies and practices in mountain areas of Pakistan in order to reduce carbon emissions and to improve the well being of communities. The objective of the project was that communities are able to manufacture and install energy-efficient products at the village level with the specific objectives of:

1. Reducing the emission of carbon at the household level by introducing smokeless stoves and by disseminating the dangers of smoke.
2. Creating demand for energy-efficient products by promotion and awareness rising regarding the benefits of the products.
3. Enabling local artisans and entrepreneurs to manufacture stock and sell energy-efficient and house improvement products.

4. Continuing the on-going refinement and development of locally relevant energy-efficient and house improvement products.

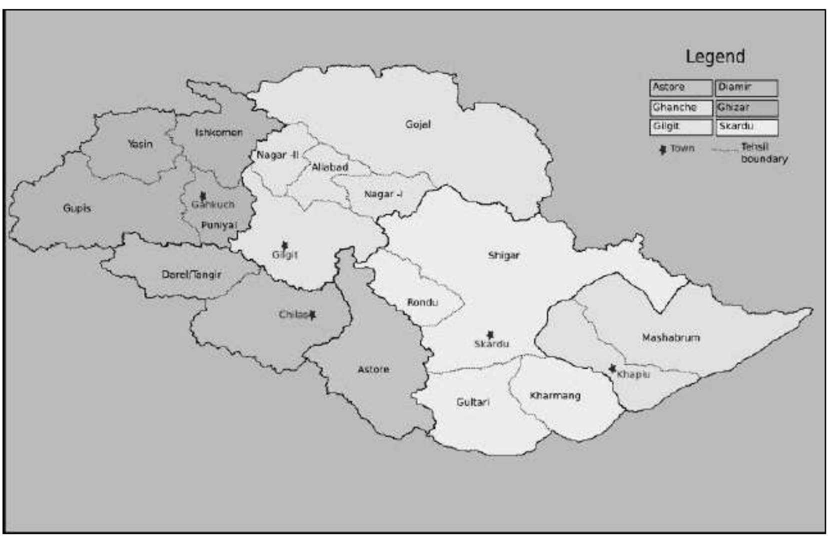
Improving Energy Efficiency in Northern Pakistan was an 18-month project implemented in the remote communities of Yasin Valley of Ghizar District, where communities suffer most from fuel poverty.

The chapter will focus on the methodologies and findings in determining the impact of BACIP Energy-Efficient and House Improvement (EE-HI) products on the household fuel requirement reduction and the subsequent reduction in carbon emissions. The chapter will also discuss the resulting impact of EE-HI products on saving time, energy and money of the householders, especially of women.

2. Methodology

The objective of fuel saving assessment was to visually compare the quantity of firewood used before and after the installation of BACIP EE-HI products. The methods adopted for assessment were appropriate and flexible enough to adapt the local contexts, ensuring that the methods were standardized, comparable and statically sound. Prior to the interventions a baseline survey was conducted in Yasin valley and firewood were weighed in the sampled house, which then continued for 9 months after BACIP EE-HI products were installed and used.

Figure 14.1
Map of the Northern Areas of Pakistan © AKPBS-P



Baseline Data Collection

Paired sampled assessment of fuel requirements started with the commencement of a contextual assessment of the actual situation of energy efficiency of the houses and the fuel requirement trends within the households in Yasin Valley. This study was conducted in five villages covering 1755 houses, 30 percent of the total households in the five villages were surveyed. The key informants, women were interviewed by trained local enumerators. The results of this survey are discussed in Section 3 of this chapter. During the baseline assessment, the actual firewood was also weighed in the sampled households by assessing the actual firewood requirement of the households.

Firewood Requirement Assessment

The methodology used for monitoring of the firewood consumption and related carbon emissions in the sample households is given below:

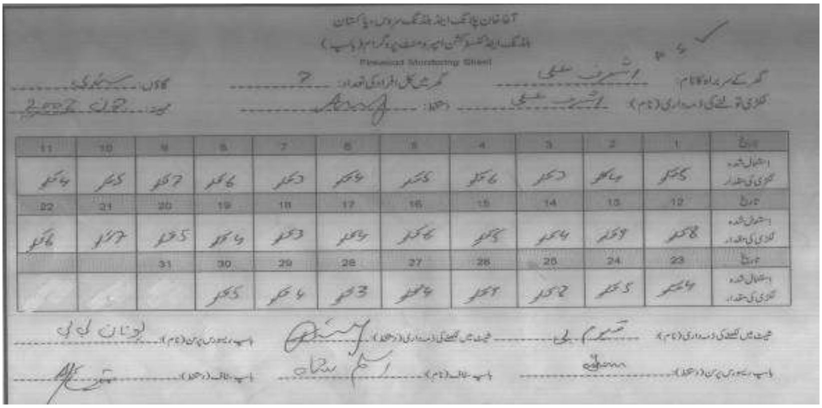
Sample household selection. The amount of firewood consumed was monitored in 15 percent of the demonstration households (200) where one or combinations of EE-HI products including: Water Warming Facility (WWF), Roof Hatch Window (RHW), House Insulation Techniques (HIT), Roof Treatment Techniques (RTT), Fuel-Efficient Stoves and Light Roofs (FES) are installed and are in use. The sample size was equally distributed considering the six energy-efficient products installed in the demonstration houses. The sample of 15 percent was again equally distributed in five market villages of the Climate Care Trust Limited project villages, therefore, six households were selected from each village.

Data Collection, triangulation, and verification. Two persons in the selected household were responsible for monitoring of the firewood consumption on daily basis, as per the consent given by the demonstration[1] houses.

Due to the fact that women usually spend most of their time in the house, it was ideally good that the women take the responsibility of monitoring the firewood consumption, but in most cases women were illiterate and were over-burdened with household chores, livestock catering and with on farm activities, therefore, her husband, or a school going son or daughter filled the data sheet and helped her with firewood weighing.

Data recording sheets/tables (in Urdu, see Figure 14.2) were developed and provided to the householders together with a spring scale. Trained Village Resource Persons (RPs)[2] visited households weekly for supervision and also for ensuring that the data was being recorded regularly and correctly. The RPs were paid for their firewood assessment monitoring and maintaining a data quality assessment form of the households, keep-

Figure 14.2
A Recorded Data Sheet in Urdu



ing track of indicators e.g., firewood inventory/stocking, the amount of firewood weighed and used. BACIP field staff visited each sample household once a month to assess the data quality, verify the monitoring work and collect the data recording sheets from RPs. An independent verification through triangulation and visual verification was also conducted to evaluate the validity of the data. For this, BACIP M&E staff visited the sampled households once a month for the first three months to:

1. Ask another persons (who is not responsible for firewood weighing and recording) in the house how the data is being collected.
2. Visually verify by seeing the left over amount of firewood in the stock and the recorded data for the last day.

The number of verification visit was subsequently reduced to once every two months and then once in a quarter. The verification was done by checking a format on which households are actually recording the data and weighing the wood and not doing so. During the 10 months monitoring period two households were dropped off from the monitoring as proper data was not coming.

Data analysis. The data acquired from the firewood monitoring was compared on two dimensions 1). The amount of firewood required was assessed using paired sampling methods to determine the difference in firewood requirements, and 2). The amount of firewood saved by different energy-efficient and house improvement products/ or products combinations. The baseline data was compared with the after-intervention data to see the amount of firewood saved with unit of analysis in tons. The amount of firewood saved was multiplied by carbon fraction of 1.5 to determine the total carbon avoided due to BACIP EE-HI.

3. The Pre-Intervention Scenario

In the northern areas, indigenous construction methods considered for thermally efficient techniques by minimizing the surface exposure to the outside and the doors, windows, and other openings were made as small as possible to reduce heat loss. Construction materials mostly used were mud and stone, which compared to cement concrete walls is a better insulation material for the winter. However, with the introduction of new energy intensive construction techniques such as cement concrete blocks and concrete roofs replicated from the southern cities that are unsuited to the climate, often lead to extremes temperature variations between winter and summer inside the home. This type of housing has a high heat transmission co-efficient which means the rooms rapidly cool off in cold climates. Additional problems include drainage and a lack of water proofing at the foundation level. The surface water of small water channels passing past houses often percolates into the ground and is absorbed by foundation walls. This is even more evident with cement block walls and cement mason constructions. With all housing construction related problems and existing living conditions, it is not surprising that the existing problems have resulted in an increased use of fuel wood for heating the house, poor space management, improper ventilation, low level of illumination, dampness, and dust problems.

The mountains in the area are dry and there is scarcity of firewood. However, a little forest of juniper is left, which is being cut off down the locals. Firewood, the most important domestic fuel, is gathered from mountains. This can be seen from the fact that 86 percent (BACIP and WWF-P 2001) of households in the northern areas use firewood as their main source of fuel for heating and cooking. In higher altitude areas like Yasin Valley, 96.2 percent of households use firewood for fuel, with just 0.4 percent using Liquid Petroleum Gas (LPG) for cooking. There is very little change in the trend of fuel use patterns at the household level over the last 10 years (see Table 14.1). Just 0.04 percent of the dwellers have started using LPG as a priority fuel, while just 12 percent of households are using LPG as a secondary source of fuel. There is significant change in the number of households using kerosene as their secondary fuel source, from 60 percent (1996) to 13 percent (2006). The high chersonese prices have (Rs. 36 per liter) and its inaccessibility has contributed to kerosene

Table 14.1
Kind of Fuel Used for Cooking and Heating

Fuel Type	Yasin Valley 1996 % use	Yasin Valley 2006 % use
Firewood	100	96.2
Kerosene	60	13
Electricity	9	19
LPG	0	0.4

use trend in 10 years time. Table 14.1 gives the fuel use pattern in Yasin Valley in 1996 and 2006.

With just 10.5 percent (WAPDA/GTZ) of the forest remaining in the northern areas, firewood is usually bought hence making it the third biggest expense for families. After food it accounts for 11 percent of all the household expenditures. Yasin Valley is no exceptional than the rest of the northern areas, families have to buy firewood, especially in winter—47 percent of the families totally rely on firewood bought from the market, whereas 20 percent partially buy firewood. For the householders[4] (60 percent) whose income level is less than US$ 100 a month with an average family size of 9, buying firewood is a challenging job. Moreover, the increasing prices of firewood and other fuel sources make it harder for families to come out of the vicious cycle of poverty. In 2003, the price of one kg firewood ranged from Rs.2.5 to Rs.3.00 (IUCN, 2003) but in 2007, firewood cost ranged from Rs.6 to Rs.11 per kg. That is an increase of 140 percent to 260 percent in 5 years time. Due to its scarcity and non-availability, the responsibility of firewood fetching has shifted from women to men. Men now spend a considerable amount of time, a total of 67,842 hours per year to search and gather firewood from the mountains.

This means that on an average each household in the valley spends 15 working days each year on firewood collection costing Rs.3855 (US$ 64) per households. Female-headed households usually cut green trees to fulfill their energy requirements. On an average each household in Yasin Valley consumes 25 kgs of firewood per day for heating and cooking in winter seasons resulting in 13 tons of carbon emissions each year.

4. The Energy-Efficient Products' Scaling-up

BACIP in its research phase (1997-2001) has developed house improvement products, which were based on the findings of a preliminary

Figure 14.3
Firewood Being Transported from Mountains.

Figure 14.4
Firewood from apricot trees piled-up for winter.

participatory study conducted in selected communities of the northern areas and Chitral. A list of problems related to house improvement was identified, which included: 1) smoke—caused by poor quality cook stoves; 2) cold—due to poor walls and roof insulation; and 3) the excessive amount of firewood requirements in winter. Based on the problems a considerable list of house improvement solutions were identified ranging from foundation to illumination. The main criterion employed by BACIP in developing the energy-efficient house improvement products is that "*the product relates to what already exists, what is affordable and what*

Figure 14.5
Roof Opening in the Traditional House (inside)

Figure 14.6
Roof Opening in the Traditional House (outside)

Figure 14.7
BACIP Roof Hatch Window to Cover the Roof Opening

is accessible to people" (Nienhuys, 1999). Box 14.1 explains the 18-step process taken by BACIP to develop EE-HI products.

BACIP has developed more then 60 products related to house improvement and design applicable to new and old houses. The focus of discussion will be the 8 highly energy-efficient products including, RHW, WWF, FES, RTT, and HIT, which were widely installed and replicated in Yasin Valley. The analysis of the firewood saved by an individual product and combination of products are as given below.

Box 14.1
BACIP Product Development Process

Step 1:	Participatory Research	Step 2:	Prototype Development
Step 3:	Field Testing and Models in Houses	Step 4:	Product Diversification
Step 5:	Product Manufacturing	Step 6:	Manufacturing Manual
Step 7:	Manufacturing Tools	Step 8:	Materials/Parts supply
Step 9:	Choice of Models	Step 10:	Marketing
Step 11:	Road Shows	Step 12:	More Models in Houses
Step 13:	Monitoring and Evaluation	Step 14:	Mini-Models
Step 15:	Contracting Procurement	Step 16:	Delivery of Materials
Step 17:	Promotion	Step 18:	Replication/ Entrepreneurs

Source: BACIP, 1999

Roof Hatch Window—RHW

Traditional houses in the northern areas have a 2’ x 2’ opening in the middle of the ceiling to allow smoke to escape and to let sunlight and fresh air come in. Such an opening also lets out heat and lets in cold, rain, and dust. RHW, which replaces the opening in the ceiling, was developed by BACIP as the most needed improvement. It improves the light level in the house, conserves the heat inside and stops dust transmission.

Due to its heat conserving ability, a household with RHW can save up to 60 percent of fuel required for heating. In Yasin Valley, 190 households replicated RHW. The different combination of products replicated together with the RHW and the relative reduction in CO_2 emissions in Yasin Valley are as given in Table 14.2.

The table shows that in 14 percent of the total project households, Roof Hatch Window has been replicated, showing that the product can be scaled-up due to its usefulness and adaptability. The firewood assessment shows that the product can save up to 2.7 tons of firewood per year per household hence reduce the emission of CO_2 by 4 tons per year per household. Since a Roof Hatch Window lasts for more than 8 years, 20 tons of CO_2 emissions can be avoided per household in five years.

The fuel efficiency of Roof Hatch Window (RHW) has been supplemented by House Insulation Techniques (HIT), Fuel-Efficient Stove and Water Warming Facility by saving 6 to 12 tons of firewood per household each year, resulting in avoiding 1397 tons of carbon emission per year in 183 households in Yasin valley in a year’s time.

Moreover, by replacing the roof opening with a BACIP Roof Hatch Window, a considerable time can be saved from going to the roof in the

Table 14.2
Firewood Reduction Requirements due to RHW and Product Combinations

No. of Households Using EE-HI Products (N=1356)			**Firewood Saved**	**CO2 Avoided (tons)**	
Product/Combinations	**#**	**%**	**(tons)/HH/year**	**HH/Year**	**Total/Year**
RHW	84	6.2	2.7	4.1	340.2
RHW – HIT	30	2.2	6.3	9.5	285.3
RHW – FES	2	0.1	5.4	8.1	16.2
RHW – RTT	13	1.0	5.4	8.1	105.3
RHW – WWF- FES	54	4.0	8.0	12.0	649.6
Total	**183**	**14**	**28**	**42**	**1397**

Figure 14.8
Open fire cooking practices

Figure 14.9
BACIP Smokeless Fuel-Efficient Stove

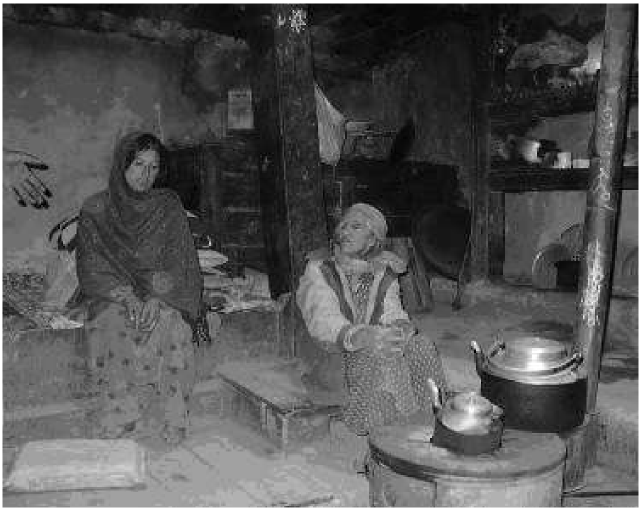


Figure 14.10
BACIP Fuel-Efficient Stove

evening and in the morning to cover/open the roof opening with plastic sheet. On an average five minutes are consumed by each trip. When the total hours is calculated, it consumes three to five working days of working hours each winter season. Households with RHW have reported the illumination level in the house has increased therefore, reducing the need to burn fuel for lighting.

BACIP Smokeless Fuel-Efficient Stoves—FES

Smokeless and fuel-efficient stoves were introduced by the Aga Khan Planning Building Service, Pakistan (formerly Aga Khan Housing Board—Pakistan) 15 years ago. The stoves replaced the three stone open hearths. In the initial years, the fuel-efficient stoves performed well, but in later years due to using low quality materials for producing the stoves resulted in quick deteriorating and hence resulted in emitting smoke in the house. Therefore, smoke was still an issue for the villagers even though stoves were being used. In some valleys e.g., Chitral and Ishkoman villagers were still cooking in open fire.

On communities demand, BACIP started developing improved stoves. Many ranges (size and shape) of durable and easy to make stoves have been developed. Customers' preference in this regard is well taken by adding in the design of the stoves. The stove not only reduces firewood consumption, but also reduces indoor smoke emission due to its chimney made up of quality sheets.

As far as the scaling-up of BACIP fuel-efficient products in Yasin Valley are concerned, a total of 1072 households have replicated fuel-efficient stoves. The firewood monitoring data and carbon calculations show that on an average a fuel-efficient stove saves up to 2.7 tons of firewood every year resulting in the reduction of 4.05 tons of carbon emissions. When firewood saving and carbon emissions are calculated for the 1072 project households, it totals to 2894 tons of saved firewood and 4342 tons of avoided CO_2 per households per year.

Water Warming Facility—WWF

The fuel-efficient stove was connected with a Water Warming Facility (WWF) to warm water during cooking, so that extra fuel on heating/warming can be saved.

Water Warming Facility is one of the cherished products of women and its replication has been on the surge by all communities across the northern areas and Chitral. Its replication has gone beyond 7000 products within a short span of time. It helps the housewives in having the warm water at threshold and allows the children take bath in the winters

Table 14.3
FES/Product Combinations and Relative Reduction CO_2 Emissions

No. of Households Using EE-HI products (N=1356)			Firewood Saved	CO2 Avoided (tons)	
Product/Combinations	**#**	**%**	**Tons/HH/Year**	**HH/Year**	**Total/Year**
FES	29	2	2	3	87
FES – RTT	8	1	5	7	56
FES - WWF	888	65	5	7	6,154
FES – RHW	2	0	Already calculated in RHW section		
FES – RHW - WWF	54	4	Already calculated in RHW section		
FES - WWF - HIT	45	3	11	17	760
FES – RTT - WWF	14	1	7	11	154
FES – RHW	2	0	Already calculated in RHW section		
Total	**1042**	**77**	**23**	**34**	**7211**

Fuel-Efficient Stove has been installed in 77 percent of the project households, resulting in avoiding 7211 tons of carbon annually.

Figure 14.11
Warming Water on Stove

Figure 14.12
BACIP Water Warming Facility

Figure 14.13
BACIP Water Warming Facility

resulting in hygienic practices among the family members. Women are very happy with it as now they do not have to travel for hours to reach spring waters down the road and/or riverbanks with a bundle of wooden sticks to heat up the water. At times women have to break their arms and legs while walking over ice and snow covered streets in the winters. Our evaluation research shows that many health benefits are associated with this product which includes an increased frequency of hand washing, bathing, washing utensils, and laundry.

As 2.7 tons of firewood is saved by the fuel-efficient stove per year per households, an additional (2.3 tons) of firewood can be saved by connecting the fuel-efficient stoves to the water warming facility. Therefore the total fuel saving for the households using both fuel-efficient stoves and water warming facilities is 5 tons per year per households, subsequently reducing 7.5 tons of CO_2 emissions. In Yasin Valley 1032 households are using Water Warming Facility with combination of different products, especially fuel-efficient stoves.

House Insulation Techniques—HIT

Cold in winter, the large amount of firewood used and the difficulty of keeping house warm was a prominent problems identified by the community members during the BACIP preliminary research. Therefore, BACIP designed four types of wall insulation techniques. The designs are based on the realization of light cavity wall constructions on the inside of heavy stone or cement block exterior wall constructions. The designs have been made in such a way that they can be applied in either existing or new houses (see Figure 14.14 for wall insulation on existing walls). The wall insulations are thermal-efficient and can save up to 40 percent of firewood requirements. The performance of the wall insulation is supplemented with the installation of RHW and Floor Insulation. In Yasin Valley during the 18-month project time, 248 households replicated different house insulation techniques, which included wall insulation and floor insulation. It was determined through carbon monitoring that a total of 3.64 tons of carbon emission is avoided each year by one household by just insulating the house. The rest of the details are as given in Table 14.4.

For Floor Insulation, P.E. foam is laid on the floor as protection from the cold. While serving as underlay in the cities, the P.E. foam is an insulation measure for the households in the villages. P.E foam replaced the traditional methods of floor insulation by putting wheat chaff or other dry straws under the rug.

Figure 14.14
BACIP Wall Insulation on Existing Walls

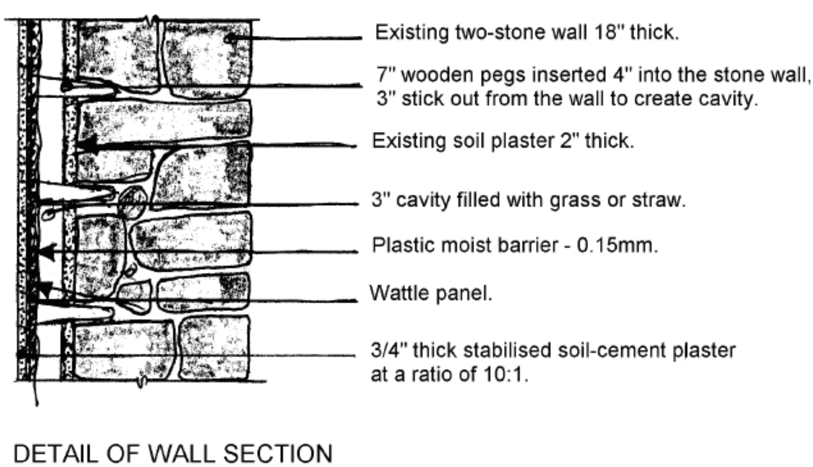


Table 14.4
WWF/Product Combinations and Relative Reduction CO_2 Emissions

No. of Households Using EE-HI Products (N=1356)			Firewood Saved	CO2 Avoided (tons)	
Product/Combinations	**#**	**%**	**(Tons)/HH/Year**	**HH/Year**	**Total/Year**
WWF	2	0	3	4	8
WWF - FES - RHW - HIT	20	1	11	16	329
WWF – FES	888	65	Already calculated in FES section		
WWF - FES - RHW	54	4	Already calculated in RHW section		
WWF - FES - HIT	45	3	Already calculated in FES section		
WWF - FES - RTT	14	1	Already calculated in FES section		
Total	**1023**	**75**	**14**	**20**	**337**

Table 14.5
HIT/Product Combinations and Relative Reduction CO_2 Emissions

No. of Households Using EE-HI Products (N=1356)			Firewood Saved	CO2 Avoided (tons)	
Product/Combinations	**#**	**%**	**(tons)/HH/Year**	**HH/Year**	**Total/Year**
HIT	151	11	4	5	824
HIT-WWF - FES- RHW	20	1	Already calculated in WWF section		
HIT – RHW	30	2.2	Already calculated in RHW section		
HIT -FES – WWF	45	3	Already calculated in FES section		
HIT-WWF	1	0	6	9	9
Total	**247**	**18**	**4**	**5**	**833**

18 percent of the project households are using house insulation techniques, while this technique helps in complementing the fuel efficiency of other products. The impact of BACIP EE-HI products in reducing CO_2 emissions is relatively lower in Yasin Valley than other project regions mainly due to the fact the householders are poor and the floor are not insulated properly.

BACIP Solar Cooker—SC

The higher altitude with less air mass, the attenuation in the intensity of solar beam, and located in the southern belt (more light zone) makes the northern areas of Pakistan suitable for solar cooking. Studies have shown that there are 225 sunny days available in a year in the northern areas. The efficiency test of BACIP solar cooker showed that solar cooking is slower and hence is nice for cooking and baking without burning or over cooking food. Solar Cooking is a very new concept in the northern areas; people are still finding it difficult to buy the idea, especially the cooking times with the solar cooker is longer than the conventional cooking methods. Adaptation to this production is not very easy due to conventional cooking methods, but 70 households have bought BACIP Solar Cooker and are using it. The benefits of the solar cooker and fuel saving efficiency can be seen from the case study given in Box 14.2.

5. Conclusions

BACIP's Energy-Efficient and House Improvement Products including: Water Warming Facility (WWF), Roof Hatch Window (RHW), House Insulation Techniques (HIT), Roof Treatment Techniques (RTT), Fuel-Efficient Stoves and Light Roofs (FES) not only helps in reducing domestic fuel requirements, but also improve the space management in the house, increase illumination, improve ventilation, seismic resistance and ensure availability of warm water for hygienic practices. The scaling-up of this project can result in significance reduction in CO_2 emissions.

Firewood requirements are great in higher altitude regions e.g., Yasin Valley, situated on an altitude of 8500 ft above sea level with 8 months of

Box 14.2
Case Study

Bibi Mahi, a mother of five, uses BACIP solar cooker since 2001. The main source of fuel in her house is Liquid Petroleum Gas (LPG) in cylinders for she lives in the Gilgit town. The prices of LPG were growing every month. Therefore, she convinced her husband to buy her a Solar Cooker costing Rs. 2500 (US$ 41). At first she used the solar cooker to soak lentils and boil rice. Gradually, she started cooking every kind of food with it. She came up with her own recipes for the food cooked in it, which she shared with BACIP staff back in 2003.

Mahi uses the solar cooker throughout the year and cooks every kind of food in the cooker. Her fuel cost on buying LPG cylinder has reduced to 40 percent to 50 percent. She now uses an 11 kg LPG cylinder for 15 to 20 days. She is very happy with the result of the cooker, as it has lessened her time to spend in the kitchen. In 2001 an 11 kg LPG cylinder used to cost Rs. 600 (Rs.55/kg), where as in 2008, it cost about Rs. 900 (Rs. 82 per kg), showing a 49 percent increase in the price during the last 8 years. Since Bibi Mahi is using the BACIP Solar Cooker from 2001, therefore, she has been saving Rs. 5425 (US$ 90) per year for the last 9 years. She puts the food in the solar cooker and goes to the market or visits a friend and by the time she is back the food is ready.

Figure 14.15
Bibi Mahi with her Solar Cooker

winter season, and face fuel shortage through out the year. The majority (67 percent) of households have to buy firewood from the local market costing up to Rs. 450 (US$ 8) a mound (40 kgs). On average 25 kgs of firewood is being used on daily basis during the winter months for cooking and heating, spending US$ 4 a day while most households depend on subsistence farming and livestock for their daily livelihoods.

The objective of the assessment was to determine the reduction in fuel requirement after the installation and replications of BACIP EE-HI products. The methods adopted for assessment were appropriate and flexible enough to adapt the local contexts, ensuring that the methods were standardized, comparable and statically sound. The method that was chosen for monitoring the fuel wood consumption was "before and after" with a baseline survey and baseline firewood monitoring before the interventions begin.

The EE-HI products installed in Yasin are: WWF, RHW, wall and floor insulation techniques HIT, RTT, FES, and Light Roofs. The most popular EE-HI products were Fuel-Efficient Stoves, replicated in 1042 houses, and WWF replicated in 1023 houses in 18 months showing that the products are highly adaptable and can be scaled-up in all the houses in the mountain communities.

The fuel assessment in Yasin shows that BACIP EE-HI products can save from 2 tons to 3.64 tons of firewood and 3 tons to 5.46 tons of CO_2

emissions respectively with just one EE-HI product. The majority (77 percent) of houses have installed two EE-HI products, thereby saving up to five tons of firewood yearly per household. For example, WWF and FES have been installed in 1042 houses, resulting in saving 5160 tons of firewood and subsequently resulting in 7740 tons of CO_2 emission reduction.

Notes

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1. For promotion purposes, BACIP installs an EE-HI product in selected house in the community, in return the household is to buy another EE-HI product and take part in research and evaluation regarding the products with BACIP staff.
2. Village Resource Persons are volunteer males and females from villages playing the role of a coordinating body between BACIP and the villagers.
3. Comprehensive Planning of Hydro Power Resource on Tributaries of Indus River in Northern Areas, Volume 1 of 2 (table 3.1) by WAPDA and GTZ (1992-1996).
4. A household consist of 8 to 10 members in Yasin Valley.

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Part IV

Adaptation to Climate Change

15

Monitoring and Evaluation of Adaptation to Climate Change Interventions

Osvaldo Feinstein

This section of the book discusses methodological challenges in the design and implementation of monitoring and evaluation (M&E) frameworks for projects dealing with adaptation to climate change. The chapters draw on the GEF and UNDP experience with this type of projects, and specific M&E proposals are made which could be useful also for other types of projects (or projects of the same type, but funded by other agencies or governments). Furthermore, tools and experiences in M&E of climate change adaptation projects are presented in a chapter based on the Bangladesh experience.

The presentations on which this section's chapters draw triggered a dialogue during the Alexandria international conference which served to validate some of the proposals and arguments made in the presentations, and also helped to identify promising M&E practices, knowledge gaps and innovative ideas to monitor and evaluate adaptation to climate change interventions.

Key conclusions and recommendations concerning M&E approaches, methods and tools in this area, which are developed in the chapters included in this part of the book, can be summarized as follows:

a) Promising M&E frameworks to deal with adaptation to climate change interventions are under development but have not been applied.

b) There are very few ex post evaluations of adaptation initiatives, though it is acknowledged that evaluation is necessary for learning, accountability and transparency.

c) Adaptation initiatives are sector or theme specific so evaluations should be sector or theme specific as well, but designed in such a way that it would be feasible to aggregate findings in meta-studies.

d) Stakeholders participation is very important in monitoring and evaluation of adaptation interventions and in the design of adaptation projects/programs.

e) Concerning indicators, good examples were identified in disaster and water resources projects, whereas in other themes or sectors there is an "indicator gap."

f) Insufficient attention has been paid to ex ante evaluation of the relevance of interventions, which is precisely something that can and should be done before implementation.

g) M&E of adaptation interventions should enable the provision of quick feedback to new initiatives. Furthermore, the examples presented in the chapters of this section suggest the following conclusions on interventions aiming at adaptation to climate change[1]:

1) Project goals are sometimes formulated too broadly, and the proposed adaptation measures are not sufficiently clear.

2) There should be a discussion of the advantages and disadvantages of full integration of adaptation into sustainable development vis-à-vis isolated adaptation projects; in practice there are few stand alone adaptation projects.

3) People have been coping with weather events throughout history but weather variability has increased. Their ability to cope with threats to their livelihoods during events and to infrastructure has been eroded and an "adaptation deficit" has thus emerged.

4) Adaptation measures are applied within complex contexts making coping mechanisms weaker (i.e., corruption, weak governance, vulnerable groups, population growth, etc.).

5) The possibility of "Black Swans"[2] in climate change should be considered: large impacts from hard to predict and rare events beyond the realm of normal expectations. Coping with them will be extremely difficult but being aware of their possibility would enrich the risk management perspective.

The chapters identify (and to some extent address) a set of *evaluation challenges* such as: attribution in complex and high uncertainty contexts; the need to consider "relevance" at the project level and in a wider context; the different scales of adaptation interventions; and the implications for evaluation of considering success when nothing negative happens (which requires a careful identification of a relevant and practical counterfactual).

Finally, and as ways to cope with the challenges referred to in the preceding paragraph, examples of some concrete suggestions provided in these chapters are the following: baselines, essential for adaptation projects, should be done as part of project design and implementation, rather than as stand-alone exercises; adaptation assessment tools should be developed; piloting participatory M&E to improve capacity and for learning; use, and when needed guidelines for developing indicators (i.e., nesting, use of Geographic Information Systems, etc.); pay due attention to context and use (and eventually further develop) cost-benefit tools for the evaluation of climate change adaptation interventions.[3]

Notes

1. On this topic see the valuable collection of cases in Leary, N., Adejuwon, J., Barros, V., Burton, Ian, Kulkarni, J. and Lasco, R., (2008) editors, *Climate Change and Adaptation*, London, Earthscan.
2. "Black swans" are a metaphor for extremely low probability events. See Taleb, N. (2007): *The Black Swan*, New York: Random House.
3. The limitations of standard cost/benefit tools for valuation of consequences of climate change have been clearly pointed out by Stern, N. (2008) "The Economics of Climate Change," in *American Economic Review: Papers & Proceedings*, Vol.98: p. 11.

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Evaluation of Adaptation to Climate Change from a Development Perspective

Merylyn Mckenzie Hedger, Lisa Horrocks, Tom Mitchell, Jennifer Leavy, and Martin Greeley

This chapter is intended to provide an assessment of the state of the art and identify main gaps in evaluation of climate change adaptation interventions. Some development agencies are starting to evaluate their climate change adaptation interventions. Therefore, this is an opportune time to assess emerging efforts, to identify the key issues for further attention, and to see where consensus should be built.

We need to be able to evaluate adaptation to climate change and also measures which increase resilience to current climate variability within a broader development perspective. This can mean that climate change provides a longer-term perspective for development efforts, which opens up the possibility of new and different strategies.

From literature reviews it is known that adaptation measures that consider climate change are being undertaken by a range of public and private actors through policies, investments in infrastructure and technologies and behavioral change. It is possible to identify eleven distinct adaptation strategies including: changing natural resource management practices; promoting planning and policy changes; improving infrastructure and empowering people. These diverse activities take place at different scales; international, national, programmatic, project, community and local levels, and across many sectors, currently agriculture and water notably, but also health and poverty reduction.

Very few evaluations of Climate Change Adaptation Interventions have been undertaken. Whilst many projects are participatory and demand driven, monitoring and evaluation has been designed post-hoc and frequently not embedded in the project. The review of the GEF database shows that methods used so far in the evaluation of climate change adaptation interventions could be improved and strengthened with a greater focus on the critical features of what makes successful climate change interventions. The key modifications that are needed to evaluate climate change adaptation interventions include:

- Time frames: mechanisms to provide ongoing feedback on impacts beyond the lifespan of the project and Institutional memory—Information storage and retrieval systems
- Methods: Participatory evaluation—360°
- Impact indicators developed in partnership with beneficiaries
- The establishment of baseline scenarios and development of the capacity to monitor and evaluate change over long timescales, retaining the information and provide it in usable formats at the right time.

Efforts should be made to build a consensus about what is successful adaptation, so that there is a clearer framework for evaluation of interventions intended to deliver it. The five main factors which can determine successful adaptation are: effectiveness—achieving objectives; flexibility—to account for the uncertainty of climate change and the evolving knowledge base; equity—across sectors; regions and societies; efficiency—to address agreed acceptable levels of risk; and sustainability—the wider implications of adaptation.

Adaptation evaluations must be integrated with existing evaluation frameworks to avoid issue fatigue on the ground. Commonly used indicator frameworks for vulnerability and sustainable livelihoods analysis can provide a considerable amount of data that is compatible with climate change adaptation, which require no more than "re-packaging" to fit an adaptation context. This is particularly important given that many development agencies and practitioners are fatigued by yet another new issue appearing as a fad to those with long-standing experience. Accommodating climate change adaptation interventions within existing evaluation frameworks, reducing additional work, is vital.

Due to the diversity of climate change adaptation interventions, across the continuum and across all scales (project, program, national, international, systemic) a variety of monitoring and evaluation tools could be used to cope with the complexities and the specific context in which the tools are being used.

Having established why evaluations of climate change adaptation interventions are needed, this chapter discusses the following questions:

What are the key issues involved in evaluating climate change adaptation interventions? And what approaches to and methods for adaptation evaluation have or could be used at different levels?

1. Why Are Evaluations of Climate Change Adaptation Interventions Needed?

Climate change adaptation interventions are evaluated for four reasons:

- Increases in funding
- Gathering political momentum
- Evolving approaches to evaluation of development assistance
- Increasing understanding of adaptation and its relationship with development

For the purposes of evaluation, and although the survey was not comprehensive, some relevant conclusions can be drawn from the WRI review.[1]

- Sometimes adaptation is being viewed as a means to achieve a development objective, while other times development provides a means to achieve an adaptation objective. It will be increasingly difficult to distinguish adaptation from development.
- A significant area of overlap between adaptation and development is methodological. Rarely do adaptation efforts entail activities not found in the development "toolbox" such as raising awareness, community participation, improving the knowledge base, communications and facilitating dialogue between local to national and cross-sectoral actors. Those uniquely "adaptive" elements are those involved in defining problems, selecting strategies and setting priorities—not implementing solutions.

The following sections will examine the particular features of adaptation and what evaluation methods and indicators could be developed.

2. Key Issues Involved in Evaluating Climate Change Adaptation Interventions

This section identifies and reviews the key issues involved in evaluating climate change adaptation interventions. It first examines the nature of climate change adaptation and its relationship to the concept of adaptive capacity, It then explores what the particular are features of climate change adaptation interventions.

What Is Climate Change Adaptation?

A crucial starting point in the evaluation of adaptation to climate change is to define the term “adaptation” and then clarify what might constitute “good” or “successful” adaptation. Adaptation has been understood to mean slightly different things by different organizations, and studies that have attempted to review adaptation in practice[2] have confronted challenges over the classification of activities that result in unplanned adaptation or “adaptation by accident.”

An OECD report[3] drew together definitions for key terms related to climate change adaptation. It discussed definitions of adaptation from the IPCC, UNFCCC Secretariat, the United Nations Development Programme (UNDP) and the UK Climate Impacts Programme (UKCIP), and found that these four definitions differed from one another in several ways (see Figure 16.3). They used different words to describe what adaptation is, including: “adjustment,” “practical steps,” “process” and “outcome,” all of which can be interpreted differently by various

Figure 16.1
Four Ways of Defining “Adaptation”

Definitions of adaptation

Adaptation—Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effect, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (IPCC TAR, 2001)

Adaptation—Practical steps to protect countries and communities from the likely disruption and damage that will result from effects of climate change. For example, floodwalls should be built and in numerous cases it is probably advisable to move human settlements out of flood plains and other low-lying areas… (Website of the UNFCCC Secretariat)

Adaptation—Is a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented. (UNDP, 2005)

Adaptation—The process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change. (UK Climate Impacts Programme, UKCIP, 2003)

Source: Levina and Tirpak, OECD 2006

stakeholders. "Process" is an open-ended term lacking time or subject references. Expectations from adaptation as an "outcome" might be much higher than expectations from it as a "process." Evaluation of achieved results would vary accordingly.

These seemingly small differences might create different expectations from different stakeholders. Some stakeholders (e.g., community-based adaptation practitioners) use a more technical interpretation of the term, while others (e.g., adaptation policymakers) use a broader definition and emphasize the institutional/policy side of adaptation. These varied interpretations would mean different approaches to evaluation would be required.

If adaptation is understood as a decision process, rather than a specific action or a series of one-off decisions, then tools, including evaluation tools, are needed not merely to inform or justify single decisions, but to assist decision-makers and those who have a stake in the outcomes of their decisions. If adaptation is understood as an outcome (for example, of climate change resilient development) then evaluations would logically need to focus on the long-term effectiveness of development decisions in the face of the changed climate.

Adaptation and Adaptive Capacity

One of the critical issues arises in connection with the term "adaptive capacity," which is used widely with reference to adaptation in the context of development. Does adaptation lead to increased adaptive capacity? Alternatively, does increased adaptive capacity increase your ability to adapt? Does adaptive capacity indicate the possible limit of adaptation? It seems that most authors and practitioners use the term "adaptive capacity" as a characteristic of a system and its ability to adjust to climate change on its own. Thus, adaptation will increase this ability.

Studies on how to measure adaptive capacity are in their infancy and have not reached consensus.[4] Taking one example, Yohe (2001) suggests the following determinants for adaptive capacity:

- The range of available technological options for adaptation;
- The availability of resources and their distribution across the population;
- The structure of critical institutions, the derivative allocation of decision-making authority, and the decision criteria that would be employed;
- The stock of human capital, including education and personal security;

- The stock of social capital, including the definition of property rights;
- The system's access to risk-spreading processes, e.g., insurance;
- The ability of decision makers to manage information, the processes by which these decision-makers determine which information is credible and the credibility of the decision-makers, themselves, and
- The public's perceived attribution of the source of stress and the significance of exposure to its local manifestations.

Gathering data on these determinants and then measuring change in them is extremely challenging, particular in developing country contexts.

Type of Adaptation

Adaptation strategies contain a wide variety of interventions, reflecting its multi-facetted nature. One typology is included below—this excludes consideration of scale—and also encompasses both process-type activities, in relation to building adaptive capacity and also direct interventions that deliver adaptation actions, such as physical infrastructure. Some adaptation programs may cover several of these elements.

What Is Successful Adaptation?

There is a lack of consensus about what constitutes *successful* adaptation, starting at the global level and having rippling effects downwards. Ultimately, successful adaptation will be seen on multi-decadal timeframes based on the achievement of development objectives sensitive to a changing climate. However, the assessment of such long-term achievements would require monitoring and evaluation to extend over periods much longer than with those associated with project and program lifetimes.

OECD's Development Assistance Committee has agreed a standard set of international criteria to guide all evaluations of development assistance. These are: relevance, effectiveness, efficiency, impact and sustainability. We propose that a modified set of these criteria will help to define successful adaptation for evaluation purposes. Figure 16.4 sets out the five criteria of *Effectiveness*: Achieving objectives; *Flexibility:* How far can we adapt? *Equity*: Inequality dimensions to adaptation; *Efficiency:* Cost-effectiveness; and, *Sustainability*: The wider implications of adaptation.

Frameworks for evaluating the success of climate change adaptation must recognize that CCAI occur at all scales, requiring reflection on what constitutes success at each level scales.

Figure 16.2
Typology of Adaptation Strategies Modified from McGray, Hammill and Bradley (2007)

Adaptation Strategy	Description
Changing Natural Resource Management Practices	Emphasizes new or different natural resource management practices (e.g., for managing water, land, protected areas, fisheries) as adaptation strategies.
Building Institutions	Creates new or strengthens existing institutions (e.g., establishing committees, identifying mechanisms for sharing information across institutional boundaries, training staff responsible for policy development).
Launching Planning Processes	Sets in motion a specific process for adaptation planning (e.g., developing a disaster preparedness plan, convening stakeholders around vulnerability assessment findings).
Raising Awareness	Raises stakeholder awareness of climate change, specific climate impacts, adaptation strategies, or the environment in general.
Promoting Technology Change	Promotes implementation or development of a technology new to the location (e.g., irrigation technology, communications technology).
Establishing Monitoring/Early Warning Systems	Emphasizes the importance of creating, implementing, and/or maintaining monitoring and/or early warning systems.
Changing Agricultural Practices	Focuses on new or different agricultural practices as adaptation strategies.
Empowering People	Emphasizes literacy, gender empowerment, or the creation of income generation opportunities as a basis for adaptation.
Promoting Policy Change	Promotes establishing a new policy or adjusting an existing policy.
Improving Infrastructure	Focuses on creating or improving built infrastructure (e.g., roads, sea walls, irrigation systems).
Providing Social Protection	Creates, modifies and promotes insurance, credit, asset transfers and safety nets.
Other Strategies	Adaptation in disaster relief, eradication of climate-related diseases, assisted migration schemes etc.

Source: Developed from Burton et al., etc.

Figure 16.3
Factors in determining the success of climate change adaptation

Measure	Description
Effectiveness: Achieving objectives	An effective adaptation intervention will achieve its stated objectives, be these to reduce vulnerability or risk, increase adaptive capacity, or achieve an enhanced level of protection. Evaluation against this criterion should therefore be relatively straightforward, providing that measurable objectives have been stated and clearly defined at the outset. Whilst effectiveness relates to adaptation outcomes, it also relates to the adaptation process, including capacity building, information exchange and social learning. Complications arise when evaluations are extended to examine the impact of CCAI on poverty, as care must be taken that the achievement of adaptation objectives does not have a detrimental affect on level of poverty nor a negative longer-term impact on vulnerability. Therefore, all adaptation evaluations should include measures of the overall development impact the intervention has in addition to any evaluation of how well it has achieved the objectives. There is potential for conflict between funders and beneficiaries, and within different groups of beneficiaries, which need to be addressed at the outset.
Flexibility: How far can we adapt?	Climate change is uncertain, due partly to an incomplete understanding of climate science, and partly to the fact that climate change will impact upon a future world. The large uncertainty around climate change means that it is likely we will either do too much, or too little, adaptation. One response to this is to plan for the "worst case scenario." However, there are disadvantages to this approach, not least because it is extremely expensive, and spending more money on adaptation (especially in relation to potential benefits in the far future) reduces resources available for pressing development needs now. Instead, there is a growing recognition that adaptation should seek to avoid large up-front sunk

Figure 16.3 (cont.)

	costs, and focus instead on building capacity to improve current climate resilience, and on "no regret" and "win-win" interventions, allowing for better decisions downstream. Successful adaptation therefore has to be flexible, not least because of the potential range of climate changes projected under different emissions scenarios.
Equity: Inequality dimensions to adaptation	Adaptation aims to reduce vulnerability to climate change shocks and stresses. However, vulnerability also depends on socio-economic factors, which implies that any given adaptation may reduce vulnerability inconsistently across groups. Adaptation can reinforce existing inequalities, or it could be designed in such a way as to protect especially vulnerable groups. With respect to equity and vulnerability, it is possible to consider: • Inequalities between sectors, e.g., ecosystems are particularly vulnerable to climate change because of low capacity to adapt. • Inequalities between regions, e.g., greater impacts from climate change in small island states compared to developed countries; • Inequalities within societies, e.g., cementing the voicelessness of excluded groups, or gender inequalities in access to education or healthcare, lowering adaptive capacity. In some situations these interact. For example recent analyses in Africa, Asia and Latin America, for example, show that marginalized, primary resource-dependent livelihood groups are particularly vulnerable to climate change impacts if their natural resource base is severely stressed or degraded by overuse or if their governance systems are not capable of responding effectively Adaptation interventions that are inequitable will undermine the potential for welfare gains in the future, and are unsustainable.

Figure 16.3 (cont.)

Efficiency: Cost-effectiveness	Efficiency or cost-effectiveness is typically used to compare the costs of alternative ways of producing the same or similar results, i.e., to assess the least-cost path to reaching a given target. However, we note that cost-effectiveness only provides comparative information between two or more options. It does not provide an analysis of whether an intervention is justified in itself. Secondly, in relation to adaptation, it is unclear what level of ambition, in terms of reducing risk, to aim towards. This is particularly since communities have always dealt with climate variability and there will inevitably be residual risk in future. Successful adaptation will involve deciding on acceptable levels of risk (defined to some extent by communities, policy-makers and funders in a collaborative way) as a trade off with the resource invests needed to reduce this risk, and whether this should involve maintaining or improving on current levels of risk and resilience accordingly. Financial markets can directly internalize information on climate risks and help transfer adaptation and risk-reduction incentives to communities and individuals. The insurance sector- especially property, health and crop insurance- can efficiently spread risks and help reduce the financial hardships linked to extreme events. There are also opportunities for “regulatory” incentives on adaptation where there is a high or very high likelihood of specific patterns of climate change. In some sectors, e.g., housing in areas of high hurricane risk, insurance markets may drive such change. Also, public awareness of specific risks will drive market-based adaptation response. Adaptation is not then restricted to projects or programs but is a function of governments using climate change science for designing incentives and regulations and markets driving technological change in both processes and outputs of production.

Figure 16.3 (cont.)

Sustainability: The wider implications of adaptation	Sustainability of an adaptation is concerned with looking beyond the immediate sphere of the intervention's impact. It considers the longer-term viability of the intervention (e.g., how far are the benefits of an activity likely to continue after donor funding has been used up or withdrawn). It also considers the broader environmental, social and economic impacts of implementing an intervention. Thus there is potential overlap with the criteria of "Equity" (Social) and "Efficiency" (Economic), above (those adaptations which are equitable and efficient are more likely to be sustainable). The characteristic of sustainability provides an opportunity to prioritize those adaptations, which offer "win-win" solutions—that is those which offer ancillary benefits (social, economic, environmental) in the context of development, even if the anticipated climate impacts were not to occur. Sustainable adaptation is likely to include strong elements of partnership-building, community engagement, education and awareness-raising, as well as focusing on interventions which are "mainstreamed" into existing development processes and mechanisms, and cutting across key sectors (water management, agriculture, health and education).

Dealing with Maladaptation

Whilst there has been much attention focused on the effectiveness of adaptation in reducing climate change vulnerability, and so potential impacts, it is rarely appreciated that if done badly, (adaptation) interventions can actually exacerbate the effects of climate change. This is termed "maladaptation." The IPCC (2001) defines maladaptation as "any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability, but increases it instead." Following on from the discussion of successful adaptation (above) and Downing et al. (2005), a more pragmatic explanation of maladaptation is any kind of action that might involve one or more of the following:

- Inefficient use of resources compared to other options (e.g., unnecessarily displacing development funds away from other concerns)
- Ineffective (e.g., relying on scenarios of future climatic risks that are not subsequently realized and actions that have no other benefits)
- Inequitable reductions in vulnerability (or shifting vulnerability from one group to another)
- Inflexible decisions or investments that may reduce the possibility for future adaptation

It is vital therefore to consider this issue when indicators are being framed, particularly for short and long-term periods. While not specific to climate change adaptation, evaluations must also consider whether processes of change and pathways to "success," are likely to exhibit linearity or may indeed suffer periods of stagnation or reversal as a necessary step in the route towards long-term success. Alternately, maladaptation means that initial progress towards success may eventually lead to long-term increases in vulnerability to climate change.[6]

3. Challenges for Monitoring and Evaluating Adaptation

The Nature of Adaptation

The particular issues presented by adaptation for evaluation have been discussed previously in a number of publications.[7] The nature of adaptation makes it particularly challenging for monitoring and evaluation using standard approaches, because of a range of factors:

- The long timescales associated with climate change, the difficulties with distinguishing the "noise" of natural climate variability from anthropogenic climate change, and the indirect impacts of climate-driven socio-economic change;

- The moving baseline presented by climate change (evaluation against a backdrop of a changing norm);
- The need for effective adaptation to safeguard against potential discontinuities and surprises resulting from climate variability, and the inherent uncertainty associated with climate projections;
- The mix of hazards and opportunities (e.g., taking advantage of opportunities such as longer growing seasons may increase exposure to hazards such as mid-season drought);
- The multi-sectoral nature of adaptation and the involvement of a large number of agencies and delivery partners at different scales (e.g., each may have different requirements for indicators and their own appropriate monitoring and evaluation systems and information networks);
- The inherent challenges of defining a long-term vision of the outcome of adaptation, since it constitutes the process of making adjustments to everything else (infrastructure, livelihoods, institutions, etc);
- The absence of agreed definitions of acceptable performance in adaptation, or even agreement over what constitutes success, coupled with the wide range of potential adaptation activities and a need for multi-stakeholder agreement on levels of acceptable risk.

If the aim of adaptation projects is to help communities and households to reduce their vulnerability to the impacts of climate change, two important questions are:

- How has adaptation increased the asset portfolio and governance support in such a way that decreases vulnerability to climate change?
- To what extent has adaptation investment resulted in improvement?

This implies the need for identifying appropriate, wide-ranging indicators encompassing processes as well as outcomes in order to determine what is happening at the level of the household as a result of the intervention. Because the household level is the critical unit for poverty reduction outcomes, it is logical to make it the focus also for monitoring outcomes in reducing vulnerability to climate change risks and impacts.

Effective mechanisms to feed indicator data back up through the different levels of engagement—from household to local/community, program, sub-national regions (local government), national, regional, and international—as well as ways to share information across levels of indicators, are also key. Most of the evaluations do list program and project-level context-relevant indicators, but there needs to be more systematic engagement with ultimate beneficiaries (households and communities), including 360° feedback loops as a component of participatory evaluation and stakeholder/beneficiary-determined indicators. Given the potential for differential impacts on men and women in terms of effects of climate change impacts on livelihoods, participation of women and the development of gender-sensitive indicators are also necessary. Again, there are clear benefits to be gained in carrying these up through all levels.

Another key component in monitoring and evaluation of projects and programs is that of attribution, including establishing a credible counterfactual to enable comparisons of outcomes with and without the intervention. Evaluating and attributing "success" in the absence of an event is necessary. Attribution requires clear definitions of vulnerabilities at the local level, as well as baseline scenarios, risk analysis, development of monitoring procedures, and identifying strengths and weaknesses relevant to improving community resilience.

4. A Framework for Evaluating CCAI from a Development Perspective and Next Stages

Databases of Climate Change Interventions

One critical area where more progress is necessary is to develop a database of climate change adaptations. A number of submissions have been requested by the UNFCCC, most recently in connection with the development of the Nairobi Work Programme, but it is clear that even for the leading donor group, the European Union and its Member States, bilateral and Commission efforts have not yet been brought together in a consistent way.[8] In the UNFCCC as well, there is a database of 151 coping strategies, but scope, objectives, funders, agents and implementers are not always explicit and there is also considerable overlap with the WRI database, although it is not always possible to determine project match because information is recorded in inconsistent formats in both databases—by country in the UNFCCC database and by project type in WRI's.

The most complete is WRI's analysis, based on a review of 135 "adaptation" activities labeled as such by project implementers or researchers. A significant number of cases were excluded as being knowledge generation only, and not practical action. It was also recognized that the dependence on Internet sources captured a relatively low number of legislative and policy activities. This might be why the largest body of cases were found at the community, followed by other sub national jurisdictions such as a coastal zone, a water basin or a district. Agriculture and disaster risk management predominate, followed by water resource management and coastal resources.

Climate Change and Development: National-Level Evaluation Perspectives

A comprehensive evaluation of adaptation at national level will require the development of indicators of progress. The nature and focus of such indicators will depend strongly on the purpose (and customer) of the evaluation. Adaptation indicators required by donors and development partners serve two distinct purposes. First, as a particular donor agency reviews and plans funding and program activities across its portfolio, it may need to track the status of one country against others in order to ensure that investments are directed towards the greatest need and/or where it will make the greatest difference. Indicators of adaptation at a national level in this case need not be tied to broader in-country policy goals; rather they should be transferable from one country to another. Second, a donor agency may wish to monitor the efficacy of its investment in adaptation interventions in a given country by measuring the aggregate impact at national level over a given period. In this case, it would be helpful for indicators to be scalable from community up to national level, or from project to program level.

A third situation in which adaptation indicators could be used is linked to the international political scene. Increasing levels of funding are being provided for adaptation in UNFCCC non-Annex 1 countries, and negotiations on binding climate targets are heating up. Indicators that provide a comparative measure of a country's "adaptation status" might prove instrumental in justifying access to adaptation funds as well as strengthening the case for particular international climate targets. Indicators in this context would need to be tied somehow to the individual NAPA, but also transferable across countries. Strangely, in this situation there may be tension for countries between achieving high scores insofar as it shows real reductions in climate vulnerability, and retaining low scores, if that justifies increased access to funds.

Given the range of potential evaluation needs, it is unlikely that a single indicator or set of indicators for adaptation at national level would be suitable across the board. Additionally, since climate change adaptation is still a relatively new area of policy implementation, there is very little in the way of good practice, particularly at national scale, from which to draw out best options for indicators. Finally, we highlight a further complication in monitoring adaptation: it cannot easily be separated from all of the different areas of development, which are implied by the term. The adaptation concept involves making changes to another policy area because of climate change; so there are inevitably overlaps and problems of attribution. This means that indicators may well require sector-specific dimensions. One key area of overlap is likely to be DRR.

National level evaluations of adaptation could fit appropriately into any of these categories, depending upon the purpose for which the evaluation is intended. Given that the systems, processes and data can be put in place to enable this range of development evaluations, there is no reason why similar procedures could not be used to generate adaptation evaluations. It is likely that similar indicators could be used, notwithstanding the critical issue of attribution. Just as with development, there is unlikely to be one single indicator that can be used as a measure of a country's success in adaptation, rather a group of key indicators will be required, along with crucial elements of stakeholder consultation and written review.

Household Level

In terms of poverty alleviation, which is a core concern of development, the crucial unit of measurement for impact is the household. Especially poor households that are most vulnerable to lasting damage from climate change events, are the "bottom line" in assessing CCAI impacts. Evaluation is highly relevant and there are some special challenges here. Ultimately we need to know whether household climate change vulnerability has been sustainably reduced.

When CCAI address drivers of vulnerability they are about enhancing the capacity of the household to manage climate change risks and can be evaluated quite precisely. CCAI evaluations are challenged by the absence of a counterfactual but this challenge is illusory. If household capacity to manage climate change events (i.e., their resilience) is measured through household wealth defined by their asset portfolio, as in the sustainable livelihoods framework, then before and after comparisons can provide a measure of impact.

Where CCAI relate to building response capacity, concerns process; the intervention may be, for example, a disaster preparedness intervention that does not impact at the level of the household until a climate-related event occurs. This type of DRR intervention is in a wider group of interventions that are driven by a precautionary motive. Unless the event occurs such precautionary interventions have no immediate welfare impact and rely on theory to establish their efficiency and effectiveness.

Adaptive capacity interventions—to both rapid and slow onset climate change-related events—are the major component of this set.

Where climate change adaptation interventions are about managing climate risk, they are potentially the most complex to evaluate. Such interventions are anyway precautionary, unless our science is good enough to make predictions reliable, and involve the use of climate screening guidelines to avoid maladaptation practice. They involve decisions about *changing* proposed development interventions to incorporate climate risk. They are susceptible to Type One Errors, making changes when no risk is there, in order to prevent Type Two Errors when failure to adapt results in climate change having avoidable negative impact.

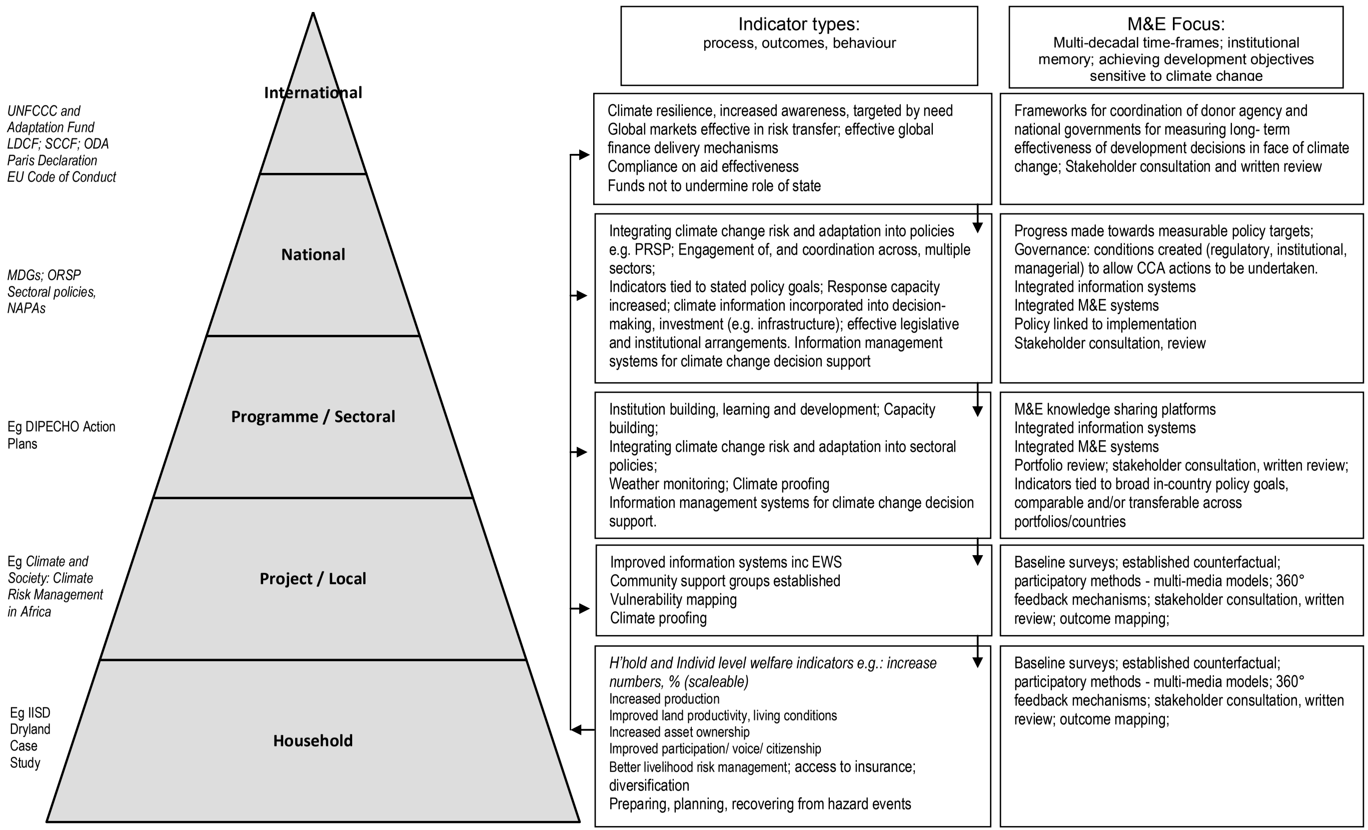
Climate change adaptation interventions that directly confront climate change are the most straightforward to evaluate. These are adaptive responses to specific identified climate change events where we are fairly certain of very high risk, and of welfare loss through failure to act. Evaluation here is concerned primarily with the cost effectiveness of alternative responses, allowing for distributional consequences.

The real need now is for the climate change adaptation industry to engage with the professionals working in evaluation and develop coherent evaluation strategies. The long-term benefits to climate change adaptation interventions welfare effectiveness may be large. Moreover, addressing this need for professional evaluation will expand the evidence base available for political debate on adaptation funding.

5. Pyramid of Adaptation Evaluation

In order to cut through the complexity involved in the evaluation of climate change adaptation interventions, we have devised a pyramid diagram, to show the interrelationships of scale, evaluation methods and indicators. What it does not do explicitly is take account of the factors for success which we have previously identified—effectiveness, flexibility, equity, efficiency and sustainability—these will need to be fully explored by the selected evaluation method and reflected in the indicators. The main point of the pyramid is to indicate the multi- scaled nature of effort required, and particularly that to deliver at the critical household level, a start is required at international level. And through this integration, a culmination of effort can be identified. The diagram attached is a first draft and can be further developed, and used in a number of different situations.

Figure 16.4
Pyramid of Adaptation Evaluation



6. Conclusions and Recommendations

1. Climate change adaptation interventions are diverse, cutting across sectors and scales. They need to deliver outcomes down to the household level. They need to enable unknown changes to be tackled over the next decades. Climate change adaptation interventions are delivered though a variety of institutional delivery mechanisms. There are known barriers and constraints to their delivery. The main message is that efforts should be made to build a consensus about what is successful adaptation, so that there is a clearer framework for evaluation of interventions intended to deliver it. We propose that the five main factors which can determine successful adaptation are: effectiveness—achieving objectives; flexibility—to account for the uncertainty of climate change and the evolving knowledge base; equity—across sectors; regions and societies; efficiency—to address agreed acceptable levels of risk; and sustainability—the wider implications of adaptation.
2. Due to the diversity of climate change adaptation interventions, across the continuum and across all scales (project, program, national, international, systemic) a variety of monitoring and evaluation tools could be used to cope with the complex and the specific context in which the tools are being used. Where climate change adaptation interventions closely match development projects, this is already happening. We have proposed a pyramid of indicators that might provide a framework to measure the accumulation and culmination of effort at local, national and global levels.
3. As climate change impacts in the hydrological cycle are not likely to move outside the range of natural variability for another 20 years, and in the case of sea-level rise will be unfolding for many centuries even after greenhouse gases are stabilized in the atmosphere, it will also be impossible to undertake ex-post evaluations. So the key will be to devise indicators that can measure progress in knowledge generation, its assimilation and application and flexible institutions at all scales.
4. Within development and DRR contexts very many evaluations have been undertaken. One important point, which does emerge, is for the need for attention to be given to the evaluation of risk reduction associated with slow onset climate-related risks. Substantially more attention has been given to rapid onset disasters. Working to evaluate slow onset disasters requires the establishment of vulnerabilities at the outset, the establishment of baseline scenarios and development of the capacity to monitor change over long timescales, retain the information and provide it in usable formats at the right time.
5. Several agencies are experiencing "indicator overload." Many of the development indicators already in use will be related to adaptation (or at least adaptive capacity), even if only tangentially. So, where established monitoring and reporting systems on sectoral issues related to adaptation are already in place, any indicator framework for adaptation should avoid duplicating them. Instead, adaptation evalu-

ations should include an element of interpreting the extent to which existing development policy and practice is contributing to progress in adaptation. Adaptation evaluations must be integrated with existing evaluation frameworks to avoid issue fatigue on the ground. Commonly used indicator frameworks for vulnerability and sustainable livelihoods analysis can provide a considerable amount of data that is compatible with climate change adaptation, which require no more than "re-packaging" to fit an adaptation context. This is particularly important given many development agencies and practitioners are fatigued by yet another new issue appearing as a fad to those with long-standing experience. Accommodating climate change adaptation interventions within existing evaluation frameworks, reducing additional work, is vital.

Acknowledgments

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17

Lessons on M&E from GEF Climate Change Adaptation Projects

Iván Darío Valencia

1. Introduction

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has made clear that climate change is happening now and taking a severe toll on societies throughout the world, particularly in developing countries. Therefore, the need for implementing adaptation measures on the ground is high on the sustainable development agenda. Although much work has been done on vulnerability and climate change impact assessments, the actual evaluation of adaptation actions on the ground is in its early stages. It is imperative to address this topic given that the world needs to rapidly learn lessons on how best to adapt to a changing climate.

This chapter is based on a report by the GEF Evaluation Office that reviews the monitoring and evaluation (M&E) systems of 17 GEF adaptation projects, approved between 1995 and 2007 and covering 42 countries. After examining the theoretical background behind evaluation of adaptation to climate change, it highlights pitfalls and successes of the methods and indicators used by the projects, and proceeds to give a series of suggestions for the development of a GEF M&E Framework for Adaptation, particularly for the LDCF and SCCF funds.[1]

The GEF and Adaptation to Climate Change

The Global Environmental Facility (GEF) is recognized as one of the largest international financiers of adaptation projects in the developing world, through the Strategic Priority on Adaptation (SPA), a one-time allocation within the GEF Trust Fund; and the independently established Special Climate Change Fund (SCCF) and Least Developed Countries Fund (LDCF).

SPA – Strategic Priority to Pilot an Operational Approach on Adaptation

The SPA has supported projects dealing with adaptation within the implementation of the GEF focal areas programs (in particular Biodiversity, International Waters, Land Degradation and, when appropriate, in projects that combine climate change mitigation and adaptation).

LDCF – Least Developed Countries Fund

The LDCF was originally created to support the preparation of National Adaptation Programs of Action (NAPAs), but has moved into a second phase of financing urgent and immediate adaptation needs of least developed countries. The priority adaptation areas of the LDCF are the following (GEF, 2006b): Water Resources; Food Security and Agriculture; Health; Disaster Preparedness and Risk Management; Coastal Zone Management and Infrastructure; Natural Resource Management and Community-Based Adaptation.

SCCF – Special Climate Change Fund

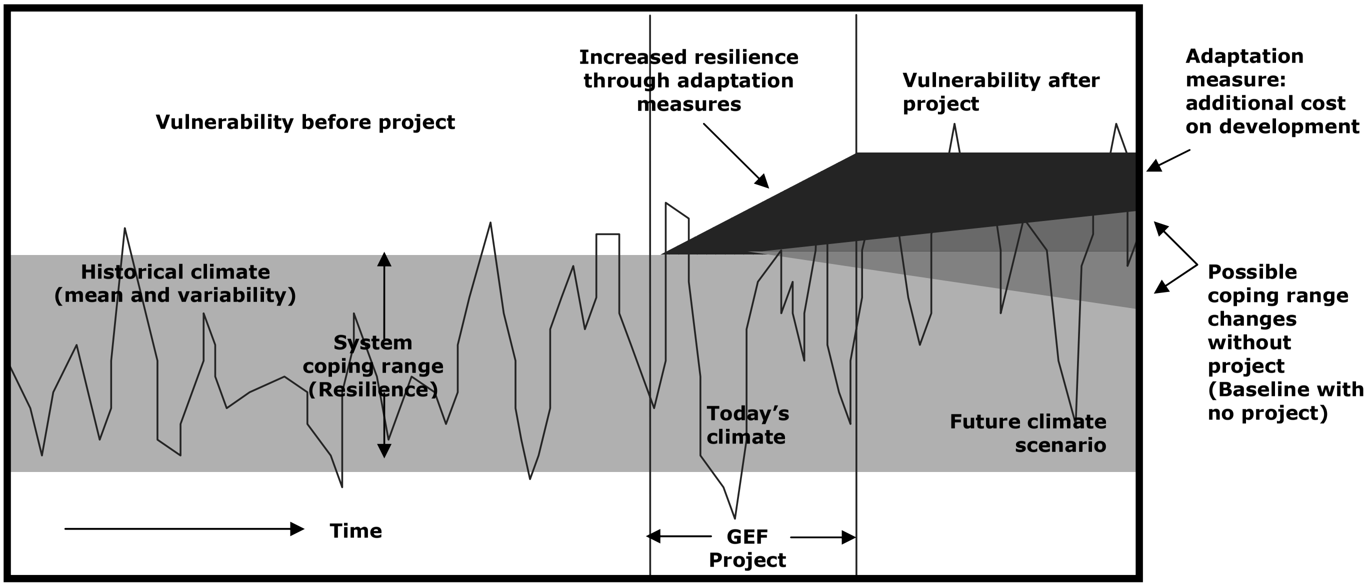
The SCCF was established to finance activities, programs and measures complementary to those funded by the resources allocated to the climate change focal area of the GEF and by bilateral and multilateral funding. This includes efforts in adaptation, technology transfer, economic sectors and economic diversification. Its priority areas for adaptation are: • Water Resources Management • Land Management • Agriculture • Health • Infrastructure Development • Fragile Ecosystems (including mountain ecosystems) • Integrated Coastal Zone Management • Capacity building for disaster risk management • Establishment of rapid response networks to weather events • Monitoring, prevention and early-warning of diseases and vectors affected by climate change

2. Monitoring and Evaluation within the Adaptation Process

GEF Projects within the Context of Adaptation

Figure 17.1 presents the different concepts within adaptation applicable to GEF projects. For a given *historical climate* baseline, with a given mean and variability, there is a *coping range* within which a system (i.e.,

Figure 17.1
Adaptation to Climate Change and the Role of GEF LDCF/SCCF Adaptation Projects



Source: Adapted from Adaptation Policy Framework (Lim et al., 2004, Technical Paper 5, Figure 5-2) a community, an economic sector, an ecosystem) can cope with climatic variability. For instance, some years are naturally wetter than others, but for the most part rainfall is within the system's minimal needs and/or does not exceed the amount that it can tolerate. In a changing climate, trends are moving incrementally towards new *scenarios* as projected by models. Some of these changes are manifesting now, and as a result, the existing coping range is no longer as suitable. There is therefore a need to *adapt* to changing conditions.

GEF adaptation projects intervene to expand or shift the coping range of the target system. They do this by implementing *adaptation measures* and activities that *reduce vulnerability* or *increase adaptive capacity.* A successful adaptation intervention would ideally contribute to a new coping range that covers most of the new climate patterns and variability under the scenario conditions. In most cases, the scenario conditions will have not materialized at the time of the project termination, although the adaptation measures might be tested by one-time events that resemble them (i.e., cyclones causing storm surges similar to the sea level rise predicted for the future).

Several development achievements such as infrastructure building, public health and poverty reduction are in peril because climate change is increasing their vulnerability. Hence, the LDCF and SCCF channel funds to "climate-proof" these development gains. For instance, efforts to reduce the incidence of malaria might be hampered by an increased risk of epidemics due to an expansion in the range of malaria-prone areas. The inclusion of climate change risk considerations is a necessary addition to the strategies to curtail the disease.

Outcomes of adaptation activities, namely *enhanced resilience, vulnerability reduction* and *improvement in adaptive capacity* are measured as outcomes for the GEF LDCF/SCCF-financed adaptation activities (GEF 2006, 2006b and 2007, UNDP, 2007), so these concepts frame the indicators to measure progress in adaptation. In order to avoid semantic discussions surrounding terminology, this paper employs the IPCC definitions of these concepts (Parry et al., 2007).[2] In the context of GEF LDCF/SCCF projects, *vulnerability reduction* would entail activities that reduce directly the susceptibility of ecosystems and human systems from the adverse impacts of climate change. It must be emphasized though, that vulnerability depends on the nature of the climate hazard and the affected system. Indicators of enhanced resilience can be thought of as indicators of vulnerability reduction. Activities to *improve adaptive capacity* would target the capacity that is used in response to or in anticipation of climate change (technological ability, information availability, policy reform, early warning systems, economic means, diversification of activities, climate change awareness, risk management, etc.) Increased adaptive capacity also allows for further reductions in vulnerability as the climate progressively changes.

Monitoring and Evaluation Systems for Adaptation

The goal for an M&E system for adaptation is to identify the aspects that are working, those that are not working, and the reasons why, as well as providing mechanisms and feedback to adjust the adaptation process accordingly. A sound M&E system would have a framework with defined goals, objectives and measures, which enables planning for data collection in anticipation of the requirements for evaluation. M&E procedures in projects can be thought of as having two distinct components. One is the monitoring and evaluation of project implementation, which makes sure the project is running well according to plan; and the M&E of project achievements, which looks at how much impact the project is having. It is important to distinguish monitoring and evaluation of adaptation interventions—implementation monitoring and ex-post evaluation, from vulnerability or climate change impact assessments—ex-ante evaluation.

3. Evaluation of Achievements of GEF Interventions for Adaptation

The evaluation of achievement of objectives in GEF adaptation projects has to satisfy both scientific and technical scrutiny, as well as the political and institutional context in which the SCCF and the LDCF were set up. Politically and institutionally, the mandates and objectives of these funds are clear: enhance resilience, reduce vulnerability and increase adaptive capacity, address the urgent and immediate adaptation needs of least developed countries (LDCF), and secure development achievements that are sensitive to climate change (SCCF). Yet, it is practical to translate those objectives into a more rigorous technical categorization, in order to identify different components of adaptation that require different methods for evaluation. UNDP's Adaptation Policy Framework (Lim et al., 2004) classifies the objectives of adaptation as follows:

Increasing the robustness of infrastructure. Achievement of this objective would be to effectively climate-proof infrastructure and development investments. Investments should be judged then by how they perform against an expected climate scenario, not against a current historical climate. For instance, the first hurricane ever recorded in the South Atlantic hit Brazil in 2004. A plausible climate change scenario for Brazil might include hurricanes as a new occurrence every few years. Thus, investments such as housing projects would be judged successful in adaptation if they adhered to higher standards and were strong enough to withstand hurricane-level winds and storm surges.

Increasing the flexibility of vulnerable managed systems. Achievement of this objective might be evaluated by having a wider coping range of a system, either by increased resilience or by the availability of alternatives. For instance, in an agricultural area where crop failure is becoming frequent, successful adaptation would mean that farmers are able to shift to a less water demanding crop if the seasonal precipitation forecast predicts dry conditions. It can also mean that crop insurance is available for farmers. The larger share of adaptation interventions belong in this category, as it virtually includes all sectors of development.

Enhancing adaptability of vulnerable natural systems. The classic case of a successful adaptation in this category involves reducing non-climatic pressures on natural ecosystems. For example, the reduction of land-based marine pollution, elimination of dynamite fishing and anchor damage from scuba diving boats on coral reefs may enable corals to be more resilient to high sea surface temperatures, diminishing the impact of coral bleaching.

Reversing trends that increase vulnerability. A successful adaptation entails preventing vulnerability in the first place. Thus, success in this category would be measured more by activities avoided than by those carried out. As an example, the reversal of deforestation in the upper parts of a watershed will reduce chances of water scarcity for users downstream in a new climate change scenario. Also, denying the building of a hotel development project on a coastline that is highly vulnerable to storms and sea level rise will be a measure of success in the reversal of maladaptation.

Improving societal awareness and preparedness. This refers almost entirely to improvements in adaptive capacity to react to climate change. Success may range from the inclusion of climate change considerations at all levels of policy, to the education and training of the population in adaptation strategies, changes in public attitudes and behaviors; and/or the existence of early warning systems to react promptly to warnings of natural hazards. An example of a successful case would be a city where an early warning system for heat waves enabled the city authorities to prepare beforehand, establishing cooling centers for residents and attending the needs of the homeless and elderly.

It should be clear that success in adaptation does not necessarily mean an improvement in the current conditions. In some cases, the best outcome that can be expected is to maintain the present state of a system and prevent it from deteriorating. Win-win situations, where adaptive capacity or vulnerability reduction is achieved concurrently with other development objectives, are not possible in some sectors and trade-offs are unavoidable. In some cases, particularly where climate change impacts seem irreversible, such as with glacier melting or coral bleaching, the most realistic positive outcome is to reduce the extent of collateral damage caused by these impacts. In other cases, however, climate change impacts could present opportunities for enhanced development. For instance, adaptation measures may involve developing markets for new technologies more resilient to new climate scenarios.

Methods to Evaluate Adaptation Success

In all the above cases there are several crosscutting criteria through which projects can be evaluated. Adapted from Horrocks (n.d.), the following paragraphs describe various approaches for evaluating adaptation projects:

1. *Evaluation against climate scenarios*. A project's outcomes should be measured against the future climate scenarios and specific hazard to which the system is adapting to, regardless of whether the scenario or hazards have actually materialized by the end of the project. Unidirectional trends like sea level rise, melting of glaciers and increase in temperatures have a higher degree of certainty in the scenarios, albeit with uncertainty in the timing; whereas precipitation variability and trends in extreme weather events generally have less precise predictions. In any case, adaptation projects should account for these conditions and be evaluated with the range of potential hazards in mind, although focusing more on those with higher likelihood of occurrence.
2. *Performance of project interventions against climate impacts*. Project activities can be tested against forecasted climate conditions if they occur during the implementation of the project. The specifications of a particular building code, the resistance of a crop variety or the performance of an early warning system adopted by a project can be tested by the advent of a storm, drought or a heat wave similar to those expected in the future.
3. *Comparison of performance between areas*. Comparing the conditions and performance in the project area with similar areas outside the project can facilitate the attribution of success or failure to a project intervention and generate compelling information that induces replication or abandonment of such a strategy. Other comparisons can be

made between areas that have suffered similar disasters at different times, in terms of relative damage or number of victims, to assess the effectiveness of disaster risk reduction measures.

4. *Assessment of outcomes against known best practices, global targets or recommended standards*. Numerous authoritative organizations (ISO, World Health Organization, IUCN, etc.) have issued quality standards, recommended benchmarks, targets and codes of practice that apply to numerous development investments. In engineering, established codes for incorporating flood risk into infrastructure design take into account return periods and magnitude of flood events. The safety of a climate-proofed bridge, seawall or levee, for instance, would be evaluated bearing in mind the return period of floods adjusted for the climate change scenario available for the region. In other cases, where adaptation means sustaining development gains, measures of success will be to maintain certain benchmarks such as nutritional indicators, water availability per capita or agricultural productivity.
5. *Comparison of vulnerability and adaptive capacity indicators via vulnerability assessments at the project completion*. The field of disaster risk reduction has ample experience on measuring reductions in vulnerability and improvements in adaptive capacity to natural disasters by developing indicators and benchmarks. Many of their indicators can be carried to the adaptation field to account for success or failure of project interventions. Given that adaptation projects by the SCCF and LDCF presuppose the existence of a previous vulnerability assessment, a reassessment of vulnerability at the end of a given project can be an excellent tool to measure project success and sustainability into the future. However, it is necessary to distinguish the role that other factors besides the project have played in changing vulnerability over time.
6. *Proxy indicators and procedural indicators*. Procedural indicators, those that account for the advancement of project activities but not their completion, are the ones that show the quickest changes within the timeframe of GEF interventions, so they are appropriate to provide milestones in the process of adaptation. However, process indicators alone, such as "policy drafted," are not sufficient to assess achievements, and it is desirable to complement them with concrete indicators of adaptive capacity improvement or vulnerability reduction (e.g., Policy approved, enforced, evaluated).

   Proxy or indirect indicators are necessary when the actual measurement of an impact is difficult to directly calculate, or its timeframe for achievement lies beyond the project lifetime. For instance, the indicator "Mangrove density and extent" would be a proxy indicator for the strength of a coastal defense against storm surges, in the absence of direct measures of resistance to storms.
7. *The Role of Context Indicators*. Depending on the type of projects, different indicators might be relevant and useful as a reference to put the GEF interventions in context. Some of them might be local in

nature, while others can be national. National level indicators such as the Disaster Risk Index (UNDP, 2005) or rates of access to potable water can help assess progress at the scale of a program. Local level data can include water quality measures and poverty levels. Changes in context indicators from the onset to the end of the project can also help assess the impact of GEF interventions.

Most countries have established development and sectoral targets and indicators. By referring to them it is possible to assess how a GEF adaptation project contributes to the development policies and strategies of the country.

Difficulties of Evaluating Adaptation

The process of adaptation to climate change has peculiar features that complicate the task of evaluating it:

1. *Success when nothing happens*. Akin to the natural disaster prevention field, there is a reverse logic in many adaptation projects: success occurs when nothing happens. Success is easily detectable if a climatic extreme occurs and the system effectively withstands it, but it is not when such an extreme does not happen or changes are more gradual. In these cases, an evaluator also needs to be satisfied that without the project intervention, the system would have had less ability to withstand the extreme event or a projected future average condition. Proxy indicators measuring adaptive capacity to manage change may be a way to overcome this.
2. *Evaluations occur too early*. There is no established reference time to which adaptation measures should be targeted; commonly cited years are 2020, 2050 and 2100. Evaluations will usually occur much earlier than the date of the targeted scenario and the expected impacts. A strategy to address this is to have regular ex-post evaluations a few years after a project's completion. To evaluate adaptive capacity in lieu of adaptation measures themselves is also helpful here because it dwells less on the effectiveness of measures at one point in time and more on the system's flexibility and readiness to change.
3. *Uncertainty in climate scenarios*. Some areas of the world have a great deal of uncertainty regarding their climate variability and change, as projected by existing models, although a common trend of many scenarios is to anticipate greater variability between dry and wet periods. In these cases, there would be a need to plan for adaptations to extreme dry and wet periods simultaneously.
4. *Short-term weather variability disguises effectiveness of adaptation measures*. The weather during the project may affect the performance of the adaptation measures carried out by the project, either positively or negatively. Therefore, it is important to monitor the climate baseline during the course of the project to discern the effect. For instance, good rainy seasons during an agricultural adaptation project may not really

test measures directed to adapt to drought, so the performance of crops during those years would not be the best measure of success for the project. Conversely, apparent failures in adaptation might actually be project successes if it is evident that without the project intervention the situation would have been much worse (UNDP, 2007).

5. *Contribution rather than attribution.* According to the GEF M&E policy (GEF EO, 2006), rather than demonstrating that a particular impact or outcome is due to a GEF intervention, it is sufficient to document a contribution to that outcome. This is in recognition of the fact that besides GEF, there are many other influential actors and events at project sites. This is aligned to current M&E thinking and removes a burden on project managers and evaluators. Through adequate baseline monitoring, the contribution of GEF interventions to adaptation benefits is much easier to determine.

Trade-offs and Synergies

A full evaluation of success in adaptation has to consider the trade-offs and synergies involved with the implementation of those adaptation actions. The ideal adaptation actions GEF projects fund are activities aligned to sustainable development principles: those that benefit development objectives, are not harmful to the environment, and yield social dividends as well. SCCF and LDCF adaptation projects, although not part of the GEF trust fund, should not work against the environmental targets the GEF has set for its focal areas.

1. *Maladaptation measures.* A successful adaptation action should not enhance the vulnerability of the system to climate change. If it does so, it is a maladaptation measure. At a local level, an adaptation action that taps groundwater supplies in lieu of rainwater for agriculture would become a maladaptation action if the groundwater were to be extracted at an unsustainable rate; making people even more vulnerable to water scarcity in the long term. There are trade-offs at the spatial and temporal scales as well. Vulnerability assessments made before the onset of project are useful to prevent the implementation of measures that might be maladaptive in the end. A local adaptation action might also increase overall vulnerability at a global level if it increases greenhouse gas emissions substantially over the baseline, for instance, by recurring to inefficient air conditioning for cooling in response to increased temperatures. Where possible and applicable, adaptation projects should strive to follow best practices of GHG mitigation.

2. *No-regrets and low-regrets measures.* A “no regrets” adaptation action is one that yields development or environmental benefits on its own, even if the regional climate scenario or hazard to which it is adapting

does not materialize as expected. A classic example is mangrove replanting for storm protection. If tropical storms do not actually intensify nor increase their frequency in the coming decades, healthy mangroves still provide nursery grounds for fish and shellfish.

Low-regrets adaptation actions are ones where the investments would be slightly regretted if the climate scenario did not materialize, but given the limited additional costs involved, are judged appropriate to perform anyway. For instance, investment on an early warning system for a heat wave involves personnel time, planning and certain equipment, but rarely massive investments. Therefore, it is deemed appropriate even if heat waves fail to occur.

High-regrets adaptation actions are actions that are very costly and might not be worth it because the economical and societal costs of the measures outweigh the benefits they bring. For instance, a massive seawall that protects a road against erosion, sea level rise and storms might be judged a high regrets option if the structures would cost large sums of money to maintain every year and many other societal expenses would not occur as a result. In such a case, it may actually be less costly for society to build an alternate road inland and let the ocean eventually reclaim the previous road.

Efficiency, cost-effectiveness and the level of risk a system can tolerate should be considered when evaluating adaptation investments. Of course, no-regrets actions are preferred to low or high regrets investments for adaptation.

3. *Environmental and social impact of adaptation measures*. The least desirable result of adaptation measures is that we find the cure worse than the disease. Therefore, when evaluating the implementation of adaptation measures, their environmental and social impact has to be taken into account beyond their effect on vulnerability and adaptive capacity to climate change. Many vulnerability assessments carried out so far have been sectoral and do not lend themselves to understanding likely impacts of adaptation in one sector on another related sector. For instance, building a dam with irrigation infrastructure to boost agricultural production might have adverse health outcomes that were never considered. Integrated assessments are necessary to minimize these kinds of problems.

Much has been discussed about the negative effects of the promotion of biofuels as a GHG mitigation activity, such as its incentives for deforestation of tropical forests and the relative increase in the price of food. Adaptation activities could have similar problems if promoted without care. One example is the migration of ski resorts uphill in the Alps; an adaptation measure that could alter the fragile ecology of pristine high mountain ecosystems, even if it succeeded in taking the ski resorts to areas with more reliable snow every year.

Conversely, another parameter by which to evaluate adaptation projects is the synergism with the global development and environmental agenda, such as the Millennium Development Goals, Poverty Reduction Strategies, contribution to biodiversity loss reduction, greenhouse gas mitigation, among others. National level priorities should also be considered when evaluating synergies.

4. Monitoring, Evaluation, and Indicators in GEF Adaptation Projects: State of the Art

Review of Project Indicators and M&E Systems in GEF Adaptation Projects

The seventeen GEF projects reviewed in 2007 were still under implementation, closed, or with a sufficiently advanced proposal to include an indicator framework. The small number reflects the limited funding available for countries and the recent implementation of the funds. Although other adaptation projects have been carried out outside of the GEF, the scope of this review was limited to the GEF portfolio. The review consisted of inventorying the indicators used, documenting the monitoring and evaluation provisions and the use of baselines.

Project Indicators

1. *Robustness of indicators by thematic area*. Relative to other project areas, projects dealing with Disaster Risk Management and Water Resources had generally more robust indicators for assessing adaptation to climate change. These sectors are closely related to climate conditions and variability, so the extension of indicators to assess adaptation is relatively straightforward. For instance, the same indicators for efficient use of water can be applied to adaptation. On the other hand, indicators for adaptation to climate change for agriculture, public health, land management and biodiversity are less straightforward. These fields, although affected by climate change, are greatly impacted by other phenomena as well, so it is difficult to isolate the climate effect from other variables and hence gauge whether the sectors are adapting successfully to a new climate. The time lag of reaction to climate is longer in many cases too.

2. *Generic indicators of adaptation*. There is a plethora of generic indicators employed by projects that have the potential to be aggregated

across multiple projects and make possible the evaluation of the total impact of the GEF. These indicators cover crosscutting issues such as policy mainstreaming, public awareness, funding, capacity building and meteorological monitoring. Surprisingly, none of the projects employed direct indicators of "reduction in vulnerability" or "increase in adaptive capacity" as measures of their success, even though these were the stated ultimate objectives of many adaptation projects.

3. *Indicators of chain of results and evaluative criteria*. Projects showed a good balance of indicators of process, outputs, outcomes and impact; as well as indicators that cover the evaluative criteria of coverage, effectiveness, sustainability and replication, required by the GEF M&E Policy (GEF EO, 2006). However, efficiency indicators were altogether absent from the sample surveyed.

In some projects, indicators of impact measure effects that might take much longer than the project lifetime. This is the case of indicators of "*area of ecosystems effectively restored*" in the Sri Lanka post-tsunami project; or "*continuous river flow guaranteed for hydropower generation*" in the Ecuador water governance project. The time lag involved requires additional indicators of progress during the project lifetime. In other cases, outcomes are more immediate, so indicators like "*percentage reduction in water leakage,*" in the Kiribati adaptation program, and "*contingency plans for flood events in place,*" in the Colombia adaptation plan, are sufficient.

Overall, the indicators used by GEF adaptation projects do not comply fully with the SMART criteria as defined by the GEF EO (2006) (specific, measurable, achievable and attributable, relevant and realistic, time-bound, timely, trackable and targeted) This is not surprising given the difficulties of measuring adaptation.

4. *Vagueness, ambiguity, and disconnection among indicators*. Among the projects surveyed, there was a tendency to define indicators in a vague or very broad way, rather than in a specific and unambiguous way. For instance, the indicator *"Reduced time lapsed between reported drought stress and response (Percentage change in decrease of time),"* from the Kenya KACCAL project, did not define what would qualify as a response. This makes aggregation of indicators all the more difficult.

With relative frequency, there was also a disconnection between the adaptation activities to be implemented and the actual indicators proposed. For instance, in the "Coping with Drought and Climate Change" project from Mozambique, the "*Food production*" indicator relies on multiple activities, such as increasing seed quality, providing technical assistance and controlling pests. However, there was only one measure of outcome, with no sub-indicators that would enable to track the success of the most important activities.

There were very few projects with indicators tallying the implementation of a concrete activity. Two examples are "*Rainwater collection facilities added*" in the Kiribati project, or "*retrofitting of infrastructure for withstanding storms*" in the coastal adaptation measures project in the Lesser Antilles. Given the problems existing with measuring success in adaptation, it is desirable for projects to use more indicators of activities, not only because they narrate a story, but also because they complement measures of outcomes and impact that may be fuzzier and more difficult to measure within a project lifetime.

5. *Binary and numerical indicators*. Simple binary indicators of a Yes/No category proved to be very straightforward and useful in many projects. These indicators can be aggregated successfully across projects. Some of them referred to the inclusion of climate change considerations in different policies and plans (mainstreaming); or to the release of publications or products (adaptation tool kit, public awareness campaign). Quantitative indicators were also common, particularly documenting the number of actions, products and beneficiaries. Although these indicators are fairly easy to collect, the information they provide on their own or aggregated across projects is limited if not given in the appropriate context. For instance, adding the number of policies that include climate change across projects may indeed give a number, but may not indicate whether the programs are effective. It is sensible to couple numerical indicators with measures of proportion, such as proportion of teachers trained with respect to the whole population of teachers.

6. *Context indicators*. Context indicators are not required from GEF projects and so they were rarely presented in a structured way. These hindrances restrict the interpretation of the rest of the project indicators. For instance, indicators such as "*rainwater collection facilities installed*" would provide much more information to the evaluator when put into context with additional context indicators like the amount of precipitation, number of days of rainfall and number of households in the area.

M&E Systems

The monitoring and evaluation systems of the adaptation projects reviewed reflected the M&E requirements of the GEF and the GEF Implementing Agencies, for the most part UNDP and the World Bank. The procedures devised are highly standardized and elaborate, focusing heavily on performance measurement, adaptive management of projects, learning and sharing of lessons, participatory monitoring and independent evaluations.

With respect to the means of verification employed by projects for their monitoring, the methods were fairly standard, such as through information found on official documents or via household surveys, interviews and questionnaires. A comparison with the baseline as a method of verification was explicit in a few projects, although it was implicit for all projects. Field surveys and field verification were mentioned too, albeit with little information as to the exact nature of the measurements involved. This reflects both uncertainty in what to measure to evaluate the success of adaptation measures, as well as the fact that many of the projects still focused on advancing adaptation in the policy and planning agenda. Unfortunately in some cases, ambiguity and vagueness seemed like a safety tactic to reduce the burden of accountability during the evaluation phase in the event that the project wasn't as successful as planned.

1. *Use of the Vulnerability Reduction Assessment.* Two projects: "Community-based Adaptation Programme" (CBA) and "Adaptation to Climate Change - Responding to Coastline Change and Its Human Dimensions in West Africa through Integrated Coastal Area Management" employed the Vulnerability Reduction Assessment (UNDP, 2007c), a simple tracking tool with seven areas of inquiry covering the different steps in the process of adaptation. The VRA follows the approach of the Tracking Tool for Management Effectiveness of Protected Areas mandated for GEF projects in protected areas (GEF, 2003).

2. *Monitoring of baselines.* A few projects paid significant attention to the monitoring of baselines. The project "'Mainstreaming Climate Change in Integrated Water Resources Management in Pangani River Basin," from Tanzania, included the monitoring not only of baseline conditions, but also of the risks and assumptions included in the log frame. The project "Adaptation to Climate Change in Arid Lands" (KACCAL) from Kenya established a baseline survey to be repeated yearly as a monitoring procedure.

3. *Adaptive management.* The vast majority of projects had provisions for adaptive management (i.e., receiving feedback from M&E activities, providing input for replication, scaling up of activities or course correction, and even review of the indicators and monitoring system themselves). Projects that were global or regional in nature emphasized the learning component and sharing of lessons learnt as a central element of the M&E strategy (UNDP, 2007b).

4. *Experimental design for M&E*. The Kenya KACCAL project was the only project of those reviewed which provided an experimental design for monitoring impacts. The project planned to compare the results of semiarid land management in districts with project interventions to conditions in districts without project interventions, which would serve as a control. This kind of experimental design is complex to carry out in practice due to the difficulty of isolating the impact of the project from other external factors that also differentiate the control and project sites. Furthermore, it is difficult to identify areas that remain comparable throughout the project life. Nonetheless, it is as a potentially effective approach because it may provide compelling evidence of the success of an adaptation measure, or of its lack of impact.

5. Suggestions for an M&E Adaptation Framework for the GEF

Both the theory and the limited practice to date show that an M&E Framework for adaptation is necessary given the complexity of the subject, its urgency, and the differences with respect to standard development and environmental projects This chapter concludes with a few suggestions about the development of a GEF M&E framework for adaptation at the program and project levels:

1. Given that the GEF adaptation programs do not have targets, the GEF could use other proxies as measurements of its achievements.

As of 2008, the GEF does not have targets in any of its adaptation programs, making the reporting of achievements more difficult. At different levels, there are alternative targets against which to report achievements:

- The targets and goals proposed by countries in their NAPAs and National Communications aggregated at the program level.
- Targets defined and agreed within the work programs of specialized agencies and international conventions relevant to appropriate thematic areas at the global level (e.g., WHO, UN-ISDR (2005), CBD).
- Aggregation of contributions of projects in certain sectors, opportunistically if they share common or similar indicators.

Another alternative is to evaluate GEF support against global priorities for adaptation. There are several existing vulnerability indices that could be used to define these prioritizations, for example: the Disaster Risk Index (UNDP, 2005), vulnerability indicators by Brooks et al. (2005), impact vulnerability index (Buys et al., 2007) and the Disaster Deficit Index (Cardona, 2005).

2. Development of an Adaptation Assessment Tracking Tool (AAT)

The use of a standard AAT across GEF adaptation projects would facilitate evaluation at the project and program level. An ideal AAT would produce useful, generic indicators of change for all adaptation projects, regardless of sector, address the overall success of the project in light of GEF's goals and evaluative criteria, and strike a balance between comprehensiveness and ease of use. UNDP's Vulnerability Reduction Assessment (VRA) scorecard (UNDP, 2007c), which captures the dimensions of change in adaptation, is a good model from which the AAT could evolve. It has been used by some UNDP/GEF projects already.

3. At the project level, the GEF should require monitoring and reporting of baselines and scenarios when appropriate.

Every project should have a presentation of baselines, in terms of climate, development, vulnerability and adaptive capacity. Projects should be explicit about the climate change scenarios they are employing and the adaptation targets they are pursuing, as well as the linkages between the two. Climate variability should be monitored during the project and adaptation measures tested if scenario-like conditions occur during project implementation.

4. Establish guidelines, identify best practices and compile references for adaptation indicators.

The GEF should develop a menu of recommended adaptation indicators both at the generic and the sectoral level to be made available to project developers. It should also encourage the combination and nesting of indicators, which help compensate for the flaws of individual indicators.

5. Evaluate trade-offs of adaptation.

Evaluators should explicitly look at the possible trade-offs involved with adaptation projects: maladaptation measures, sustainability at the local and regional scales, environmental and social impacts of adaptation measures; impacts on other sectors and cost-effectiveness of alternative adaptation options. Synergies and win-win situations should also be contemplated in project evaluation.

6. The Way Forward

The information document from which this chapter was adapted was presented to the LDCF/SCCF Council in April 2008. As a result, the Council recognized the need for an M&E framework for adaptation, and the GEF Secretariat was tasked with its development building upon this document. The full establishment of the framework, its application and its evaluation are still a few years from now, but hopefully it will help in making investments in adaptation more effective, efficient, sustainable and accountable.

Notes

1. This chapter is based on a document written by the GEF Evaluation Office with contributions from the GEF Adaptation Task Force for consideration by the LDCF/SCCF Council in April 2008.
2. *"*Resilience *is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change."*

   *"*Vulnerability *is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its* adaptive capacity.*"*

   "*Adaptive Capacity* is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (Parry et al., 2007).

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A Framework for Evaluating Adaptation to Climate Change: Evaluating Climate Change and Development

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1. Background

Adaptation is expected to have a prominent place in the "Global Deal" which is currently being negotiated in the lead up to the Conferences of Parties, Copenhagen, December 2009. Although adaptation research has rapidly expanded in recent years, it is barely keeping pace with political developments as we approach Copenhagen. One stumbling block is the issue of adaptation finance, and questions surrounding how much adaptation will cost, where the money will come from, and how we know that it has been well spent. To date, many of these questions remain largely unanswered. This paper presents a first step in evaluating adaptation, and addresses some of the basic concerns of the climate negotiators.

From as early as 2005 when the UNDP adaptation portfolio began to grow, we realized the need to develop programming guidance for adaptation (Brooks et al., in prep.), including a framework for monitoring and evaluation. At that time, there were no off-the-shelf methods. Until then, much of the knowledge and experience, including UNDP's program, was centered around its "enabling activity" portfolio of vulnerability and adaptation assessments (1994-2005). These enabling activity projects were designed to prepare reports for the United Nations Framework on Climate Change through National Communications and National Adaptation Programmes of Action (NAPAs). At that stage, few adaptation projects were designed and actually on the ground.

The depth and range of experience has since evolved, although slowly. Greater attention is being paid to the cross-cutting implications of climate change risks to development objectives, as evidenced by a growing number of high-level climate change strategies and action plans, both at the national level and within development agencies. M&E considerations and guidance presented in this chapter are in line with this shift toward mainstreaming and implementation of adaptation actions. Seven considerations are suggested for establishing adaptation monitoring and evaluation approaches, based on several factors: good practices in monitoring and evaluation, a clear definition of adaptation, and UNDP's experience to date. The considerations apply to a range of contexts and challenges in designing and implementing "climate-resilient" development (i.e., via mainstreaming) and addressing priority climate change threats (i.e., via specific program and project initiatives). These considerations are intended to simplify the seemingly daunting task of tracking adaptation in a structured way. The outcome of applying these considerations in the UNDP context is reflected in the monitoring and evaluation framework for climate change adaptation presented in the final section.

The guidance and indicators in UNDP's monitoring and evaluation framework for adaptation can be applied at the portfolio, program, or project scale. The framework is based on initial experiences in programming 20 adaptation projects[1] and is designed to track wide-ranging adaptation objectives. The portfolio has focused on the following outcomes:

- Developing institutional and individual capacity for managing climate change risks;
- Integrating climate change risks into sensitive policies at the sectoral, national or area scales;
- Implementing adaptation practices and measures at various scales; and
- Implementing information management systems for climate change decision support.

2. Current State of Knowledge

Adaptation is challenging because of its enormous scope. It covers activities that increase the resilience of national development sectors to the impacts of climate change through long-term planned responses, particularly in water resources, land, agriculture, health, infrastructure development, disaster preparedness, and in fragile ecosystems and coastal zones. Increasingly the adaptation debate is moving beyond simply providing means for accountability and tracking delivery of results.

Monitoring and evaluation tools offer promising avenues for accelerating knowledge and learning through the sharing of applied experiences—for example, case studies, lessons learned, and other results.

In addition to tracking standard adaptation indicators across the UNDP portfolio (http://www.undp.org/climatechange/adapt/alm.html), monitoring and evaluation processes also include the systematic capture of experiences or "lessons learned" following the completion of project development and annually during project implementation. These lessons are consequently shared through the Adaptation Learning Mechanism (ALM). Templates to document experiences have been developed to provide a simple structure for capturing knowledge, which are integrated into standard M&E procedures for adaptation programming. Other agencies are free to employ these templates to help broaden the base of shared knowledge. The template includes a cover sheet on "knowledge gaps" to guide responses, which will evolve as the state of knowledge advances. Experiences and lessons learned are a critical part of UNDP's broader M&E framework, and the ALM is a means through which good practices can be widely shared.

Knowledge sharing is a growing priority on the topic of monitoring and evaluation, as well as others. Among the various efforts underway is the ALM, a project of UNDP and the Global Environment Facility (GEF), implemented in partnership with the World Bank, UNEP and UNFCCC, and open to all stakeholders. The project aims to share adaptation knowledge gained from experience by providing simple structures for sharing lessons and a range of other resources. The ALM (http://www.adaptationlearning.net/) is both a M&E tool in itself, as well as a potential repository for learning about program- or project-specific monitoring and evaluation. This is particularly relevant for stakeholders mobilizing UNFCCC or other funds for adaptation, and those bringing climate change and development communications closer together. Interest in the subject seems to be high. Nearly 250 respondents to a survey of adaptation knowledge needs, or 65 percent, indicated some interest in contributing M&E experiences or results to the ALM knowledge base. (UNDP, 2007b) Precise mechanisms for knowledge sharing on M&E through the ALM are under discussion.

3. Developing an M&E Framework

The starting point for developing an M&E approach is naturally, what is the business-as-usual situation and "what are we trying to achieve?" The second question is "how are we trying to achieve it?" Ultimately development projects aim to achieve results and impacts—understanding the differences and synergies between climate change adaptation and "business-as-usual" (the counterfactual) policies and practices becomes important.

So what is known about the differences? Early adaptation literature focused on the differences between adapting to climate change and business-as-usual development and environmental management. This was a helpful phase for a few reasons:

- Examples were gained of adaptation needs that extend beyond the scope of ongoing development priorities to cope with new and emerging climate risks—for example, securing coastal infrastructure and settlements against sea level rise, reducing the risks of glacial lake outburst flooding, combating new health risks, and dealing with saline intrusion into aquifers, to name just a few. These may not fall within the scope of ongoing efforts and suggest that simply redoubling the efforts of business-as-usual development could be insufficient in addressing many of the risks of climate change.
- National vulnerability and adaptation assessments were launched that began to link climate change risks to national development objectives and to identify priorities and specific ideas for doing things differently. While NAPAs and National Communication V&A assessments are not national adaptation frameworks, they begin to lay the analytical and capacity foundations for drawing linkages and setting priorities.
- Climate change scenarios and impact models were used in management and decision processes, and as the foundation for risk assessments. The principle of incorporating forward-looking climate information into planning and decision processes remains a principle of adaptation, regardless of the current limitations. Imperfect climate change information is no barrier for action, but some decisions will hinge on greater certainty. "Soft" approaches and adaptive capacity have become priorities in many cases. As we move towards the inclusion of climate risks in planning and development assistance, the effective communication of climate change information is increasingly becoming a barrier to "mainstreaming" activities.

More recently, the conceptual and practical synergies are becoming clearer. With the growing awareness of climate change among the development community, disaster risk management and other climate-sensitive areas, the adaptation topic and "community" is beginning to expand and to attract practitioners and academics from other disciplines. As the debate broadens, knowledge from a wide range of fields is being applied to climate change challenges, enriching the discussion with practical ways to enhance resilience. Synergies will continue to evolve from the conceptual level to the technical. Both must become clearer in order to communicate and strategize coherently, and to link climate change information and tools into the technical standards of related disciplines.

During the UNDP Adaptation Financing Discussion at Climate and Development Days in Bali (December 2007), representatives from Uganda and the Gambia reported on advances being made to address climate change risks through national policy and budget processes in their countries, rather than focusing on new mechanisms or funding. Many opportunities for adaptation are already apparent at the national level, although additional financing is clearly needed, and representatives also stressed the need for enhanced national capacity.[2] At a national level, the perception of synergies with ongoing governance processes is promising.

Based on this emerging understanding of differences and synergies, the seven considerations for developing adaptation M&E approaches recognize that:

- *Climate change includes changes in variability*; adapting to near-term variability is a basis for reducing vulnerability to long-term climate change in an incremental manner;
- *Adaptation policy and measures are assessed in a development context;* this shifts the focus away from free-standing projects as a response to climate change, and towards integration of climate change into key policy and planning processes;
- *Adaptation occurs at different scales, including at the local level;* this requires a national enabling framework to promote local action;
- *Both strategy and process by which adaptation occurs are equally important;* climate change by definition is long-term, but adaptation must bring immediate and perceived benefits to stakeholders. This means that stakeholders should be part of M&E processes to generate incentives for continued adaptation and changes in adaptation measures.

These principles are embodied in the Adaptation Policy Framework (2005) but are taken to a practical level here.

4. Challenges

A number of challenges face the development of monitoring and evaluation frameworks for adaptation, including conceptual and practical issues. At the conceptual level, there is disagreement on the definition and scope of adaptation. For example, there are various views about how adaptation differs from business-as-usual development, and from existing areas of work, such as disaster risk management (see, for example, Schipper, 2007 and Eriksen et al., 2007). Here adaptation is seen as different in terms of information used, timeline of planning, and the scope of problem analysis (addressing climate vulnerability, observed change, and future risks). There is no formula to identify the "additional" adaptation component to respond to climate change relative to the development ("business-as-usual") baseline. In practice, determining what is additional is the result of a negotiated agreement, rather than a strictly technical assessment. Other approaches are being explored to avoid the thorny issue of additionality, mainly by integrating climate risks into development planning and financing, but these approaches are confronted with similar issues.

Practical challenges facing M&E for adaptation have been discussed elsewhere (see UNDP 2007 and GEF 2008), but include:

- the nature of adaptive capacity and factors contributing to vulnerability vary greatly across circumstances;
- "calibration" is a challenge given constantly changing climatic conditions that provide the backdrop for adaptation.

These challenges have been addressed at the conceptual level by clearly stating the synergies and differences between adaptation and ongoing development. At the practical level, a structured approach recognizes the varied elements of adaptation. These steps are discussed in greater detail in the following sections.

Ultimately, successful adaptation will be measured by the long-term achievement of development objectives that are sensitive to climate change. The assessment of progress toward such long-term development objectives would require M&E to extend over long periods and to successfully take into consideration multiple factors beyond climate change. This paper recognizes that any M&E approach must make informed assumptions. One unique feature of the UNDP framework is that it acknowledges these constraints and introduces alternative approaches, such as qualitative stakeholder surveys to validate quantitative indicators. The framework recognizes that quantification of processes with indicators is inherently subjective. It is often said that M&E is more of an art than a science.

5. Considerations for Designing M&E Approaches for Adaptation

The following considerations address the challenges of designing an M&E framework for adaptation. Each consideration is, itself, not novel, but taken together, they capture the unique dimensions of adaptation and reinforce good M&E practices. Applications could be made to a portfolio-scale monitoring and evaluation framework, or to monitoring and evaluation at the project scale.

1. Drawing development-climate change linkages: Defining common objectives; entry points for integrating climate change; and selecting development-oriented indicators to validate adaptation over time.

Questions: What is the motivating objective for adaptation (e.g., food security, disaster resilience, etc.), and could indicators used to monitor these objectives be useful in combination with others to validate the success of adaptation actions over time? (e.g., crop production, disaster losses)

Crop production, for example, is influenced by a wide range of factors including many non-climate issues. Such indicators may still be useful for tracking adaptation over a longer term. These would not be the only type of indicator to employ since they reflect little about adaptation in practice. Stakeholders' views can reveal factors contributing to these indicators and the role of projects (see consideration 6).

2. Focusing the scope for adaptation on key sectors, themes, or issues: Linking adaptation to sectors/themes (e.g., water, agriculture, disaster risk management, etc.), and identifying practical entry points for integrating climate change, as well as roles and responsibilities.

Rather than trying to influence every factor related to the development objective in consideration 1, this helps to set the scope for M&E and narrow down the actors for considerations 3-5. This focus can aid communication by generating specific examples of adaptation (in water resources management, for example). This step should not limit the integration of sectors and themes.

3. Identifying target processes, institutions, and capacities to strengthen system-wide adaptive capacity: Ensuring that the components of capacity that support adaptation beyond one-time measures are incorporated into M&E.

Questions: What institutional and process-related issues factor into the system's vulnerability or resilience (e.g., analysis, interpretation and use of climate information; integrated health planning; land management or policies; agricultural extension services; etc.)?

Adaptation may be commonly defined in terms of actions taken, but a broader objective is likely strengthened capacity to adapt as risks evolve. Capacity often relates to decision processes, governance structures, and institutions.

4. Identifying adaptation practices and behaviors related to development outcomes: Ensuring that behaviors and practices that put people at risk are adjusted toward more resilient ones; identifying the actors involved in adaptation, and the change sought.

Questions: What are the practices and/or behaviors that increase or reduce vulnerability (e.g., the use of climate information, crop selection, livelihood activities, building practices, etc.)?

5. Identifying adaptation measures necessary to reduce climate-related risks: Ensuring that current and/or future climate-related risks are reduced through cost-effective measures; implementing priority adaptation actions (e.g., identified in NAPAs).

This is the common conception of adaptation: building storm shelters, increasing water storage capacity, etc. Here it becomes a part of broader vulnerability reduction and capacity development.

6. Incorporating climate hazard and capacity/vulnerability factors: Ensuring that *both* the vulnerability and hazard factors identified in project studies and stakeholder dialogue inform the selection of indicators and M&E approaches. Indicators and survey questions should reflect the role of both hazards and vulnerability in resilience.

Questions: What vulnerability factors relate to climate and other risks and what climate hazards are important? Can survey questions be developed for stakeholders to rate their vulnerability over time (using stakeholders' own terms, drawing from assessments)?

Addressing hazards alone does not necessarily establish adaptive systems, and vulnerability-reduction alone may not be sustainable to certain future risks. Both components of the risk equation are incorporated here.

7. Balancing quantitative, qualitative, and narrative M&E tools: Ensuring that a mix of indicator types are used so results can be "triangulated" to give the most accurate picture possible of progress toward adaptation and the factors involved.

The use of surveys, scorecards, and quantitative indicators in adaptation contexts could be an area of greater exchange of experience through knowledge sharing platforms.

Considerations 1, 2, 6 and 7 are more or less equally relevant, while considerations 3, 4, and 5 will be more or less important in different types of efforts. The results of applying these considerations at a portfolio scale are illustrated in the next section.

6. UNDP's Climate Change Adaptation M&E Framework

Defining Adaptation to Structure M&E

A review of UNDP's climate change-related risks and opportunities to enhance resilience was the first step in shaping the formulation of an M&E framework for UNDP's Adaptation Programme. Building on the findings of this internal review, adaptation was defined in both strategic and practical terms that were consistent with the agency's human development mandate and operational strengths.

The overarching goal for the adaptation program is to "ensure progress toward Millennium Development Goals (MDGs) under a changing climate" (consideration 1). However, to guide programming at a practical level, the M&E framework sets more specific sectoral/thematic objectives in line with climate-sensitive development topics, aligned with the MDGs (considerations 1, 2). The framework recognizes that objectives and practices for adaptation vary significantly depending on the themes or sectors involved. Specific objectives set for each of six "Thematic Areas" (sectors/themes), such as improved food security and reduced climate-related disaster losses.[3] UNDP encourages cross-sectoral adaptation approaches, but recognizes that themes help to "zoom in" and determine actors, roles, responsibilities, technologies, methods, and results for adaptation:

Thematic Area 1: Agriculture/food security
Thematic Area 2: Water resources and quality
Thematic Area 3: Public health
Thematic Area 4: Disaster risk management
Thematic Area 5: Coastal zone development
Thematic Area 6: Natural resources management

Next, a set of adaptation practices were identified, which, based on preliminary experience,[4] when addressed in combination, are expected to reduce vulnerability, enhance adaptive capacity, and ameliorate priority climate change hazards (considerations 3, 4, 5):

i. Policymaking and planning (including budget and regulatory processes);
ii. Capacity development and awareness raising;
iii. Information management (including monitoring and analysis processes);
iv. Design and decision-making for investments; and
v. Risk reduction practices/livelihood activities and/or resource management.

Having identified these five components of adaptation programming, and different themes across and within which they apply, UNDP's M&E framework proposed four categories of indicators to be tracked using various techniques, including the quantitative indicators, stakeholder perceptions, and narrative (consideration 7). The indicator categories are:
i. Coverage (quantitative)
ii. Impact (quantitative, qualitative, survey-based, narrative)
iii. Sustainability (quantitative, qualitative, survey-based, narrative)
iv. Replicability (quantitative)

Figure 18.1 reflects the main elements of the structure of UNDP's M&E framework

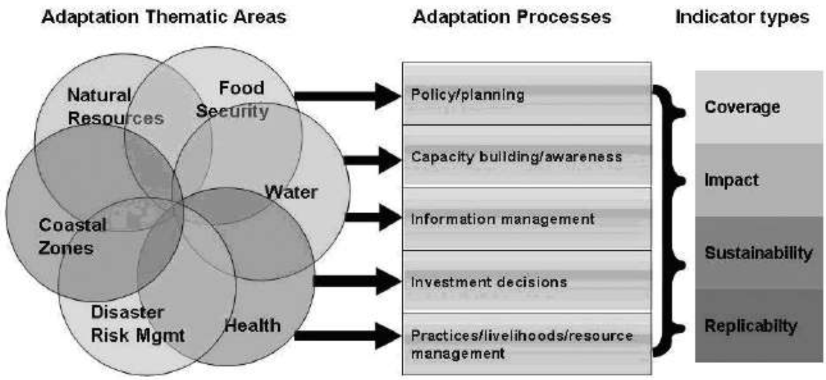
UNDP's Standard Indicators for Adapting to Relevant Thematic Areas

Based on this structure, a standard set of indicators covering the range of adaptation processes, applicable across different themes, and employing a variety of methods was developed. The indicators in Table 18.1

Box 18.1
Vulnerability Reduction Assessment

Vulnerability reduction assessment (VRA) is an evaluation tool that allows stakeholders to rate behaviors, vulnerabilities, capacities or practices through surveys or interviews on a scale from 1-10 and to provide reasons alongside their scores. Survey questions structured around the VRA build on the vulnerability and hazard factors identified by stakeholders and other assessments undertaken during project development phases (consideration 6). Monitored throughout a project's lifetime, VRA scores should reveal changes in conditions and the reasons for these changes, as seen through the eyes of stakeholders. Reasons provided in these evaluations can feed into adaptive management and help describe the role of project activities in progress observed.

Figure 18.1
Structure of UNDP's M&E Framework for Adaptation



provide options for adaptation projects and programs to select from and adapt as appropriate to different contexts. More detailed guidance and thematic illustrations are currently under preparation.

Lessons to Date—Putting M&E in Context

UNDP has learned a number of valuable lessons about how to successfully support countries in adaptation at the national level. Identifying specific strategies to further advance knowledge on these topics is a focus of current and future programs and projects.

- *Misconceptions of adaptation must be overcome.* Adaptation as a concept is often misunderstood. This gives rise to unrealistic expectations for adaptation interventions among stakeholders. The challenge to gain operational clarity on the definition.
- *There is a high demand for successful project examples.* Given the increasing interest in adaptation, practitioners are hungry for experiences from the field that demonstrate what approaches work, what to avoid, and best practices for operationalizing activities.
- *There is a high demand for policy and technical support.* Countries are seeking assistance in:
  - "Soft" adaptation measures, such as policies, plans, regulations, and incentives;
  - Integration of climate change risks into national level policies and plans;
  - Adaptation assessments to support national adaptation frameworks.
- *Capacity building is a continual process.* Building an adaptation program in a country is a long-term investment requiring ongoing

Table 18.1
Standard Indicators Applicable across Themes or Sectors

I. Coverage

i. Number of policies, plans or programs introduced or adjusted to incorporate climate change risks.
ii. Number of stakeholders (e.g., communities, households, agencies, decision-makers) engaged in capacity development activities for vulnerability reduction or improved adaptive capacity.
iii. Number of stakeholders served by new or expanded climate information management systems (e.g., early warning systems, forecasting, etc.)
iv. Number of investment decisions revised or made to incorporate climate change risks).
v. Number of risk-reducing practices/measures implemented to support adaptation of livelihoods and/or resource management.

II. Impact

i. Percent change in stakeholders' behaviors utilizing adjusted processes, practices or methods for managing climate change risks, assessed via QBS or other evidence (relevant across processes i-v).
ii. Percent change in stakeholders' capacities to manage climate change (e.g., communicate climate change risks, disseminate information, or make decisions based on high quality information), as relevant, assessed via qualitative survey (e.g., H form).
iii. Percent change in use of/performance of information management systems, for example, early warning response times.
iv. Percent change in stakeholder perceptions of vulnerability to (or capacity to adapt to) a recurrence of primary climate change-related threat(s), assessed via qualitative survey.
v. Improvement in the relevant quantitative development outcome (food security, water resources, health outcomes, etc.) in relation to average historic data or to years marked by extreme conditions.

III. Sustainability

i. Number of project beneficiaries involved in capacity development for implementation of specific adaptation measures or decision-support tools.
ii. Availability of skills and resources necessary to continue adaptation after conclusion of project (at relevant scale), assessed via qualitative survey.
iii. Stakeholder perceptions of adaptation sustainability, assessed via qualitative survey.

IV. Replicability

i. Number of "lessons learned" codified.
ii. Number of relevant networks or communities with which lessons learned are disseminated.

support and the flexibility to adjust to changing circumstances. It requires sustained engagement, perhaps extending over decades.

- *Meeting the strategic challenges of adaptation requires the expertise of all development partners.* To support societal transformation of the scale required, development partners need to mobilize their joint expertise.
- *Standards and guidance for the design and implementation of adaptation projects are needed.* Guidance documents can play a key role in developing sound adaptation projects. One such guideline is the Adaptation Policy Frameworks developed by UNDP on behalf of the GEF, which provide a structured approach to formulating and implementing adaptation strategies, policies, and measures. Guidance alone is not sufficient.

7. Conclusion

Monitoring and evaluation tools play a key role in accelerating knowledge and learning on the topic of climate change adaptation, particularly given its inherent complexity and the vital importance of getting it right. Standard development and environment indicators fall short in the adaptation context. They do not reflect the nature of adaptation—which is about capacity, behavior, and risk-reducing measures for the advancement of development outcomes. The structured approach to M&E described in this chapter can help to convey both the conceptual foundations and the practical means by which resilience will be achieved. It also provides a basis for further improvement and innovation. Scaling up mainstreaming efforts and mobilizing funds for adaptation will hinge on sound methods and clear results. A broad exchange of approaches and applied experiences is essential in this area, and an open interface for structuring the exchange of monitoring and evaluation experiences and good practices is being explored through the Adaptation Learning Mechanism (ALM).

Notes

1. The UNDP adaptation portfolio can be accessed at www.undp.org/climatechange/adapt.
2. UNDP unpublished report from the High Level Discussion on Adaptation Financing, Climate and Development Days, December 12, 2007, Bali, Indonesia.
3. A programming guidance paper is under development that details the nature and scope of adaptation in each theme or sector.
4. UNDP's portfolio of adaptation projects at the end of 2007 totaled ~$50 million in GEF funding, and ~$140 million including co-financing. Approximately 20 projects had carried out project development phases (involving $25k to $1 million for a 10-country project). Thirty countries had been supported in developing NAPAs. A handful of countries began project implementation in 2007.

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Climate Change and Adaptation Accounting for Flood Hazard in Bangladesh

Monirul Qader Mirza

1. Introduction

In the recent past, increasing episodes of climate extremes and variability (e.g., floods, droughts) have demonstrated the vulnerability of the human, economic and social systems to these events. The frequency of extreme weather events is on the rise. In 2006, the Munich Re registered 30 devastating loss events in 2006 as against 15 in the preceding year that means a 50 percent increase. Since 1950, an increasing trend in catastrophic losses is also registered (Munich Re, 2007). In the last few years we see increasing episodes of flooding worldwide. Some large events are: devastating floods in Bangladesh (2004 and 2007), India (2005 and 2007), Mozambique (2001), Europe (2003), and Horn of Africa (2006). These are due largely to increases in frequency of heavy precipitation events over most land areas that lead to flooding but not everywhere. This is consistent with warming and observed increases in atmospheric water vapor (IPCC, 2007a).

The Intergovernmental Panel on Climate Change (IPCC) has recently mentioned about high likelihood of increasing extremes in future as a result of climate change (IPCC, 2007). Extreme temperature and precipitation will increase in many regions bringing heat waves and flooding. Increases in summer precipitation imply flooding in Asian monsoon region and other tropical areas. The increased risk of flooding in a number of major river basins in a future warmer climate has been related to an increase in river discharge with an increased risk of future intense storm-related precipitation events and flooding. Sea level rise could inundate large tracts of coastal territories in the low-lying deltas in the world, for example, the Ganges, Brahmaputra and Meghna (Figure 19.1) and Mekong. Millions of people would lose their settlements and livelihoods. Cyclones/hurricanes could be more frequent and stronger than now and would pose threats to lives of coastal and offshore populations, infrastructures and economies (IPCC, 2007b). In some regions in northern latitude countries, increased extreme precipitation events as well as storm surge will cause greater risks of flooding.

The IPCC (2007) in its Fourth Assessment Report (AR4) has provided empirical evidences of adaptation measures to climate extremes in various economic sectors including water. It also categorically mentioned "more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change" (IPCC, 2007b, p. 19). Emphasis on adaptation is gradually increasing including the UNFCCC process because it can reduce vulnerability both in the short- and the long-term. The World Bank has estimated tens of billions (US$ 10-40 billion per year) of dollars investment for adaptation in the next few decades. If funds could be secured, the investment will occur gradually in both developing and developed countries. But the major question remains, how do we measure adaptation; whether it is advancing or not. While it is relatively easier to measure progress in mitigation, it is comparatively difficult for adaptation because its complex nexus with many socio-economic and environmental issues. In this paper an attempt is made to measure/advancement in adaptation with the aid of: risk transference, adaptation deficit, casualties and economic recovery as major indicators.

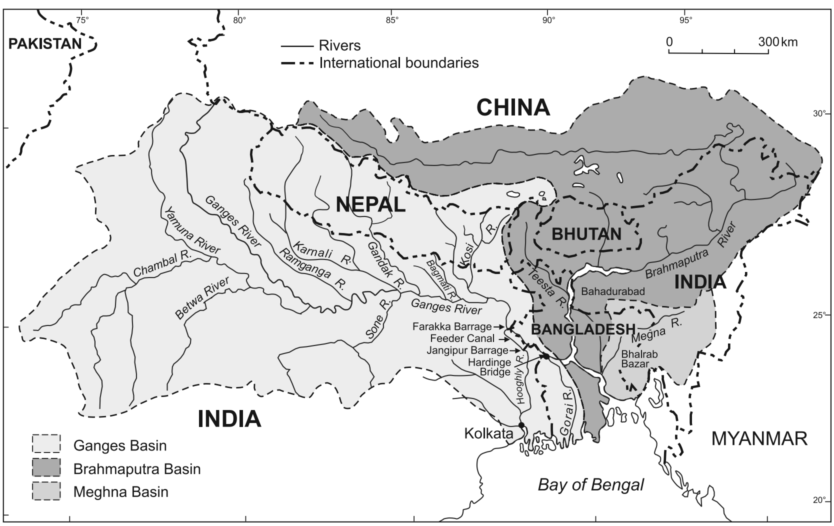
2. Climate Change and Extreme Flood Hazards: Observed Changes in Hydrometeorology

A trend analysis of the past temperature in Bangladesh shows that, during the past three decades a warming has indeed taken place: the minimum temperature of the winter and post-monsoon seasons has been increasing in most parts of the country, while the maximum temperature of winter shows weaker warming compared to the minimum temperature (Choudhury et al., 2003). The overall trend suggests that the winter is growing milder and the amplitude of diurnal variation during winter is also decreasing. Post-monsoon temperature profile exhibits strong warming in the maximum temperature. A trend analysis with mean annual temperature shows that it has been increasing over central and southern Bangladesh at moderate to high rates. For monsoon season a strong warming of about 0.1 to 0.3°C/decade has taken place over the past thirty years.

In Bangladesh, occurrence of rainfall has increased by some 18 percent in the north, west and southwest region of the country since 1970s. However, a withdrawal of annual mean rainfall has also been observed in the southeast region of the country. In general, the pre-monsoon rainfall has increased significantly over the northern parts of Bangladesh. Choudhury (1994) found a correlation between extreme rainfall events and a rapid change in Southern Oscillation Index (SOI), especially when La Nina phase (i.e., positive SOI values) takes over from El Nino (i.e., negative SOI values).

Geographically Bangladesh is located at the lowest part of the GBM region, just south of the Meghalaya Hills and Cherapunjee. Bangladesh possesses only about 7 percent of the catchment area of the GBM systems, while over 92 percent of the water volume is discharged through it. Such an imbalance in the draining of the regional surface water causes abundance of water in the monsoon months (more than 80 percent flows from June to September) and makes the country highly vulnerable to flooding. Furthermore, a decline in drainage gradient along the Ganges and other rivers results in severe drainage congestion close to the estuary. As a result, an estimated average of around 25 percent of the landmass of the country is flooded every year, while about 70 percent landmass is prone to flooding.

Figure 19.1
Location of Bangladesh in the GBM Basins



Source: Mirza, 2003.

Sometimes the peak flows of the major rivers synchronize due to timing of high rainfall and consequent runoff. Table 19.1 demonstrates the distribution of lag-times between the Ganges and Brahmaputra rivers. It is evident that about 26 percent of the time peaks of the two major rivers occurred in the range of –13 to 10 days (Table 19.1)(Mirza, 2003). During such events the confluence of the rivers swells and retards the discharge. The compounding effects of the above mentioned factors can cause floods of very severe intensity, as has been observed during 1988 and 1998. The deluge of 1998 submerged about 68 percent of the country, continued for about 66 days (Table 19.2), affecting almost half the population and causing damages of an estimated value of US$ 2.5 billion.

Recent analysis suggests that the frequency of devastating floods in Bangladesh is on the increase (Ahmad et al., 2000). Seven of the most severe floods have occurred in the past 37 years, whereas only two floods with comparable intensity visited Bangladesh during the preceding 77 years. The time-gap between two extreme floods is decreasing (Figure 19.5).

3. Climate Change and Future Extreme Flood Hazards

Because of changes in precipitation patterns in the GBM basins, Bangladesh will likely to be highly vulnerable to flood hazards in fu-

Table 19.1
Distribution of Lag-Times between Yearly Peaks, Ganges River at Hardinge Bridge and Brahmaputra River at Bahadurabad

Time-Lag (days)	Number (cumulative)	% distribution	% (Cumulative)
-82-72	-	3.57	-
-71 to 24	2	7.14	7.14
-23 to -14	3	3.57	10.71
-13 to -1	4	3.57	14.28
0-10	10	21.43	35.71
11-30	12	7.14	42.85
31-40	18	21.43	64.28
41-50	21	10.72	75.00
51-60	25	14.28	89.28
61-70	26	3.57	92.85
71-88	28	7.15	100.00

Note: A minus sign indicates the Ganges peaks occurred first. The shaded area indicates "period of simultaneous occurrence of floods." Source: Mirza, 2003.

Table 19.2
Water Level of Major Floods in Bangladesh

River	DL(m)	Annual Peak			Days above danger level		
		1987	1988	1998	1987	1988	1998
Ganges	14.25	14.80	14.87	15.19	55	23	27
Brahmaputra	19.50	19.68	20.62	20.37	13	27	66
Meghna	6.25	6.91	7.66	7.33	30	68	68

Source: FFWC, 1998

ture. Mirza et al. (2002) investigated impacts of climate change on the magnitude, extent and depth of flooding in Bangladesh. A sequence of empirical models and the MIKE11-GIS hydrodynamic model were used. Climate scenarios were constructed from the results of four climate models—CSIRO9, UKTR, GFDL and LLNL. Changes in magnitude, depth and extent of flood vary considerably between the GCMs.

The MIKE11-GIS model results show that the current mean flooded area is 3.77 million ha based on the mean discharge of 52,680 m^3/sec, 64,866 m^3/sec and 14,060 m^3/sec for the Ganges, Brahmaputra and the Meghna Rivers, respectively, together with local rainfall in the river basins. The mean flooded area produced by the MIKE11-GIS model seems to be very reasonable in relation to observational records.

With regard to the mean flooded area, the model results indicate three main outcomes:

- the largest change in flooded area occurs between 0^oC and 2^oC;
- there is a clear difference in flooded area outcomes from the UKTR and GFDL models when compared with the CSIRO9 and LLNL models; and
- the Brahmaputra and Meghna Rivers will play a major role in future flooding.

Surprisingly, the model results indicate that most changes in the mean flooded areas occur between 0^oC and 2^oC in relation to the increases in the peak discharges of the Ganges, Brahmaputra and Meghna Rivers (Table 19.4 and Figure 19.2) rather than at higher temperature increases. In the range of 0^oC-2^oC, 2^oC-4^oC and 4^oC-6^oC increases in temperature, increases in flooded area for per degree warming is 0.44 mha to 0.55 mha, 0.015 mha to 0.09 mha and 0.015 mha to 0.075 mha, respectively. In general, increases in peak discharge between 0^oC-2^oC

will engulf most of the flood vulnerable areas. Therefore, at higher temperature increases, proportionate increases in discharge will not be able to increase the spatial extent of flooding as it will possibly be limited by the elevation of the lands.

The second point to be made from the analyses of the flooded area is that there is a clear distinction to be seen in the outputs from the UKTR and GFDL models when compared to the CSIRO9 and LLNL models. The former two models show greater discharge, and thereby higher flooded area, than the latter (Table 19.4).

Results of the inter-model comparison show that, although there is little difference in results between the UKTR and GFDL models, the UKTR model gives the largest increases in the mean peak discharge for 2°C, 4°C and 6°C temperature changes. Consequently, the MIKE11-GIS model yields the highest changes in the mean flooded area for the UKTR model. For a 2°C temperature increase, the expected change in the mean flooded area is +29 percent. This is perhaps caused by higher increases in the peak discharge of the Ganges River. This helps increase the flooded area in the Brahmaputra basin by slowing down drainage of its water at Baruria Transit. The change is expected to be +39 percent for a 6°C temperature rise. For the GFDL model, the changes are 28 percent and 37 percent in the flooded area, respectively.

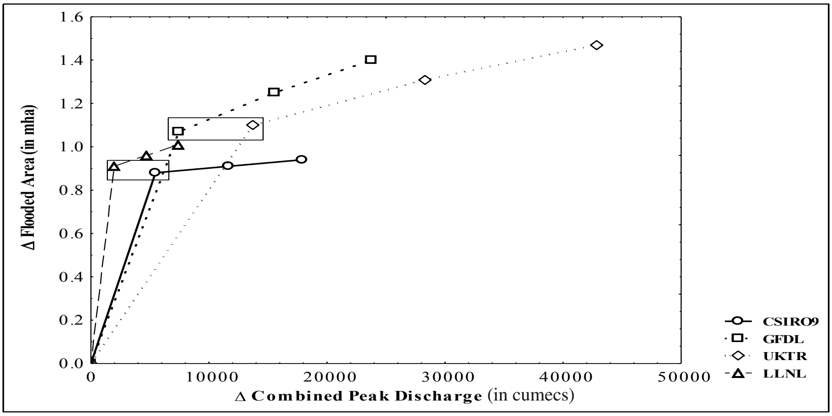
The third point to emerge from the analysis of flooded areas is that the Brahmaputra and Meghna peak discharges play a major role in flooding. The role of the Ganges River in flooding is somewhat catalytic. The peak discharge of the Ganges slows down the drainage of the Brahmaputra River through the Baruria transit. This helps to increase the real extent, depth and duration of floods in the Brahmaputra basin because the Brah-

Table 19.4
Area (in million ha) Inundated under 2, 4 and 6°C Temperature Increases for the Four GCMs

Model	Mean				20-year			
	0°C	2°C	4°C	6°C	0°C	2°C	4°C	6°C
CSIRO9	3.77	4.65	4.68	4.71	5.18	5.18	5.20	5.22
UKTR	3.77	4.87	5.08	5.24	5.18	5.35	5.50	5.61
GFDL	3.77	4.84	5.02	5.17	5.18	5.33	5.36	5.48
LLNL	3.77	4.68	4.73	4.78	5.18	5.20	5.25	5.29

Source: Mirza et al., 2002.

Figure 19.2
Changes in the Combined Mean Discharges of the Ganges, Brahmaputra and Meghna Rivers (under Control and Climate Change Scenarios) and the Mean Flooded Areas



Values within boxes indicate changes for a 2°C rise in temperature (Mirza et al., 2002).

maputra water cannot be drained out quickly. Further downstream in Chandpur, the combined flow of the Ganges and Brahmaputra obstructs drainage from the Meghna basin. This phenomenon creates problems in the Meghna basin similar to those of the Brahmaputra.

4. Climate Change and the Unexpected Events

Although climate models are not projecting any surprising events, surprises could occur. Taleb (2007) called them as *Black Swans*. The most important attribute of such an event is an outlier that lies outside the realm of regular expectations. Past empirical evidences are inadequate to project its occurrence possibility. Although a *Black Swan* is a possibility, analysis suggests that in the climate change regime, more extreme flooding events in terms of magnitude and frequency would occur in Bangladesh (Mirza, 2002) because of changes in mean and standard deviation (at this moment unknown). For example, under a 2°C global temperature rise, the probability of excedence of a current 20-year flood may change from 0.05 to 0.12, under the CSIRO9 scenario. In other words, a particular magnitude of the flood (in this case a 20-year event) would be about 2.5 times more likely to occur annually than at present.

Flooding Hazard: Evolution of Adaptation Measures/Policies

Although the region present day Bangladesh has a long history of flooding (for example, seven severe floods occurred between 1870-1922.), an organized planned adaptation process initiated a decade after partition of India in 1947. Over the last 50 years (1957-2007), water resources development policy in erstwhile Pakistan and Bangladesh significantly shifted. These periodical shifts have affected natural environment of the country as well as complicated management of its water resources (World Bank, 2000). Adaptation measures/policies that crafted so far can be divided into five broad phases and summarized in Table 19.5.

Needs to Adapt to Future Climate Change

For a very long time societies have been trying to adapt to extreme weather events. There are several success stories of adaptation. However, in the past many adaptation measures have been implemented but found to be inadequate to reduce economic and social damages for a host of reasons (see Section 6). On the other hand, without those measures, the damages would have been much higher which indicates some progress in adaptation has been made. Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions (more explained below). A large number of adaptation options are available for various economic sectors, but more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change (IPCC, 2007b) and below are some key reasons why there is a need to adapt.

- *Climate change and sea level rise cannot be totally avoided* (Burton, 1997). Further *warming* is projected for continuation of greenhouse gases at current or higher rates (Figure 19.3); For example, for the next two decades, using a range of SRES scenarios in the climate models, the IPCC (2007a) projected a warming of 0.2°C/decade. On the other hand, even if the atmospheric concentrations of the GHGs are maintained at the 2000 level, a further warming of 0.1°C would be expected. Therefore, climate change cannot be completely avoided. Sea level rise under any warming scenario is inevitable because the process of thermal expansion would continue for many centuries even

Table 19.5
Flood Hazard Adaptation Measures/Policies Adopted in Bangladesh (1957-2007)

Phase/Studies	Major Policy Focus	Policy Shift/Criticism
I (1957-1959) Krug Mission Report	Construction of embankments, inter-basin transfer of flood waters, river training, flood zoning, flood warning and forecasting, construction of a barrage, dredging for navigation and drainage of flood waters, creation of an autonomous institution, cross-border cooperation and negotiation, etc.	-
II (1959-1972) 1964 Water and Power Master Plan (IECO 1964)	Emphasis was on large-scale public sector development in both dry season (irrigation) and wet season (flooding) management. Implementation of 59 large FCD/FCDI (flood control, drainage and irrigation) projects, expansion of surface water irrigation, installation pumps to drain out flood water (in case of gravity failure). Protections were in most of the coastal zone from tidal flooding.	High emphasis on (large scale) structural measures, ignored non-structural measures, climatic extremes, environmental aspects, and people's participation; intra-country solution of flood problem; broad institutional setting over-looked. (Based on inadequate data analysis, lacks of long-term time series data)
III (1972-1987) 1972 IBRD Land & Water Resources Study	Analysis of flood characteristics, regional (only flash flood prone north-east) emphasis on flood control. Emphasis towards small-scale private sector irrigation development by LLPs (low lift pumps) and STWs (shallow tubewells), rather than major projects.	Flood control received less priority, indirectly recommended a policy of adaptation or adjustment with regard to floods. Shift towards small-scale quick return developments.
IV (1987-1998) National Water Master Plans (NWP) of 1987 and 1991; Flood Action Plan (FAP)	Structural and non-structural measures, shows more balance covering issues relevant to flood, drainage, irrigation, navigation, environment, and socio-economies. Little attention is given to urban flood control and drainage.	Widely ignored environmental issues related to structural measures; intra-country emphasis; no-guidelines regarding cooperation and negotiations with upstream countries
V (1998-2007) National Water Policy (NWPo) 1999; National Water Management Plan 2001.	Early warning and flood-proofing systems to manage natural disasters like flood and drought; designating flood risk zones and take appropriate measures to provide desired levels of protection for life, property, vital infrastructure, agriculture and wetlands. Clearly more emphasis on urban FCD development.	The NWPo puts emphasis on cross-border cooperation; NWMP, more shift towards structural measures (specially for urban flooding) ; cross-border issues ignored; shift towards less scientific assessment of floods

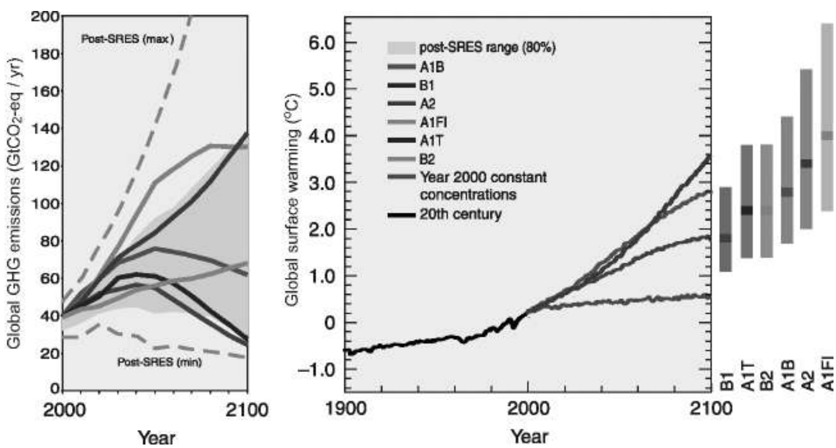
after stabilization GHG concentrations. This will result in a much larger sea-level rise projected by the IPCC for the current century. For example, for the 2000 level stabilization scenario, further sea level rise 30-80 cm is expected. If the Greenland ice sheet is melted, sea level rise could be of few meters and could have significant implications for the low-lying coastal areas (IPCC, 2007c).

- *Climate change may be more rapid and more pronounced than current estimate suggest. Unexpected events are possible* (Burton, 1997) *and they are also inevitable* (Taleb, 2007).

Rate of and magnitude of climate change due to anthropogenic warming could cause some abrupt or irreversible impacts. One example is likely impacts on the ecosystems. With global average warming exceeding 1.5-2.5°C (relative to 1980-1990), approximately 20-30 percent of the assessed species could be at increased risk of extinction. However, at higher warming of 3.5°C, the extinction could be as high as 70 percent. The second example is possible changes in the meridional overturning circulation (MOC) of the Atlantic Ocean. It is very likely that the MOC will slowdown in the 21st century as found in the model simulations. Despite this, temperatures in the region are projected to rise. But it is very unlikely to undergo a large abrupt change in the MOC in the current century (IPCC, 2007c).

- *Higher risks of extreme weather events*. During the recent episodes of extreme weather events (e.g., floods in Bangladesh, Red River flood in Canada and European floods and heatwaves; these events have far reaching consequences in terms of damage and policies), responses occurred at various levels that include government, private sector, international organizations, NGOs and individuals. The scales of these responses demonstrate higher levels of vulnerabilities in both developing and developed countries. Projections are made with higher confidence about future increases in extreme weather events and associated impacts including increased flood risk, extreme high sea level, damage to infrastructure, inundations of human settlements, decreased food production, increased risks of hunger and malnutrition and adverse health impacts (IPCC, 2007c).

Figure 19.3
Year 2000 CO_2-eq Emissions and Temperature Increase



Source: IPCC, 2007a.

- *Uneven distribution of impacts and vulnerabilities*. Economic, financial and technological resources unevenly distributed across the world; the differences are sharper when broken down at various socio-economic groups in the societies. The weakest in the societies (both in developed and developing) are more vulnerable to extreme climate hazards together with other non-climatic stresses that include poverty and unequal access to resources, HIV/AIDS, food insecurity, trends in economic globalization and conflict (IPCC 2007b). This assessment also projects with increase evidence that low-latitude and less-developed areas (e.g., the Asian mega-deltas where Bangladesh is located) are usually at greater risks of climatic extremes and sea-level rise.

Adaptation Accounting

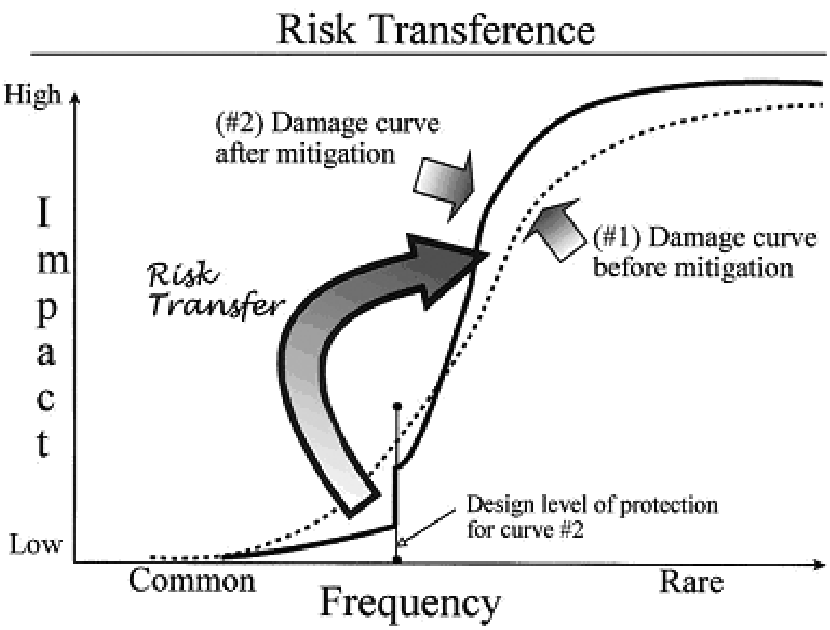
Measurement or accounting of adaptation to climate extremes is becoming an important issue. Individual countries, regions, and municipalities can measure progress towards reaching their greenhouse gas reductions target under the Kyoto Protocol against emission baselines (Smeh et al., 2008). However, a comparable baseline does not exist for adaptation and establishing such baseline is a complex work. Once it is defined, the baseline will vary from place to place for any particular hazard. As adaptation is receiving growing importance in the activities of the UNFCCC and many other international and national programs, there is a need of mechanism to account the effectiveness of adaptation measures from a baseline and the adaptive capacity of various economic sectors, regions and activities. Following there are some ways (not an exhaustive list) in which "adaptation" can be measured. The IPCC (2007b) defines "adaptation" as "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."

Risk Transference

Adaptation can be measured by evaluating how the issue of "risk transference" is addressed in the past planned adaptation measures. In the financial sector, "risk transference" is defined as "shifting the consequence of a risk and responsibility for its management to a third party." In the natural hazards science, it is defined differently as "by actions taken to lessen hazards impacts, societies may make themselves catastrophically vulnerable to extreme events that exceed the expected (Burton et al., 1993, p. 253). The implicit meaning of two definitions is same. There are many approaches of disaster risk reduction especially structural flood defenses alter the hazard but do little to affect vulnerability (Figure 19.4) (Etkin, 1999). Structural measures provide protection to only designed extreme events (e.g., flood) and it must fail at some stage by an event greater than the designed value (Kelman, 2007). These measures usually create a false sense of security and facilitate development within the area protected. With the failure of the structures, the damage caused by extreme events would be substantially higher. The consequence is increased risk over time because altering the hazard transfers risk from the present into the future. However, Etkin (1999) argues that long-term vulnerability need not be increased if protective measures are well designed and properly implemented.

Despite implementation of many flood control projects, risks of flooding in *Bangladesh* have not decreased (Figure 19.5). With these projects, some areas have been made flood free, but the problem is transferred to somewhere else, which can precisely be monitored by applying Geographic Information Systems (GIS). By and large, structural flood

Figure 19.4
Schematic Diagram for Risk Transference

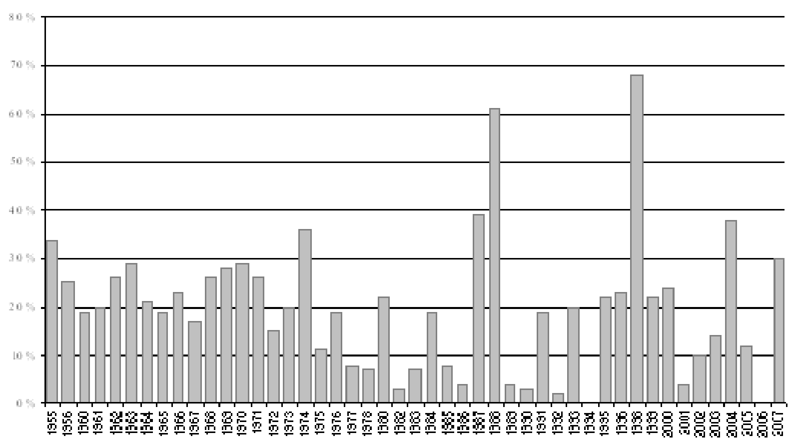


Long-term vulnerability increases when the designed adaptation measure cannot cope with an extreme hazard. Source: Etkin, 1999.

control approach is an example of "risk transference" in Bangladesh. The crux of this "risk transference" phenomenon lies in the design criteria chosen for the structures. Generally for the design, a 100-year return period is considered appropriate for the major rivers, the Brahmaputra-Jamuna, the Ganges-Padma and the Meghna (Figure 19.1). A 20-year return period is adopted for the coastal embankments that are designed to prevent tidal inundations not the extreme surges generated by storms (Table 19.6). Therefore, the structures designed with these criteria cannot withstand a flood of higher return period. Development of infrastructures and settlements is a common phenomenon inside the flood control projects. Two perfect examples of "risk transference" are Dhaka City Flood Control Project and the Dhaka-Demra-Narayangonj (DMD) project. Flood vulnerability in the Dhaka City project has increased after construction of the project. The project was implemented hurriedly influenced by a political decision and some elements of the plan have not been implemented at all.

Chowdhury et al. (1996) criticized the "return periods" criteria for the design flood events selected by the Bangladesh Water Development Board (BWDB). Because "flood protection and drainage structures are not selected on the basis of so called risk-based approach that the floods would be controlled up to the point where the additional costs of flood mitigation equaled the expected value of the remaining flood damages."

Figure 19.5
Area (%) Flooded in Bangladesh since 1954 Demonstrates Increased Risk



Source: Bangladesh Water Development Board (BWDB).

He suggested that selection of the level of flood protection and the capacity of drainage structures should be based on the minimization of the sum of annualized capital cost, expected risk-damage costs, and costs of operation and routine maintenance.

Adaptation Deficit

Climatic variations and extremes cause substantial damages to households, communities, natural resources and economies. In many places the damages are increasing, giving evidence of an adaptation deficit. In other words, practices in use to manage climate hazards are falling short of what can be done for full adaptation (Burton, 2004). To estimate adaptation, damages from comparable natural hazards over a period of time can be compared with the baseline damage. If the damage is reduced, adaptation is occurring and the adaptive capacity in the society is increasing.

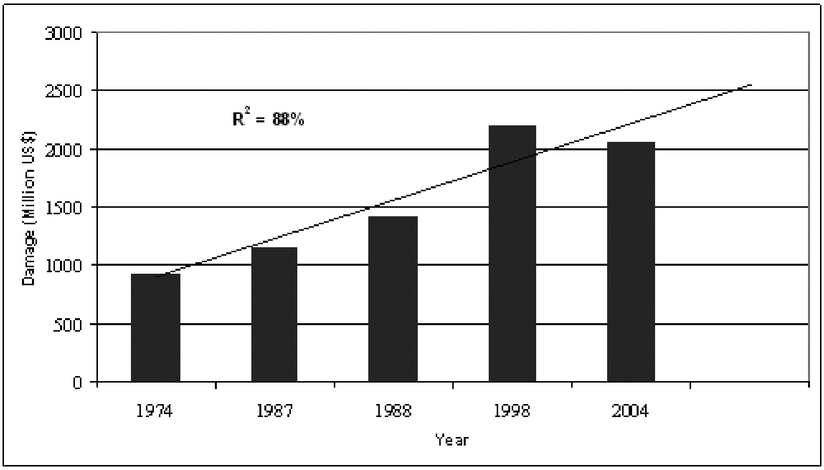
In Bangladesh, records show an increase in flood-related damage or adaptation deficit in recent years (Figure 19.6). Approximately 40 percent of the damage occurs to infrastructure, followed by agriculture (30 percent). The increasing incidences of flooding are also a concern (Figure 19.5) which has become a significant obstacle to macro-level recovery. For example, after the 2004 flood, which caused $2.06 billion loss, ADB (2004) recommended a mid-term (3 to 5 years) recovery assistance plan

Table 19.6
Return Period of the Design Floods in Determining the Height of Embankments

Purpose	Return period	Basis of selection
Protection against pre-monsoon flash floods by low-height embankment but not against monsoon river floods	10-year	Agricultural damage is predominant
Protection against river floods during monsoon	20-year	
	100-year	Loss of human lives, property and installations is predominant

Source: Bangladesh Water Development Board, 1996.
Conclusion: Based on the above discussion the conclusion is that if "risk transference" in the life cycle of the projects is detected, progress in adaptation is not occurring and vice versa.

Figure 19.6
Flood Damage in Bangladesh (1974-2004)



Source: Islam, 2007.
Conclusion: Growing flood-related damage demonstrates an "adaptation deficit" in Bangladesh. A deeper study of the causes of the damage may allow a rectification of policies that can close the adaptation gap.

for critical sectors that include social and physical infrastructure. But just within 3 years (in between the recovery cycle) of the previous flood, another devastating flooding event hit Bangladesh in 2007. Total damage from the latest flood (only the riverine) was estimated to be US$1.4 billion. Losses from storm surge flooding caused by the cyclone *Sidr* in November 2007 are yet to be finalized.

Casualties

Floods cause hundreds of thousands of deaths worldwide. Most (80 percent and over) of the flood-related deaths occur in developing countries and the remaining 20 percent in developed countries. In developing countries causes of flood-related deaths are: drowning, snake bites, water-related diseases such as cholera and diarrhea, hunger and malnutrition. In developed countries, the causes are drowning and water-related diseases.

Analysis of flood-related deaths can be used as a measuring stick for increasing adaptive capacity. An example is deaths/km^2 area inundated and duration of inundation. An increasing number of deaths indicate that adaptive capacity is declining while a decreasing number denotes increasing adaptive capacity with regard to rescuing people and moving them to safer places, well equipped health facilities, food security, supply of safe potable water, access to sanitation facilities, etc.

Table 19.7 demonstrates over the years adaptive capacity of the flood-affected people in Bangladesh has improved. In 1974, Bangladesh was a young independent nation and was struggling with socio-economic and governance problems. In the next decade, flood management issue was at a low priority (see Table 19.5). High death rates in 1987 resulted due to: lack of sufficient time for preparedness as huge rainfall over a short duration generated large flood; and also inadequate administrative preparedness. Next year, government and its institutions learnt lessons; rescue and relief operations mobilized very quickly. This is comparable with the capacity that Mozambique demonstrated during 2001 flood through learning from the devastating flood of 2000. The 1998 flood management in Bangladesh was very efficiently handled. Note that during the flood many international agencies expressed their concerns about large-scale deaths from starvation but it did not occur at all due to well managed disaster responses and recovery operations.

Conclusion: If the number of dead and injured is gradually decreasing, progress in adaptation is made or vice versa. Empirical evidence demonstrates that Bangladesh has made substantial progress in this area.

Economic Recovery

The fourth way is looking at economic recovery after a natural hazard induced disaster. The usual practice is to look at macro-economic recovery. For example, after the devastating flood of 2004, the Asian Development Bank sent a mission. One conclusion of the mission was "Preliminary analysis shows that, because of the flood, FY05 GDP growth could be about 0.5 percentage points lower than the 5.5 percent growth achieved in FY04. These macroeconomic effects are temporary and

Table 19.7
Bangladesh Flood-Related Deaths in Extreme Flooding Years

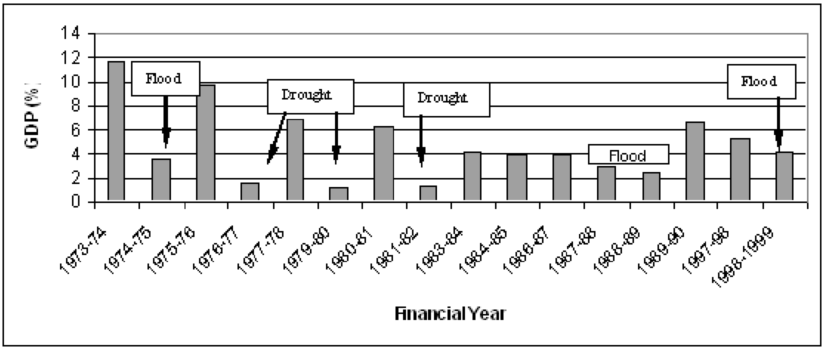
Extreme Flood Year	**1974**	**1987**	**1988**	**1998**	**2004**
Number of reported deaths	1987	3680	2379	1050	285
Area flooded (x 1000 sq. km)	39	57	82	102	52
Death/(1000 sq. km) area flooded	51	65	29	10	5

are expected to be overcome in the context of Bangladesh's good fiscal and macroeconomic performance (ADB, 2004)." The micro-economic impacts were not looked at by the mission. However, macro-economic recovery statement can mask economic and social issues at the micro-economic level.

In many developed and developing countries, disadvantaged section of the society has to share a large part of the socio-economic shocks created by hazards and disasters. Usually it takes considerably a long time for most of poor people to recover from the losses. Recently Das Gupta (2007) looked at micro-economic data to establish relationship between flooding and poverty by employing regression analysis. She used three different poverty measures: poverty headcount ratios, poverty gap ratio and human poverty index. Two major findings of the research are: negative effects of floods are especially strong in the short term, the immediate after effects of major floods; clear persistence of longer-term effects, because catastrophic flooding depletes savings, capital, and assets, both physical and human. In the aftermath of the 1998 flooding, Jahan (2000) examined socio-economic data of affected urban population in Dhaka. Of the surveyed households, 40 percent recovered fully from the flood damage and most of these people belong to high-income groups such as doctors, engineers, businessmen, etc. Partially recovered households were 40 percent and the remaining 16 percent did not recover at all. Flood and poverty relationship can also be explained with the GDP loss figures.

GDP growth rates have significantly reduced in extreme flood (1974, 1987, 1988 and 1998) and drought years (Figure 19.7). These reductions cause long-term impacts on poverty reduction process in Bangladesh. One percentile GDP growth means 1.5 percent decrease in poverty. About 63 million people are now under the poverty line and 1 percent GDP loss means pushing one additional million people to poverty. The International Monetary Fund (IMF) recognized this grim fact in its Poverty Reduction Strategy Paper (PRSP) for Bangladesh. "The analysis of the macroeconomic impact of floods in 2004 points out that the growth of per capita income is likely to fall from 4.5 percent to 3.7 percent due to income loss. The fall in per capita income may be more for the poor and the non-poor households that are very near the poverty threshold. An estimate of the non-poor household groups within 10 percent above the poverty line in the districts hit by floods in 2004 shows that they accounted for 4.3 million people in 2000.These people risk slipping into poverty unless they are protected under appropriate safety net programs. In a country where the growth of aggregate output in the recent past has

Figure 19.7
Floods and Droughts in Bangladesh and Loss in GDP (%)



Source: Mirza, 2004.
Conclusion: Although macro-economic recovery shows capacity of an economy to get over onslaughts of flood hazard, t micro-economic data concerning the poorest social groups is needed in order to demonstrate whether adaptation is actually advancing.

been around 5.5 percent, the magnitude of loss of output and assets due to natural disasters as observed during the floods in 2004 does impact on the economy seriously. It may take two years just to get back to the pre-flood level of GDP, and this will have a consequent negative impact on the pace of poverty reduction" (IMF, 2005, p. 22).

5. Concluding Remarks

Adapting to natural hazards has become a challenge for the mankind. Huge investments in terms of infrastructure and capacity building have been made. Yet "adaptation deficit" is growing. In the wake of climate change, extensive adaptation measures would be required to implement to reduce the risks and losses.

There has been an increasing effort to develop and implement climate change-related adaptation measures and mainstream them in development programs. It is therefore necessary to assess the present level of adaptation with baseline indicators. Such accounting will assist in building capacity to deal with climate change.

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Part V

Vulnerability, Risks, and Climate Change

20

Vulnerability, Risks, and Climate Change

Nancy MacPherson

Coping with vulnerabilities to climate change requires different types of interventions and tools (with an emphasis on risk management approaches), as discussed in this section of the book. Drawing on experiences from across Africa, particularly Sudan, and from India, Nepal, and Mauritius, this chapter explores a range of tools and approaches used to map and assess interrelationships in complex human and ecosystems that are particularly prone to the effects of climate change, and to build local and national level capacity to better plan for, monitor, and evaluate the effects of climate change.

The experience of the Climate Change Adaptation in Africa research and capacity development program, whose purpose is to significantly improve the capacity of African countries to adapt to climate change in ways that benefit the most vulnerable, is presented by Nathalie Beaulieu, Fatima Denton, Victor Orindi, Simon Carter, and Simon Anderson. They describe three tools derived from the outcome mapping approach and discuss their use for monitoring and evaluation and to stimulate changes in practices and behavior, including the facilitation of partnerships.

Furthermore, a suite of measures that can be employed for building the capacity to cope with climate variability are presented in the chapter by Balgis Osman-Elasha, Erika Spanger-Siegfried, Bill Dougherty, and Nagmeldin Goutbi. To help assess what works, in what settings, and under what conditions, i.e., to evaluate, the authors explore the use of the sustainable livelihoods framework to help in filling the practical and conceptual gap that exists between local vulnerability to climate impacts and national adaptation assessment processes, providing examples of the application of that framework in Sudan. The case studies not only illustrate how the approach has been used but also offer results that enrich the knowledge base on evaluation and climate change.

As shown in the chapter by Sreeja Nair, the concept of climate risk screening marks a paradigm shift from a "reactive" approach of relief and rehabilitation after an extreme event, to a "pro-active" approach before the event. The skewed distributional nature of climate change impacts makes the poor the most vulnerable, owing to their high dependence on climate-sensitive sectors, limited ability to cope with the impacts of extreme events and often also due to geographical proximity to locations exposed to extreme events (such as coastal and mountainous areas). The objective of climate screening exercises is to bring out the potential entry points for specific climate risk management measures by analyzing the gaps in addressing climatic risks during the design and implementation of developmental programs in areas vulnerable to extreme events. Climate screening exercises also highlight opportunities where synergies can be drawn between the developmental program and disaster risk reduction in areas exposed to extreme events. The chapter illustrates the approach with a case study from India.

"Vulnerability assessment" (VA) is a tool that has been applied in Mauritius and is presented in the chapter by Moonoosamy Kavida, Beeharry Panray Kheswar and Munni Reddi. The results obtained for each village were disseminated to the public and the findings not only highlighted potential dangers and risks but also included recommendations that encourage resilience by proposing a series of corrective and preparedness measures. In fact, the VA have been used as a key input in the formulation of adaptation strategy plans.

In the last chapter of this section, Ram Chandra Khanal discusses another variant of VA that uses participatory tools, "participatory vulnerability assessment" (PVA). It shows (with a case study in Nepal) that participatory tools such as participatory ranking, seasonal calendar and social and resource mapping, as well as vulnerability mapping at the community level, can be useful for vulnerability assessments. In addition, these participatory tools also supported self-learning/evaluation process by the communities and helped to adjust their adaptation actions to minimize climate change impacts at the local level.

All of the approaches and tools described in this set of chapters have implications for development evaluation practice. For example, in risk prone areas, development interventions can be evaluated to assess the extent to which vulnerable populations are effectively identified and served by the interventions. Evidence collected related to the use of indicators found in climate risk screening and vulnerability assessment can be used to determine the level of awareness and targeted interventions, and to assess whether the strategies, resources, and the level of effort employed are commensurate with the level of risk of the community or whether the objective of reducing risk and vulnerability remain were just rhetorical.

21

Using Monitoring and Evaluation to Strengthen Climate Adaptive Capacity

Nathalie Beaulieu, Fatima Denton, Victor Orindi, Simon Carter, and Simon Anderson

1. Introduction

The purpose of the Climate Change Adaptation in Africa (CCAA) research and capacity development program is to significantly improve the capacity of African countries to adapt to climate change in ways that benefit the most vulnerable. CCAA funds are applied to action-research projects that aim to increase adaptive capacity. The evaluation of adaptive capacity, and changes to it, is a key challenge that these projects face at different stages of their activities.

Participatory monitoring and evaluation (PM&E) is an integral part of the Participatory Action Research (PAR) approach. It is crucial for learning among stakeholders in a process of adaptation, for assessing progress and for better understanding the successes and failures. In CCAA, PM&E is also used as a capacity development tool, to learn from successes and failures, and for overall program management, to verify if planned activities have been conducted and to re-adjust planning if necessary. CCAA encourages projects that are supported by the program to use PM&E to develop the capacities of its partners. CCAA aims to put in place a system that does not create more work for project teams than that necessary to conduct their action-research, while allowing participants to draw lessons in a coherent way across the program.

Brooks and Adger (2005, p. 168) state "adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or magnitude of harmful outcomes resulting from climate-related hazards. The adaptation process requires the capacity to learn from previous experiences to cope with current climate, and to apply these lessons to cope with future climate, including surprises."

To foster as much learning as possible, CCAA uses the Outcome Mapping (OM) approach as developed by the IDRC evaluation unit (Earl et al., 2001). This approach conceptualizes outcomes as changes in knowledge as reflected in behaviors and practices and therefore lends itself well to assessing the process of enhancing climate adaptive capacity. OM encourages the program and partners to plan activities related to the desired outcomes, as well as to map out the network of influences needed to reach the ultimate beneficiaries.

The CCAA started in September 2006 and its first projects were initiated in April 2007. With the help of a number of evaluation consultants, CCAA supports project teams to put in place PM&E systems that will feed into program-level PM&E efforts. This chapter describes the evaluation methodology, the concepts behind it, and how it is being implemented.

2. The Role of Monitoring and Evaluation in Participatory Action-Research and Learning

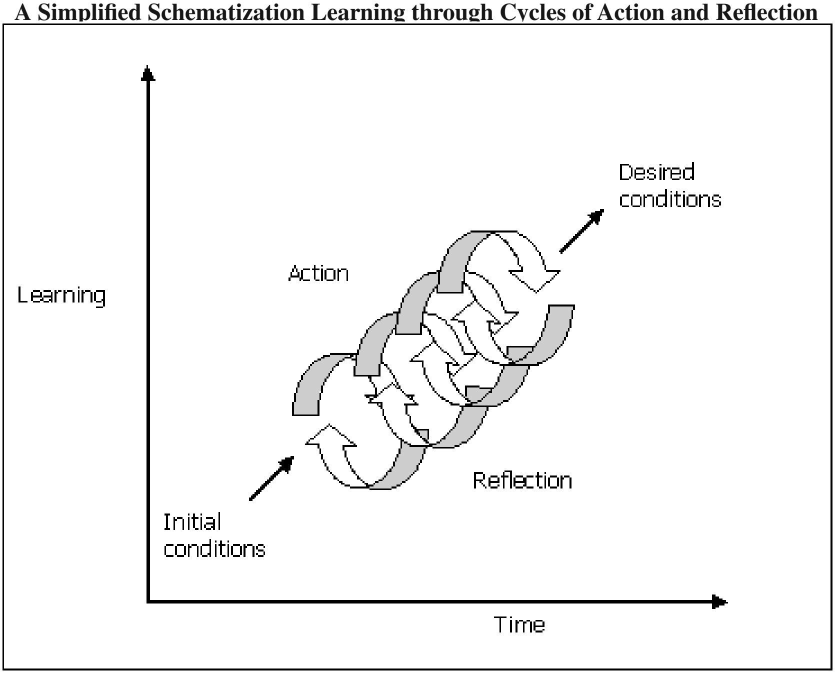
The CCAA program considers action-research as a search for knowledge, solutions or means to improve a situation, which involves trying out actions and evaluating their consequences. This is consistent with various definitions of action-research (Lewin, 1946; Christie et al., 2000; Lavoie et al., 2005). PM&E is embedded in action-research methodologies as the mechanism to evaluate the consequences of actions that are tested. In PAR, participants are also researchers and not just subjects of the research. Researchers also become actors in the process. Action-research can be led by people or groups other than professional researchers, such as agricultural producer associations, labor unions, or teachers.

One of the most important outcomes of the PAR process is the learning it fosters for all participants. This is why the CCAA program chose PAR as one of its principal methodologies for strengthening capacity in climate change adaptation, complementing it with education and training as well as communication and networking activities.

The PAR process involves cycles of action and reflection (see Figure 21.1) leading to increased learning and, hopefully, to the participant group getting closer to their desired conditions. Planning involves defining those conditions and the means to achieve them, and describing present conditions and means put forward to achieve them. Monitoring and Evaluation involves comparing present conditions to the desired ones, and judging the validity or merit of the actions put forward, by verifying whether they lead to an improvement. Learning involves adjusting means to reach desired conditions more effectively, while gaining knowledge on how to do so. To facilitate learning there must be communication to ensure that proper feedback is given to the individuals or organizations conducting the actions. Conditions can be biophysical and socioeconomic. The conditions most difficult to grasp are related to individuals and organizations, the rules and relationships between them, their knowledge and attitudes. These, which we could call "institutional[1] conditions," can be partly described through behaviors and practices, or in other words, what organizations or individuals do.

In addition to providing the information needed for feedback loops and learning in PAR, PM&E activities provide data to verify research hypotheses. Indeed, action-research on adaptation to climate change is likely to test adaptation options with a hypotheses-testing approach. Action-research projects can have hypotheses like: "Such and such soil management practice will increase water retention capacity"; "Such and

Figure 21.1
A Simplified Schematization Learning through Cycles of Action and Reflection



such water conservation measures in farmers fields could both help to recharge groundwater and prevent floods in the villages; the municipality would be willing to develop incentives for farmers to adopt such and such practice if the practice's efficacy was demonstrated"; "National authorities will use our national maps of vulnerability to hurricanes to target their capacity development programs and, as a result, previously neglected at-risk areas will be reached."

3. Outcome Mapping: A General Approach to Be Complemented by Other Approaches

OM encourages actors/ participants to ask questions such as[2]: *What is our vision of the desired future conditions? What can we do to contribute to that vision, and who else's involvement is necessary? Which other actors should be involved? Who are the ones that we seek to influence with our activities and with whom we will interact directly? Who will these partners in turn influence, and what chain of partnerships is necessary to achieve the vision? What should we be doing to achieve all of this and what do we expect (or wish) to see our partners to do as a result of our activities? How will we be able to tell that these partners are effectively doing these things?*

A specificity of OM with respect to impact assessment methodologies and the logical framework approach is that it seeks to demonstrate influence rather than to quantify impact. OM does not attempt to attribute the outcome only to the project or program activities and recognizes that other players, and in particular the boundary partners, also make important contributions. It does not attempt to determine which proportion of outcomes is attributable to the project. Therefore, it needs to be combined with other approaches. For example, in testing adaptation options, it is very important to separate the effect of the tested option from the effect of other factors. More traditional impact assessment approaches therefore need to be used. Also, it is important to conduct economic assessments when studying the feasibility of an option, or while comparing different options. Institutional analysis methodologies and frameworks, such as the Institutional Analysis and Development (IAD) framework described in Ostrom (2005) are also useful to describe external conditions, stakeholders, their arena of action, the relationships between them and the rules regulating them. The Visions, Actions and Requests approach (Beaulieu et al., 2002) can be used as a simple introductory exercise from which many of the elements needed for the design stage can be drawn. OM provides a general approach on which other methods can be anchored to describe specific aspects. Conversely, OM can also be used to complement other approaches.

The OM approach is described in detail by Earl et al. (2001). It is flexible and can be adapted by each user to suit their needs. As most other users, CCAA has made some modifications to the tables and journals proposed in Earl et al. (2001). In turn, CCAA partners can also adjust the approach to suit their needs. An evolving working paper by Beaulieu and Orindi (2008) describes the adaptations made to the outcome mapping approach. To allow us to use it routinely in our own M&E activities, the approach has been simplified and the number of journals to be kept has been reduced. The following sections describe three examples of tools derived from the outcome mapping approach for use by projects. We see them not only as tools for evaluation, but also as exercises to stimulate changes in practices and behavior, including the facilitation of partnerships.

4. Progress Marker Grids as a Negotiation Tool with Partners

OM uses the term "*boundary partners*" to refer to the partners that a group (project team, organization, or person) seeks to influence with its activities and with whom it will interact directly. There is usually a chain of partnerships needed to reach the ultimate beneficiaries and their environment. "*Progress markers*" refer to actions conducted by the boundary partner that can indicate that influence is taking place. Progress markers also indicate the level of involvement of the boundary partner beyond the direct consequences of the strategies. The OM approach suggests graduated progress markers with levels labeled "expect to see," "like to see" and "love to see," indicating an increased involvement on the part of the boundary partner. One of the adaptations that CCAA has made to progress markers is to organize them in a grid[3] for each of the boundary partners, dividing them into columns corresponding to functions that are expected or desired, usually corresponding to the verbs in the expressed "outcome challenge."

Table 21.1[4] gives an example of such a grid in the context of an imaginary project, showing progress markers for municipal authorities from the point of view of a municipal-level committee for drought and flood management. This grid could be developed in a meeting between the committee and the municipal authorities. In this imaginary project, the committee seeks, among other outcomes, to influence policy-makers in the hope that they put in place incentives for farmers to implement soil conservation and water retention infrastructure (to deal with increased rainfall variability and extreme events) and support dissemination efforts towards adoption of these practices. The municipal authorities could agree to recognize the contributions of farmers who implement such measures and to give access to communal rooms for the dissemination activities of the project, resulting in the "expect to see" markers. It could be agreed that the stages mentioned in the "like to see" and "expect to see" markers could be achieved if the municipality found resources outside of the project.

The adjustment of commitments on the part of the authorities with the expectations of the committee can help avoid misunderstandings, wishful thinking and frustrations that could damage institutional linkages. The discussions leading to the elaboration of the grids can contribute to strengthening institutional linkages. The grid only provides a simple way to organize expectations, desires, and commitments, and can contribute to a process of negotiation without being essential to it.

5. Extending the Logic of OM to Biophysical Entities

Another adaptation that CCAA has made to OM is to consider that strategies can affect components of the environment such as a forest, grasslands, agricultural soils, the water of a lake or a river whose characteristics (quality, quantity, etc.) can be measured. This allows the integration of indicators of state, relative to biophysical entities, with progress markers relative to human behaviors and practices, within a coherent framework. This preventsthe use of separate and disarticulated sets of indicators and markers. It can also prevent the definition of indicators relative to changes that are too far away from the sphere of

Table 21.1
Progress Markers for *Municipal Authorities*, from the Point of View of the Municipal Committee, in Response to Their Sensitization Activities

Boundary partner	Municipal authorities	
Outcome challenge	Put in place incentives for farmers to implement soil conservation and water retention infrastructure and support dissemination	
Level	Put in place incentives for farmers to implement soil conservation and water retention infrastructure	Support dissemination efforts
Expect to see	Recognize, in local development plans and municipal communications, that farmers who implement such measures are contributing to the community's environment	Give access to communal rooms for the dissemination activities organized in the context of the project
Like to see	Organize an event to honor farmers who have implemented soil conservation and water retention measures	Contribute to the logistics, materials and funding of dissemination activities
Love to see	Give a tax reduction or other benefits to farmers who implement such measures	Take the initiative of organizing dissemination activities on the subject

influence of those planning the strategies. Partners of the project can, in their own PM&E efforts, formulate graduated progress markers to help them evaluate how well their strategies have worked, or to help them test or compare adaptation options. In this case, the graduation would not indicate an increased involvement on the part of the environmental component, but simply a progression towards the ideal outcomes. The following table gives an example of such progress markers for runoff water, as formulated for the same hypothetical project mentioned in the last section.

This committee would greatly benefit from involving farmers and municipal authorities in the monitoring process, as the observation of evidence for even the most expected progress markers can be encouraging and stimulating. In a visit to a village having implemented this type of measure in Senegal,[5] the CCAA board heard farmers explain how excited they were when they visited their landscaping efforts during the first rain and saw water accumulating in the trenches and pits that they had dug and behind the stone bunds that they had put in place. These observations also motivated other farmers to join the effort. They can also motivate the municipal authorities to get involved and even to appropriate the process.

The qualitative markers or "indicators" in Table 21.2 can be complemented with quantitative ones. For example, well level measurements can be used in estimating groundwater recharge. Surface water levels in previously frequently flooded areas can be measured to support the progress marker relative to the frequency and severity of floods. If a university was involved in the action-research, hydrological models could be used, on the basis of storm-related flow measurements before

Table 21.2
Progress Markers for Runoff Water, in the Point of View of the Municipal Level Committee for Drought and Flood Management

Environmental component	Runoff water	
Outcome challenge	Is used to recharge groundwater and no longer causes floods	
function / Level	Recharges groundwater	No longer causes floods
Expect to see	Water accumulating in trenches, pits and behind stone bunds.	Water accumulating in trenches, pits and stone bunds.
Like to see	Water levels in wells increase	The flow in gullies and drainage ways is reduced during floods
Love to see	Wells that were dried out are now usable	Frequency and severity of floods are considerably reduced in the town and in villages

and after the implementation of measures, to define their additional retention capacity.

In a PAR context, the definition of progress markers actually results in formulating a series of research hypotheses. For example, this grid combined with other types of analyses could be used to evaluate to which extent the hypothesis mentioned earlier "The water conservation measures in farmers fields could both help to recharge groundwater and prevent floods in the villages" is verified. It is just as important to collect data that may contradict, and not just corroborate the hypotheses. These approaches can also be used to describe the results of various options that PAR participants would want to compare. They can help participants re-adjust their strategies in light of what has worked and what has not.

6. How the Progress Marker Concept Can Be Used to Evaluate Adaptive Capacity

The program does not attempt to produce a standardized evaluation tool for adaptive capacity, because practices differ so much from one location to another. Also, adaptive capacity will depend on the hazard considered; therefore a given person, group or community's adaptive capacity will be different with regard to hurricanes, drought, temperature increases or other hazards. CCAA encourages each project to develop tools with the local groups they work with, in function of the hazards they are addressing, and in function of the local practices considered.

The grid in Table 21.2 shows an example, for a different hypothetical project, of a tool to characterize adaptive capacity, during the acquisition of reference data, or in a study comparing different villages with regard to their capacity to adapt to hurricanes. Similar grid evaluation systems are frequently used for rapid appraisals in rural or urban areas. UNDP (2007) is also using a scorecard system for an adaptation project in coastal areas and IDID-ONG (2007) has used a similar one in its initial diagnosis of the evaluation capacity in its target municipalities.

In projects the criteria in the grid should be agreed upon and then used with members of the communities involved in the action-research. This not only allows the criteria to be meaningful, but it facilitates the involvement of participants in their determination as well as in subsequent observations and analysis.

The use of this type of tool can also help change practices. Relating capacity to specific practices or behaviors can motivate people who are interviewed, or people using the tool, to adopt them. Seeing that

Table 21.3
Example of a Tool for Evaluating Adaptive Capacity to Hurricanes in a Hypothetical Project

Boundary partner	Villages			
Outcome challenge	Villages with high adaptation capacity to hurricanes have housing that resists well to hurricanes, have shelters where people can protect themselves, have community food reserves kept in safe places and improve their practices in prevision for the next hurricane			
function / Level	Have adequate housing	Have community shelters	Have food reserves	Improve their practices
Situation	When a hurricane occurs…			
0 (Undesired)	All houses are destroyed	Each person is left to him(her)self.	There are no food reserves kept in safe places	Resources insufficient to improve housing or food reserves
1 (Expect to see)	Most houses are destroyed but some remain intact	Inhabitants of the better houses take in their neighbors but some people are stranded nonetheless	Some members of the community have reserves that they share with some members of the community	Individuals are more conscious of the risk and build better houses, keep food reserves in safer places
2 (Like to see)	Houses are not destroyed but heavily damaged	Inhabitants of the better houses take in their neighbors and nobody is left stranded	Some members of the community have reserves that they share with other members so that nobody is left without food	Owners of the better houses help the poorer members of the community to rebuild their houses with more resistant materials or configurations
3 (Love to see)	All houses remain intact if well barricaded	There is a community shelter	There are community food reserves, administered by a committee	The community has an emergency fund to help the re-building of damaged houses

one has changed category under a specific column can be exciting and motivating.

7. Support of Project Teams in Their M&E Activities

The CCAA recently initiated research support activities including training and guidance of project team members, as well as the facilitation of a community of practice to develop thinking and actions on how to best monitor and evaluate climate adaptive capacity.

Four African organizations, as well as some additional consultants, support and develop capacity of project teams. These organizations are Observatoire du Sahel et du Sahara (OSS) for North Africa, West African Rural Foundation (WARF) for West and Central Africa, OtherWise for South Africa and Measure Africa for East Africa. This process promotes the development of a network of consultants who have experience in monitoring and evaluation of climate adaptive capacity development, which would be available to support other initiatives as well. Almost all of the consultants involved are members of the African Evaluator's Association (AFREA). Indeed, CCAA hopes to be able to contribute to AFREA's capacity on the subject.

The community of practice under development involves project team members, staff of the CCAA program management unit as well as consultants specialized in M&E and who support projects in their efforts. It uses an electronic discussion list to share resources, including participant's own experiences in conducting M&E in the scope of their projects. The social capital in this community is greatly helped by the different capacity development workshops that project team members have participated in, and during which teams from different countries were able to get to know each other.

CCAA is seeking to encourage project teams and partners to write illustrated stories to support their PM&E process, with video and audio narratives as evidence to support progress markers. The development of guidebooks on the filming of narratives is presently under way.

8. Compiling Information and Drawing Lessons

The compilation of information is a real challenge. At the program level, two journals are being compiled, an "activities journal" and an "outcome journal," relating to what program boundary partners are doing differently. The journals have been extremely useful for the organizational reflections during team retreats, and have allowed the identification of gaps as well as successful strategies to which more resources could be allocated. They have also provided material for the annual report and have been useful to the external evaluators executing the mid-term review.

It is not enough to simply compile information, it is extremely important to analyze it in order to draw lessons. Questions for this analysis include: Have we done all that we have planned? Which strategies produced the best results? Which lessons can we carry forward? What were the external factors affecting our outcomes? How could we influence those external factors to maximize outcomes? Regarding the progress of project teams, it is particularly important how they assess vulnerability and adaptive capacity issues, which options they identify or develop, how they are putting forward the action research process, how they are engaging with at-risk groups and policy makers and how they are sharing knowledge. Furthermore, efforts are also made to capture, through project activities, progress of at-risk groups and policy makers in assessing vulnerability and adaptive capacity, develop, test and implement options and share knowledge. The program plans to provide, through its communication and networking activities, an internet space for projects to post their stories, video and audio narratives, as well as all other materials supporting their progress markers and what they would wish to share with the international community.

Early Lessons

The CCAA program has been applying the OM method to its program evaluation for one year, and is building capacity for its use among CCAA partners, in part through a learning network. The following early lessons can be drawn from this experience:

- Adaptation to climate change involves changes of behavior and practices which are difficult to assess. Outcome mapping is a recognized approach to M & E of behavioral change, which has been applied in the past in a variety of different applications, and can be applied to monitoring and evaluating adaptation processes.
- The OM approach often produces a paradigm shift for researchers because it encourages them to think about the chain of influences needed to reach the desired outcomes, to monitor the contributions of partners of the participatory action research and be attentive to ways in which partners use the results of the research.
- The approach itself can help change behaviors of these partners (including policy-makers) by providing a framework for negotiating contributions to the desired outcomes. It helps stimulate participation in the action research and helps to reflect on lessons learned, thus strengthening capacity.
- The program team and each of the supported research teams made adaptations to the outcome mapping methodology, sometimes keeping only key elements of it. A significant amount of trial and error has been needed (and is still going on) for all teams to feel comfortable with their M&E approach. Mentoring by experienced evaluators has been extremely useful in this process.

Notes

1. According to Ostrom (2005, p. 3), institutions can be broadly defined as "the prescriptions that humans use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations and governments at all scales."
2. The wording of these questions is adapted from the outcome mapping methodology, therefore it is slightly different from the guidance questions given in Earl et al. (2001).
3. The classical OM approach does not divide progress markers by functions but has a general set of "expect to see," "like to see" and "love to see markers" for each boundary partner.
4. This table is taken from the guidelines document by Beaulieu and Orindi (2008), which develops the example more fully, and gives such tables for all the boundary partners a long a chain of influence for an imaginary project.
5. Village of Lando, having developed water retention measures with the help of ENDA PRONAT and Wobine Environnement, rural community of Keur Moussa.

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22

Making Adaptation Work for the Vulnerable: An Approach for Assessing Community-Based Interventions

Balgis Osman-Elasha, Erika Spanger-Siegfried, Bill Dougherty, and Nagmeldin Goutbi

1. Introduction

Drought has taken a heavy toll on vast areas of Sudan and on the communities subsisting on these arid lands. Historically, such communities have faced periodic drought and have developed time-tested strategies to cope. Such strategies can sustain households and communities through periods of drought, provided critical thresholds are not exceeded. Over the past several decades, though, patterns of increasing drought and desertification have occurred across the Sahel, posing greater direct challenges to household coping capacity, undermining the very resources (natural, social, financial, etc.) that communities must draw upon in order to cope. Under climate change scenarios, the troubling pattern of longer and more frequent drought may intensify in Sudan, posing deep challenges for vulnerable people.

The gap between the deficit in capacity among vulnerable groups to cope with current climate impacts and the building of adaptive capacity for climate change is the central focus of this chapter.

2. Research and Assessment Framework

The study presented in this chapter was based on the following premises:

a) Increasing the capacity of the most vulnerable groups to cope with today's climate-related impacts must be a key goal of adaptation

b) To do this, small-scale, community-level strategies are needed alongside the large-scale, technical/structural approach that may dominate adaptation planning.
c) Methods have been developed in separate fields of practice—sustainable livelihoods, natural resource management, disaster risk management—which can meet these needs.
d) Lastly, strategies that increase the adaptive capacity of the most vulnerable people while accomplishing added social and environmental goals (e.g., slowing desertification) can diversify and strengthen national adaptation plans of developing countries.

For the communities addressed in this study, increased coping capacity is not only the urgent short term need, but may also represent the necessary basis upon which adaptive capacity to future climate change can be built.

Case studies, including a policy analysis component, served as the primary research tool for this purpose. Drawing from existing research platforms, the search consists of three interlinked processes: *empirical*, in which background information is gathered and organized *analytical*, in which case studies are carried out, and *participatory*, in which community input, validation and guidance is sought.[1] Within the analytical process, the project used the sustainable livelihoods framework to enable researchers to measure resilience at the local level to climate-related impacts.

Selection of Case Studies

a) The project undertook three separate case studies in different arid regions of Sudan. Case studies were concerned with current and recent historical experience, and focused in particular on the experience of the 1980s through to the present.[2]
b) To ensure adequate coverage of Sudan's rural circumstances, and adequate representation of the Sahel, as well as North and East African circumstances, each case study focused on a distinct ecosystem subtype (such as rangelands, forested lands) or agricultural system type (such as gum arabic production, rain-fed sorghum production, animal husbandry) along the agricultural-pastoral continuum.[3]

The following major elements comprise the study's *methodological approach*. Specific steps involved in the case studies are outlined in section 3.

Climate Variability and Extremes as a Proxy for Climate Change

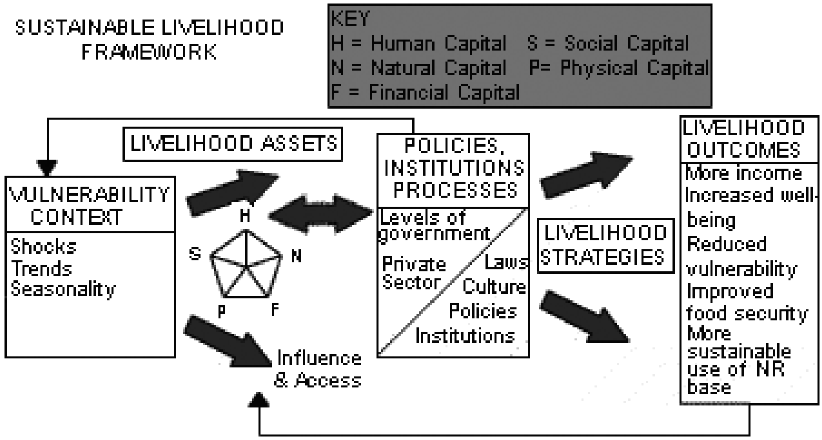
Despite progress in the science surrounding climate change scenarios, it is not currently possible to rely upon existing scenarios for Sudan (see e.g., the Sudan Initial National Communications (RoS, 2003)), or for many countries to confidently assess the impacts of climate change on vulnerable communities. In such cases, vulnerability to current climate variability can be used as a proxy for vulnerability to climate change. This approach does not equate present climate extremes with future climatic conditions; rather, a number of sources have suggested that the degree to which a sector, community, or system is adapted to today's climate extremes and variability can serve as an indicator of how vulnerable or resilient that system is likely to be to future climate change conditions. According to the IPCC WG II Summary for Policy Makers, 2001, "Experience with adaptation to climate variability and extremes can be drawn upon to develop appropriate strategies for adapting to anticipated climate change. In other words, for vulnerable communities, the most logical first step in adapting to climate change is to assess and, where necessary, increase their capacity to cope with current climate-related stressors.

Sustainable Livelihoods Approach, Framework and Assessment Tools

Much of the early work on adaptation focused on future climate scenarios using General Circulation Models (GCMs), which helped to identify potential impacts. These models proved to be of very limited use in identifying regional impacts of climate change. A new generation of research is now addressing the issue by looking at vulnerability and adaptation within the context of current climate change and variability as well as longer-term climate change, since communities who are vulnerable to today's climate stresses may become more vulnerable as global temperatures rise and as variations in rainfall patterns further reduce the threshold level of vulnerable communities vis-à-vis their adaptive capacity. It follows then that adaptation must start with actions that target current vulnerabilities, allowing communities to build more resilient and secure livelihoods that can confront the impacts of climate change.

The sustainable livelihoods approach sees poverty as vulnerability to shocks, and seeks to reduce vulnerability by building on the livelihood assets of households, increasing their access to a blend of assets and gradually building household resilience. Basically, the approach seeks to enhance existing coping and adaptive strategies in the manner most suited to the community's needs. The study attempts to clarify the potential role of this type of approach for increasing people's resilience to climate change, thus enabling them to better adapt.

Figure 22.1
DFID's Sustainable Livelihoods Framework



Source: http://www.livelihoods.org/info/guidance_sheets_pdfs/section2.pdf.
Sustainable livelihood assessment is intended to generate an understanding of the role and impact of a project on enhancing and securing local people's livelihoods. As such, it relies on a range of data collection methods, a combination of qualitative and quantitative indicators and, to varying degrees, application of a SL model or framework.

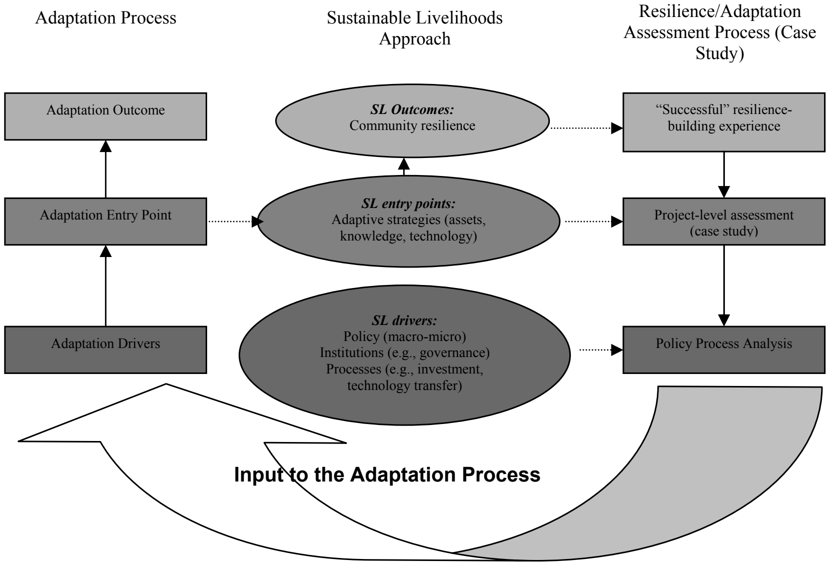
Over the past decade, the sustainable livelihoods approach has gained prominence in development work and has been used in a great number of settings. Several major development agencies (e.g., DFID, CARE, UNDP) have developed their own frameworks for describing and applying the approach (i.e., for presenting the primary influences on people's livelihoods, and the typical interactions between these), though the three adhere to a core set of ideas. The study was not wedded to a single framework and instead used its own variant (outlined in the case study methods section), drawing methods from those used by DFID, CARE, and UNDP, and from a variety of past assessment experiences.

The UNDP approach to sustainable livelihoods (Figure 22.2) may be the most compatible with the overall research goals, while the DFID framework provides a useful tool for use within the case study process itself.

"Successful" Resilience-Building Experiences

The study was motivated in part by an understanding that successful examples exist (notably, in the linked fields of sustainable livelihoods and natural resource management) of efforts to increase the resilience of communities to climate-related shocks. Numerous reports exist, docu-

Figure 22.2
Adaption of UNDP's Approach to Sustainable Livelihoods



menting project impacts and assessing success. It is therefore not the goal of the study to establish *whether* selected livelihood activities/measures have been successful, but rather to clarify (a) the nature of that success, and (b) the enabling factors behind that success. Success, however, is a subjective term, requiring judicious use. The study therefore focused only on those experiences that the communities themselves deemed to be successful—according to community-defined terms such as ownership, impact on asset base, sustainability, institutional linkages, etc.

Resilience Indicators

Borrowing from C.S. Holling and colleagues, we refer to resilience here as the capacity of a system (social and/or ecological) to tolerate disturbance without collapsing into a qualitatively different state. Resilient communities, therefore, can withstand shocks and rebuild themselves if necessary.[4] Thus, we can see vulnerable (often poor) communities as those incapable of withstanding and recovering from climate impacts, and conversely, resilient communities as those that *are* capable of coping with and recovering. Bearing in mind the sustainable livelihoods literature, which encourages the fostering of sustainable livelihoods as a mechanism for enhancing coping and adaptive capacity, the role of sustainable livelihoods in increasing resilience to climate impacts becomes clear.

The use of indicators to measure sustainable development, poverty reduction, ecosystem resilience requires a careful balance of quantitative and qualitative measures. Consensus is emerging in the sustainable livelihoods field that application of an appropriately balanced blend of both types of indicators can offer up realistic and informative assessments of changes in livelihood security and community resilience.[5]

Policy and Institutional Factors

A primary goal of the study was to draw lessons from the micro scales that are relevant to the macro scale, and vice versa. By developing this understanding, it was hoped that, ultimately, it would be possible to inform a process of scaling up (or scaling out) of relevant SL activities for climate change adaptation. At the macro scale, the study seeks to influence key policy processes—particularly, national adaptation planning and relevant national decision-making in e.g., poverty reduction, disaster mitigation, biodiversity conservation, water resources, forest management, etc. To do so requires an understanding of the interplay between local livelihood conditions and the "range of policies, institutions and processes which support or hinder them" (Goldman, 2000). This connection is of central interest in the sustainable livelihoods approach, although, there is no seminal guidance on how such lessons can be gleaned. To develop this understanding, the selected case studies involved a distinct step of policy process analysis.

Validation

Given the subjective nature—and even sensitivity—of the data to be collected (e.g., measures of household income, assets and self-sufficiency), a validation or quality-check was required at three levels. First, the community at large was used as a sounding board for the general themes emerging from the data. At the community level, informal triangulations were used to cross-check and confirm patterns and findings. Second, the local informant provided a critical review of data. Third, principal investigators conducted an examination of the data, seeking to identify and distinguish misleading information from that which it considers valid.

3. Case Study Methods

Three separate case studies were conducted, each involving travel, fieldwork, data collection, analysis and writing. The first, carried out in the Bara Province of western Kordofan state, explored the experience of communities with a concluded UNDP project on rangelands rehabilitation project. The second, carried out in the Khor Arba'at area of the Red Sea state, looked at a range of NGO-facilitated activities organized around community water harvesting and livelihood diversification. The third focused on autonomous, community-driven water harvesting activities in a cluster of communities in the Darfur region.[6]

Case study reports were prepared in such a way that their results could be compared and synthesized into a set of research findings. To achieve this, a carefully designed research protocol was prepared for each of the case study research teams to follow, the major elements of which are outlined here. In the end, each case study naturally required adaptations of the data collection methods, in order to suit the unique community context. The goal in developing and using the methods is to identify the richness of a community's experience and avoid reductionism, while at the same time, gathering comparable information.

Case studies explored examples of community-level initiatives through which local resilience to drought impacts was targeted. It was agreed that the measures or strategies explored through case studies should represent those that have been applied in Sudan and could be applied in other countries.[7] It was also agreed that case studies should explore experiences that are considered successful by e.g., government or civil society groups, and are confirmed as successful by the communities themselves.[8]

Selected systems were those in which a resilience-building approach has been previously applied—e.g., sustainable livelihoods measures had been used in the system by individuals or organizations seeking to increase system resilience and/or productivity.

In developing indicators of community resilience the study used community consultation, word picture construction, and local informant validation, as outlined below.

Initial site visit. The purpose of the initial site visit is four-fold: (1) to garner community trust, interest in, and support of the project and the approach, (2) to confirm the success of the SL activities from the community's perspective (and thus, justify the case study), (3) to scope and schedule subsequent fieldwork (including participatory framework), and (4) to identify and contract a local informant. Special attention was given to creating plans for community participation that are sensitive to relevant social barriers (gender, class, ethnicity, etc.). For its part, the community was asked to (a) develop criteria for indicator selection, based on a brainstorming exercise, (b) refine and expand the set of indicators based on these criteria, and (c) informally assess the impact of the project

Table 22.1
Constructing Local Indicators from Locally-Driven Criteria

Cells contain locally relevant criteria reflecting the productivity, equity and sustainability dimensions of each of the five capital assets	The five capital assets				
	Natural	Physical	Financial	Human	Social
Productivity	Soil fertility	Irrigation infrastructure	Income	Employment and training	Education
Equity	Access to crop land	Access to irrigation system	Access to credit	Individual/ household rights	Access to decision-making
Sustainability	Land management	Water management	Savings and investment	Health	Local institutions

activities on those indicators. Examples of criteria which served as the basis for resilience indicators relevant to a local setting are outlined in the table below (based on Bond and Mukherjee, 2002).

- These critical steps are intended to determine whether the community views the interventions as successful in increasing their livelihood security, and thus their resilience to climate impacts. The connection need not be absolute, but the researchers must be convinced that the sustainable livelihood measures have played the most significant role in recent improvements in community resilience.

The table below provides an example of the criteria developed through community consultation in the Bara Province case study.

As can be seen from this table, one of the challenges of the case study research was to identify criteria and generate indicators that could effectively measure change due to the project activities. There was some flexibility in the data collection process in the three case studies, since both the indicators and collection methods were to be adapted to suit each case study context.

- Building on the initial site visit, in which communities were asked to select and revise generic qualitative indicators and use these to assess

Table 22.2
Example Criteria for Resilience Indicators Developed through Community Consultation

Locally relevant criteria	Five types ofcapital				
	Natural	**Financial**	**Physical**	**Human**	**Social**
Productivity	1 - Area of productive range-lands, 2 - Carrying capacity of rangelands (# heads/ha), 3 - Forage production of range lands	1 - Amount of credit granted to individuals, 2 - Household income, its sources and sustainability	1 - Number of established grain mills 2 - Capacity of established grain stores 3 - Number of functioning water pumps	1 - Number of trained CAHW 2 - Capacity of veterinary services 3 - State of social services	1—Status of organized irrigated gardens 2 - Status of people organisation and communal work 3 - Area of women's irrigated gardens
Equity	Access of Kawahla to grazing allotments	1—Poor people's access to credit 2 –Women's access to credit, 3 - Kawahla people's access to credit	1 - Access of Kawahla people to village grain stores 2 - Percentage of women who participated in grain stores activities, 3—Participation of poor people in grain storage	1 - Access of marginal groups to different social services 2—Participation of women in irrigated gardens 3—Access of marginal groups to training and extension services	1 - Participation of women, Kawahla and poor people in local decision-making process
Sustainability	1—Privately held grazing allotments 2 - Sustainable grazing systems 3 - Range land quality 4 - Desirable grazing species	1 - Availability of information 2 - Local institutional management 3- Support by finance and credit systems to local income-generating activities, 4—Credit repayment by local people	1 - Effective water well management system 2 - Maintenance for water pumps 3 - Availability of spare parts	1—Use of improved technology (e.g., stoves, mud-walled houses) 2—Use of livelihood alternatives 3 - Availability of drugs	1—Use of improved technology (e.g., mud-walled public buildings) 2 - Government support of local institutions 4 - Relation between local people commit-tees and local government institutions
External Risks	1 - Annual trespass incidences 2 - Recorded size of trespassing herds.	1 - government use of pharmacy as a pool resource 2 - Government charges to the pharmacy 3 - Changing government policies	1 - Govern-ment claim on grain stores 2 - Attraction of tribes from other areas	1 - out migration of skilled people	1 - Capability of committees to perform their tasks (mandate)

project success, the second site visit focused on finalizing and using indicators to describe household circumstances, pre- and post-project activities, in order to define the net impact of the activities on their resilience to climate extremes.

- Indicators: During the initial site visit, or at the start of the second site visit, full sets of qualitative and quantitative indicators were identified and selected, based on the established criteria. Examples of both types of indicators are provided in the adjacent box. The indicators developed were reviewed by the community and by the local informant under the direction of the case study researcher and adapted as needed to accurately reflect local circumstances and experience.

- Word pictures: At the outset of the second site visit, communities were encouraged to assemble "word pictures." "Word pictures" are essentially descriptions of household circumstances which contain both quantitative and qualitative indicators. The main tool of the Livelihood Asset Status Tracking system, developed by Bond and Mukherjee, word pictures are essentially quality of life indices, constructed around the SL framework concepts of assets. Embedded in people's descriptions of household circumstances are both quantitative indicators (such as cash income, crop productivity, livestock populations, year-round wells, local grain reserves, employment rates, and savings) and qualitative indicators (such as access to forest produce, rangelands, and fertile soil, or access to credit, seeds, and markets). Word pictures can be developed to capture worst-case circumstances with regard to sets of indicators, best case circumstances, and any range in between. A hypothetical example (from Bond and Mukherjee, 2002) of worst case and best case word pictures assembled by a household during the survey process is outlined in the box below.
- By consulting with communities and individuals and using the "word picture" process, it was possible to draw out sets of indicators for each of the five capitals—natural, physical, financial, human and social. For each capital, indicators outlined a best-case snapshot of household

Box 22.1
Sample Indicators of Natural Capital (quant. and qual.)

Indicator
Land ownership/access (# ha)
Food stores (# seasons)
Fertility of land (soil quality)
Location of land (degree of slope)
Subsistence and cash crops (amounts of each; ratio)
Fodder production (amount)
Surplus seeds (ability to trade)
Access to irrigation water (type and degree of access)
Livestock holdings (# heads)
Supplemental agricultural income (type; amount)
Household food production (dairy? fruit?)
Access to forest produce (type and degree of access)

Box 22.2
Hypothetical Word Picture of Household's Access to Natural Resources
(Natural Capital)

Pre-Project Activity	Post-Project Activity
Little or no land; one or two month's food available from own land; quality of land is poor, having red soil with low fertility; land is located on a slope in such a position that rain water washes away the seed sown and the top soil and hence reduces its fertility; use of traditional seeds; some have given away land as collateral; no source of irrigation; no land for growing fodder for livestock; owns one or two livestock; no milk produced; low access to forest produce;	More of black fertile soil; more land; grows one's own fodder on one's own land; fertile land with more moisture retention power; more produce from land; grows and sells cash crops; grows vegetables; grows high yielding variety seeds; lends seeds to others; irrigation facilities available round the year; land is near the forest; access to forest produce; some have government permit to grow opium; has many fruit trees; availability of home grown food throughout the year; many livestock, high returns from livestock;

Adapted from Bond and Mukherjee (2002)

circumstances; another outlined a worst-case snapshot; roughly three indicators were developed to describe household circumstances in between.

- These indicators were assembled into assessment sheets for use in household interviews and group consultations. In the assessment sheets, both qualitative and quantitative indicators were organized along a simple scale (0-100) to enable "scoring" of responses. An example of one assessment sheet is provided below; this one containing indicators aimed at capturing household access to/ownership of natural capital.
- Based on the scores generated through the interviews, word pictures could be created of circumstances prior and to and after the project activities. Each set of pictures would have an associated score, which would be used in the analysis process.
- The patterns that emerged from the consultation and interview process were then put back before the community for reactions and validation.

Validation was accomplished at the end of the second visit. Through simple dialogue, preliminary findings regarding the role of SL/NRM measures in building local resilience to climate impacts were reviewed, discussed and as appropriate, adjusted. This represented a key opportunity to discuss causality and to explore caveats and biases of the inquiry. Often, participatory methods such as role playing can help to facilitate the validation process, though in this case such techniques were not used.

4. Analysis of the Policy Process

The analysis of the policy process began during the fieldwork stage and continued following conclusion of the fieldwork. The purpose of this analysis was to essentially back-cast from successful resilience-building outcomes, to try to determine what factors—primarily policy and institutional factors—enabled that success or hindered a successful outcome.

This phase of the study involved the use of a modified version of the steps presented in the "Livelihood - Policy Relationships in South Asia" Working Paper Series,[9] as outlined here. In "A Methodology for Policy Process Analysis," Springate-Baginski and Soussan (2001) outlined a series of six policy analysis steps. Drawing heavily upon these, but reversing their order, the pursued the following:

- *Determining outcomes and impacts for livelihoods:* this step is essentially the livelihood assessment process undertaken through the fieldwork described above. With an assessment of impacts on local livelihoods, it was possible to assemble a series of policy and institutional linkages through the subsequent steps.

Table 22.3
Sample Assessment Sheet

<table>
<tr><th colspan="8">Assessment sheet for natural resources</th></tr>
<tr><td></td><td></td><td>Worst case</td><td>2</td><td>3</td><td>4</td><td colspan="2">Best case</td></tr>
<tr><td>Criteria</td><td>Indicator</td><td>0 5 10 15 20</td><td>20-40</td><td>40-60</td><td>60-80</td><td colspan="2">80 85 90 95 100</td></tr>
<tr><td rowspan="4">Productivity:
Rangelands productivity</td><td>(1) Area of improved/rehabilitated rangelands</td><td>Area degraded, worsening</td><td>Low level of rehabilitation (0 to 30ha)</td><td>Moderate rehabilitation (30 to 60ha)</td><td>Good rehabilitation (60 to 90 ha)</td><td colspan="2">Excellent rehabilitation (>90 ha)</td></tr>
<tr><td colspan="7">Sample Interview Questions:
(a) Tell me about the status of rangelands productivity prior to the project. Were they degraded or had there been any rehabilitation, and if so, how much?
Associated response score:
(b) Tell me about the status of rangelands productivity following the project. Were they degraded or had there been any rehabilitation, and if so, how much?
Associated response score:</td></tr>
<tr><td colspan="2">(2) Carrying capacity</td><td><5 AU/ha/year</td><td>5 to 10 AU/ha/year</td><td>10 to 15 AU/ha/year</td><td>15 to 20 AU/ha/year</td><td>>20 AU/ha/year</td></tr>
<tr><td colspan="7">Sample Interview Questions:
(a) Tell me about the carrying capacity of rangelands prior to the project. How many animal units could the average hectare support, per year?
Associated response score:
(b) Tell me about the carrying capacity of rangelands following the project. How many animal units could the average hectare support, per year?
Associated response score:</td></tr>
</table>

- *Identifying key policy and institutional issues and defining their relationship to the community-based project:* this step involves identification of policies and institutions (at the macro, meso and micro-scales) that are seen as important to the development, implementation and success of the project and carefully exploring the relationship. At the macro-scale, land tenure reform, for instance, may play a critical role in certain projects, just as lack of reform may have challenged project implementation. At the micro or meso-scale, a sound framework for participation in local governance may pave the way for robust project participation and lasting project ownership. This step relies largely on interviews with key stakeholders (from government, civil society, etc.), household surveys, and community consultation.
- *Exploring the policy development process:* once key enabling factors have been identified, the challenge is to explore how and why these came to be.
- *Establishing a picture of the policy, institutional and process contexts:* this step is intended to clarify *why* enabling factors came to be. This series of nested pictures would describe first the micro, focused on the

village or village council scale, next the meso, focused on the district or sub-national scale, and finally the macro, focused on the national or regional scale. By developing these pictures of the study context, it was possible to better understand the sort of groundwork that needs to be in place in order for certain resilience-building activities to take root. For the micro and meso-scales, this step involves interviews with key stakeholders, community consultation, and desk-based research. For the meso and macro scales, it relies on interviews with key stakeholders and desk-based research.

- *Creating a history of key policy milestones:* lastly, it is instructive to anchor the analysis emerging from the above steps to a policy and institutional heritage. By piecing together the preceding information, it can become apparent that certain instances of landmark legislation, reform, etc. play a direct role in enabling resilience-building activity today. It may be valuable for climate change adaptation activity to build off of or link to these policies and processes.

5. Applying the Methods

To find out how the measures for increasing resilience to current climate have worked across the five livelihood capitals, assessment was made covering four dimensions: productivity, sustainability, equity as well as risks and uncertainty encountered, i.e., what barriers did the implementation of these measures actually face or expect to face?.

By looking at the elements of sustainability, productivity, equity and risks, the assessment is aimed at identifying whether these adaptations have effectively reduced vulnerability to current climatic variability and whether it is going to effectively reduce potential future impacts of climate change. What are expected threats; as well as identifying what gaps exist among these? *Specific experience, limitations and potential biases from each case will be d*iscussed below.

First Case Study (Khor Arbaat)

The study area is located in the Red Sea State, in north-eastern Sudan, about 50 KM north of Port Sudan town the State capital. Administratively, Arba'at is part of the Red Sea locality, one of the four localities, comprising the Red Sea State. The region is generally characterized by relative isolation and harsh terrain, highly variable rainfall system with recurrent spells of drought, small area of cultivable land, and low population density and sparse distribution. The research considered community-driven coping mechanism developed in response to drought, as well as the evaluation of livelihood strategies introduced by the SOS Sahel Project (Khor Arba'at Rehabilitation Programme (KARP), 1993-2000), such as diversification and introduction of income generation activities, their role in sustaining community's livelihood under adverse climatic conditions such as the fluctuations and/or deficiency of rainfall and the unsteady flow of Khor Arba'at Khor Arba'at Rehabilitation Project (KARP) project came in response to the Sahelian drought in the 1980s by SOS Sahel (UK). It was conceived following a regional investigation of potential development projects by SOS Sahel (UK), which was wishing to fund a suitable agricultural development project in the area. Khor Arba'at delta was chosen as an area with good potential, that upon rehabilitation of the somewhat degraded agriculture farming system it could provide considerable benefits to the local community.

In terms of contribution to adaptation, the study indicated that water harvesting; food crop production and diversification of income had been effective in improving livelihood conditions in Khor Arbaat area and their overall resilience in the face of harsh climates (drought). Involvement of local people including women in the production process, sales of vegetables and value added crops have buffered many families from climate variability. Moreover, the effect of markets has shifted the weight of production for local consumption to production for marketing in near by towns such as Port Sudan which largely decreased the out migration and encouraged the people to stick to their local land. Sustainability of the developed local coping capacities depends on the ability of rural families to continue to develop their skills and capacity to manage their resource base and contribute to decision making process with regard to the future of the Khor Delta. Overall, the coping capacity of this community is a clear reflection of changing attitudes and human behavior, adoption of new techniques and more practical solutions, all are necessary pre-requisites for future adaptation. A Major concern expressed by many respondents focused on the proposed new intervention by the state government to heighten Khor Arba'at Dam to divert more water for urban use in Port Sudan.

Second Case Study: Community-Based Rangeland Rehabilitation in Sudan in Geraigikh (Kordofan State)

Kordofan State lies within the Africa Sahel which has undergone a general decline of rainfall since the late 1960s. The period between 1961 and 1998 witnessed two widespread droughts during 1967-1973 and 1980-1984—the latter being more severe. Available records show that drought episodes have increased in both intensity and duration and have increased the vulnerability of the local populations (ADB et al., 2003, Balgis et al., 2007). In response to these adverse conditions, a UNDP/GEF project was initiated in 1992 covering 17 villages within Gireighikh Rural Council in Central Bara Province with a total population of 6116. The project, "Community-Based Rangeland Rehabilitation (CBRR) for Carbon Sequestration" had two main developmental objectives. The first was to sequester carbon through the implementation of a sustainable, local-level natural resources management system that prevents degradation, rehabilitates or improves rangelands; and the second was to reduce the risks of production failure in a drought-prone area by providing alternatives for sustainable production, increasing number of livelihood alternatives so that out-migration will decrease and population will stabilize

The study assessed the impacts of the introduced interventions on human livelihood and it showed that the interventions succeeded in increasing the overall community's resilience across the five types of capital. The five capitals were found to work in harmony in a very well-integrated manner. For instance, the Women Irrigated Gardens (WIG) (natural capital), activity was built on loans provided by the revolving-fund activity (financial capital). It has been stated that the beneficiaries need the grant only once, and thereafter they depend on themselves to continue the activity. The presence of diverse activities was one of the most important enabling factors to increasing the resilience of the community. The best situation was found with respect to natural capital, as people found alternative ways for making a living when they found access to credit through the project's revolving fund (Figures 22.3 and 22.4).

Third Case Study: Water Harvesting Technique as a Coping Mechanism to Climate Variability and Change (Drought)/North Darfur State

North Darfur is situated in Western Sudan, on the northern transitional margin of the Inter Tropical Convergence Zone. Consequently, most of the area is deficient in water even in the wettest months of July to September. The drought years of 1983-85 greatly affected the demographic and socio-economic conditions of the area. Large numbers of people left their homes due to increasing poverty, famine and other environmental impacts (desertification and land degradation). This was accompanied by tribal conflicts, the growth of shanty towns and changes in the pattern of livestock and agricultural production. This case study represents an autonomously developed adaptation measures that were basically evolved by the local community and later on supported by a project, examples of these measures include the adoption of water harvesting technique

Figure 22.3
Assessment of Productivity of Natural Capital before and after Intervention of Range Land Rehabilitation Project, Using Rehabilitation of Range Land, Carrying Capacity and Forage Production as Indicators

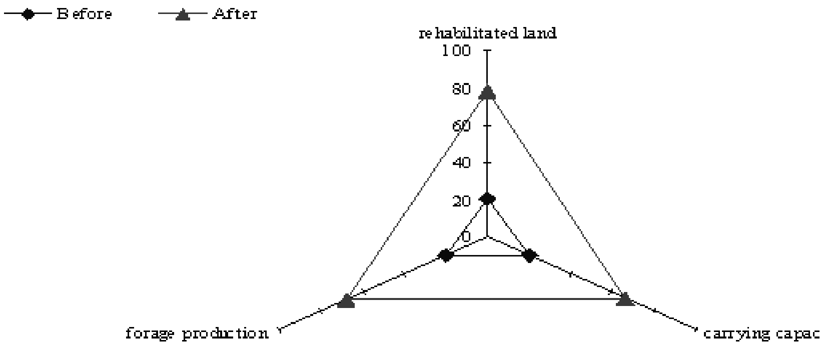
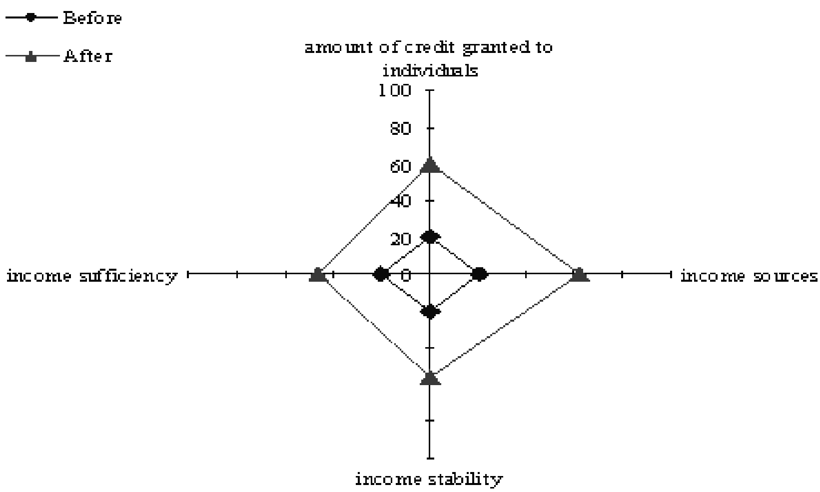


Figure 22.4
The Assessment of Productivity of Financial Capital before and after Intervention of the Rangeland Rehabilitation Project, Using Amount of Credit and Income (Sources, Stability, Sufficiency) as Indicators (from the Bara Case Study)



(Trus), the construction of terraces help the farmers to grow vegetables, including okra, eggplant, and tomatoes, which can be harvested up to five months after the rainy season and the restocking of gum trees (*Acacia Senegal*) and retention of part of the tree cover in the agricultural fields with alluvial soils for the provision of fuel-wood.

These measures were found to have largely contributed to the coping capacity of local communities across the five livelihood capitals and reflected in:

- Increased soil fertility agricultural production and diversification of crops
- Availability of physical assets necessary for sustaining their livelihoods (Storage facility for surplus production to difficult times.
- Creation of community organizations and better team work with better management skills.
- Diversified income sources, poverty alleviation, and good quality of food and improved the general household conditions. For example, the use of home garden or *jubraka*, a backyard farm which is mostly operated by women, and used for growing of fast maturing crops and some vegetables like *okra, pumpkins* and *cucumbers.*
- Increased community participation in decision making process and enhanced women's participation and involvement.
- Improving agricultural production and better health condition (improved nutrition).
- Improved communication channels between the local communities, ITDG, NGOs and CBOs.

6. Conclusions and Recommendations

Each of the case studies produced quantitative assessments of adaptation options which can be readily used in adaptation decision-making processes. However, effective prioritization and selection of adaptation options requires robust information on those options The methods outlined above, and the outputs generated have the potential to help make the inclusion and consideration of community-based activities a standard aspect of adaptation planning. A few observations:

Applicability: The assessment process outlined here is a response to clearly defined vulnerabilities. In order for this process to be useful in adaptation planning, it is necessary for priority vulnerabilities to be identified. In the case of Sudan, and much of the Sahel, vulnerability to drought is a pressing issue for vast areas and the communities therein. This knowledge, combined with climate scenarios indicating warmer and drier conditions in key regions (see e.g., RoS 2003), enable researchers in Sudan to focus a certain share of their efforts on assessing options to respond to existing vulnerability, as outlined here. This is not to suggest that vulnerability assessment is unnecessary in Sudan; clearly, greater understanding of key vulnerability hotspots, current drivers of vulnerability, important sectoral exposure to climate hazards, etc. is needed. Still, some of the broad parameters of vulnerability for vast numbers of Sudanese communities and millions of people are fairly clear. For these communities, efforts to build coping capacity are needed over vulnerability assessment.

In general, in countries where climate scenarios suggest an intensification of current climate patterns, undertaking the type of assessment outlined here can be a sensible use of resources in adaptation planning. In other countries, key climate vulnerabilities require further clarification and the bulk of effort should remain on gaining a richer understanding of the dimensions of vulnerability, and also threshold levels; with such an understanding, the type of assessment described here can then become practical and useful.

Practicality: In Sudan, much can be learned about adaptation options for drought-prone communities from these three cases, and an effort like this may be an appropriate use of time and resources, however it must be noted that the case study process outlined here may be more involved than is practical for many countries with, for example, diverse vulnerability—e.g., coastal, montane, arid zones. Ideally, an intermediary process could be derived from the case study methods outlined here, or from others, which enables more rapid and less costly, but highly insightful assessment.

Adaptation to climate vulnerability and change is increasingly gaining recognition. The experiences presented in this paper could provide a sample of possible adaptation measures that could be considered by policy makers when formulating sectoral plans aimed at sustainable development. Furthermore, by relating specific types of adaptation to rural communities and stakeholders, it is hoped that this work will contribute to the development of practical and useful adaptation programs for future climate change. Research and evaluation is needed to explore the potential sustainability of the identified adaptation measures to future climatic changes and the relative merits of different adaptation options in terms of effectiveness, economic efficiency, implementation ability, flexibility.

Notes

1. See, e.g., the *Strategic Environmental Framework for the Greater Mekong Subregion* (SEI and ADB, 2002).
2. This wide time horizon has been chosen to capture the infamous drought of 1983-1984 (persistent regional drought) that severely impacted countries of the Sahel.
3. The project favored the use of agricultural systems, as these tend to be most representative of other locations at the national and regional levels. Data on agricultural systems is more readily available and tends to be more reliable. Moreover, much of the traditional knowledge developed by communities for drought-proofing is oriented around crop and food production systems.
4. See The Resilience Alliance: http://www.resalliance.org/whatisresilience.html.
5. See, e.g., Turton (2001), Marshland *et al.* (2001), Hussein (2000), Rennie and Singh (1996).
6. It is important to note that at the time of the case study research (early 2004), the cluster of communities in question had been relatively unaffected by the violence and displacement in the vast Darfur region. However, the researchers are concerned that, like many communities in Darfur, these too have subsequently been drawn into the ongoing crisis.
7. As this is considered the key criteria that distinguish one case from another, the project select the same target system more than once, since different measures were applied in the different settings within.
8. "Success" was confirmed through site visits and assessment of community ownership of the project activities in question, as discussed below.
9. http://www.geog.leeds.ac.uk/projects/prp/downdocs.htm.

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23

Vulnerability Assessment as a Tool to Build Resilience among the Coastal Community of Mauritius

Kheswar Beehary Panray, Guruprakash Noyensing, and Krisna Muni Reddi

1. Background

Since human beings have lived on this planet they have coped with numerous forms of environmental hazards, floods, volcanic eruptions, tsunamis, earthquakes etc. Yet to cope with the warming of the planet at a speed and magnitude that is currently occurring is a new challenge, and this warming is expected to increase over the coming decades and centuries.

Although the human race has experienced environmental hazards over thousands of years, scientists cannot predict exactly when a hazard will occur, whom it will affect and how severe the impacts will be. Therefore, many individuals, especially the poor community, considering the uncertainties, choose not to prepare for the risks and when risks turn into realities the outcome is disastrous.

On the other hand, after 13 years of international agreement signed by the world governments on the need to reduce GHGs (Kyoto Protocol), no considerable changes have occurred. Globally, sea level rose 10-20 cm during the twentieth century and this rise is expected to accelerate significantly to between 9 and 88 cm during the twenty-first century as a result of human-induced climate changes. This is certainly going to affect the world's shoreline population.

Mauritius, together with other small island developing states, share certain characteristics that underscore their overall vulnerability to climate change, climate variability and sea-level rise. Although these countries are among the least responsible for climate change, they are the most likely to suffer from the adverse effects. This can lead to various forms of extreme events. Therefore, enhancing adaptive capacity is critical to meet the challenges of projected climate change and sea level rise.

Most of the inhabitants in the coastal villages are fishers that derive income directly or indirectly from the sea. The family income is low and is affected by environmental conditions. Due to their low level of education, climate change and future natural disasters, such as an increase in cyclones and droughts, flood damages from storm surges, and a variety of other potential hazards resulting from climate change are still unknown to them.

Assessing vulnerability and resilience was an essential and integral part of the project for the preparation of an adaptation strategy plan (ASP) to be implemented in the four pilot coastal villages of Mauritius. The vulnerability assessment associated with climate change and sea-level rise, was used as a tool to build resilience among the coastal community in the coastal villages as well as to give the coastal community the opportunity to join, share and learn from experiences on how to mitigate climate change impacts, which is a continuous process.

2. Justification

Knowing the threats and risks from climate change, the Republic of Mauritius was the first nation to have ratified the "UN Framework Convention on Climate Change" in September 1992, thus binding itself to the terms of the Convention, when it came into force in March 1994.

In the Initial National Communication plan submitted to the UNFCCC in April 1999, while assessing the vulnerability of key socio-economic sectors, the coastal zone together with the agriculture sector was identified as the most vulnerable. With accelerated sea-level rise, the government of Mauritius is expecting to result in land loss due to beach erosion, damages to coastal infrastructure, degradation of coral reefs and loss of wetlands and also the risks of intrusion of salt water in coastal aquifers.

A wide range of adaptation options exist that could be successfully implemented in coastal villages, but the fundamental constraints that limit the choice and implementation of these options are:

- inadequate data or information and technical capacity for timely and effective adaptation planning
- weak institutional capacity and
- limited financial resources

3. Methodology

In response to the difficulties experienced in applying IPCC Common Methodology for assessing coastal vulnerability, the method used is built on a broader assessment and decision-making support framework, appropriate to Mauritian coastal villages. Vulnerability assessment associated with climate change and sea-level rise, as a tool to build resilience among the coastal community was preceded by an informal education on climate change science.

This informal education was carried though an exhibition—using 3D and demonstration exhibits—also through data collections—or physically verifying climate-change-induced changes, through field visits and setting up of simple varying tools.

To assess vulnerability the local community were grouped into a team (20-30 persons) including women and children and this built up their technical and institutional capacity. Due to the proximity of the team to the local community, vulnerability assessment and other risks identification tasks were easily accessible.

The aim of the test was to assess the individual within the immediate environment, among the family, general living conditions, and the neighborhood, followed by a broader assessment of the village in relation to its location, availability of services and associated risks, based on various scenarios.

While vulnerability assessment is an exercise to identify and eliminate risks, techniques used to assess risks, namely through mapping, interactions and exposure to the various extreme event scenarios, equipped the coastal dwellers with the ability to build resilience through appropriate actions and programs.

Data Collection and Assessment Methods

Data describing the different physical, biological, social, economic and cultural conditions at the village was collected, followed by a questionnaires based on various scenarios.

The first set of measurement assesses the *individual/family within the immediate surrounding*. The villages may necessitate further division into zones, for example, individual living on the seaward side in relation to the coastal road and/or less than 1m to the high water mark are grouped in the same zone, or individual living at the foot of the mountain slope where landslide is possible, due to apparent cracks on existing building are rated together in a separate zone.

Family Status

The individual is assessed within the family on the following: family income, average parental age, average children age, and general health of the family. Families with low income, average parental age above 60 years, average children below 10 years, and with a sick family member were highly scored.

1. Family income. When the family income is low, investment is also low in regards to good and safe infrastructure.

What is the total family income?

Score 0	**1**	**2**	**3**	**4**	**5**
Above MRU25,000	20,000	15,000	10,000	5,000.00	below 5,000.00

2. Average parent age. Grandparents living with the family would increase the average parental age and the family vulnerability.

Total parental age divided by the number of persons

Score 0	**1**	**2**	**3**	**4**	**5**
Less 25	35	45	50	60	Above 70

3. Average children age. Families with low average children age are highly vulnerable. In a high average children age family, grown up brothers or sisters can help the parent in case of emergency or look after themselves.

Total number children age divided by the number of children.

Score 0	**1**	**2**	**3**	**4**	**5**
Above 20	15	10	8	5	Below—3

4. Family health status. The number of family members with health problems (including old age), type of health problems as well as the degree of dependency on health services or other members of the family is also rated.

Score	**0**	**1**	**2**	**3**	**4**	**5**
Number	Nil					Two members
Type						Very serious
Dependency on others	Nil					High

5. Family resources dependency. Families solely dependent on natural resources may be affected for many days in a natural calamity like a severe cyclone.

Key questions used: Is the family income solely dependent on fisheries? What will happen if a cyclone last for 10 days? Do you have any other member of the family working somewhere else in textile, for example? Do you think this would have supported the family income in extreme events?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Natural resources	Not at all			Partly on natural resources		Only on natural resources

In-House Provision

Here the individual is assessed in relation to first hand materials available during or immediately after an extreme event. These include first aid equipment, including dry matches, wood and charcoal. Availability of simple tools ranging from hammer, nails, plywood to wooden bars and other first necessity materials were also rated.

1. First aid kit and hand tools. Families without a first aid kit or simple hand tools are highly vulnerable.

Key questions used: Do you have a complete first aid kit? How are you going to help an injured person at home during an extreme event? Do you think that keeping some simple items at home can help in bad weather?

Score 0	**1**	**2**	**3**	**4**	**5**
Yes					No

Key questions used: Do you have all the small first hand tools to be used in your house to consolidate an opening (window/door) during an extreme event? Do you think that keeping some simple items at home can help, e.g., to repair a broken window, during bad weather?

List of items: Hammer Nails, Wooden Bars, Plywood, Rope, Candles, Dry Matches, Dry Cooking Wood, Dry Charcoal and Kerosene.

Score	0	1	2	3	4	5
	Yes, Fully equipped					No, not at all

2. *Food/water*. There is always an interruption in the supply of water during and at the end of an extreme event or the quality of water supply may not be fit for consumption. Here data is collected on the amount, water storage methods used before an extreme event as well as the amount of water available for use just after the natural calamity, at least for a few days until the situation improves.

The type, amount and storage of food are also rated. Improper storage, storage of perishable goods, or chilled goods in case of power cut is also highly rated.

Key questions used: Do you have sufficient food storage in your home to last for a few days during or after extreme events? What will happen to your chilled food in case of power cut? Do you think that keeping canned and dry food in a proper place would be useful in extreme event?

List of items: Flour, Rice, Canned Food, Dry pulses, Potatoes, Onions, Tomatoes, other vegetables. How are these items kept?

Score 0	1	2	3	4	5
Yes Sufficient					No Insufficient

Key questions used: How many water storage tanks do you have and what are their capacities? Do you think that storing clean water for home use before an extreme event is cost effective?

Number of water tanks and capacity of storage

Score 0	1	2	3	4	5
Fully finished			Partly finished		Incomplete

House Structure

1. *Vulnerability*. In all the coastal villages it was observed that coastal dwellers make their house in several phases. The reason may be financial constraints. Incomplete houses with improvised windows and doors make them highly vulnerable to strong gust. Interviewers also looked for at least one hiding, secured place in case of emergency retreat during an extreme event.

Key questions used: How would you describe your house? Do you think the windows and doors are strong enough to face cyclonic gust?

Score 0	**1**	**2**	**3**	**4**	**5**
Fully finished			Partly finished		Incomplete

2. *Secured place/room.* Do you have at least one secured place or room to hide with your family in case of an extreme event?

Score 0	**1**	**2**	**3**	**4**	**5**
Yes Sufficient					No Insufficient

Yard/Compound

1. *Potential dangers.* Improvised fencing using drums and iron sheets make the individual highly vulnerable and exposed to projectiles in strong wind. Water accumulation for a long time may cause health hazards. Trees, plants and other structures that may cause damage to property or cause obstruction were also highly scored.

Key questions used: Give all the details of your yard/compound? Is the fencing strong enough to resist cyclonic gust? Is it possible that part of the fencing is carried by the wind and harms any member of your family? Do you think water can accumulate in your yard and help in the proliferation of mosquitoes? Can the trees in your yard cause damage to property or block public access?

	No 0	**1**	**2**	**3**	**4**	**Yes 5**
1. Exposure to projectile						
2. Water accumulation						
3. Trees or plants that may cause damage to property						
4. Trees that may prevent public access						

2. *Live animals*. It was apparent that possession of live animals such as cows, goats, etc rendered the costal dwellers highly vulnerable, because none of them are ready to leave behind their livestock, in case they have to retreat landward during a storm surge or sea level rise.

Do you have live animal at home or in your compound?

	No 0	1	2	3	4	Yes 5
Dogs, Poultry, Goat/Cow, Others						

Are you ready to leave behind your livestock and escape in case or emergency?

Score	0	1	2	3	4	5
	Yes					No

House Supplies

1. Water. Data is collected on water quantity and quality. For electricity supply, data is collected on the type of in-house installation and the state of the aerial supply lines. Unclear telephone and electricity lines with compound vegetation are most likely to be damaged and therefore were highly scored. Gas cookers are very popular. Families with gas burners that are not properly maintained or without spare gas cylinders were also highly scored. Many accidents were reported on removing television antenna during cyclonic weather. High scores were given on inaccessibility or difficultly to remove antennas.

Key questions used: Where is your water stored? How many water tanks do you have? Where are they located? How many days can your water tank last if supply is interrupted?

Score	0	1	2	3	4	5
	Yes Sufficient					No Insufficient

Score	0 No	1	2	3	4	5 Yes
Possible Contamination						

2. Electricity. Key questions used: Was your electrical installation done by a professional? How often do you clear your electricity lines in your yard? Was your supply line damaged in the last cyclone?

	0	1	2	3	4	5
Clearance of supply line	Regularly					Not at all
Installation	New, well done					Incomplete

3. Gas. Key Questions used: How do you describe your gas supply and installation? Do you have spare gas cylinders? If no, how are you going to manage in case the gas finishes and it is impossible to venture outside?

	0	1	2	3	4	5
Spare Cylinders	Yes					No
Installation	New, well done					Incomplete or No regular servicing

4. Telephone. Key questions used: How do you describe your telephone supply? How often do you clear your line from vegetation?

	0	1	2	3	4	5
Clearance of supply line	Regularly					Not at all
Installation	New, well done					Incomplete

5. Television. Key questions used: How do you describe the position of your television antenna? Is it difficult or dangerous to remove in bad weather?

Score	0	1	2	3	4	5
Antenna Location	Good					Bad
Removal	Easy					Difficult

Bio-Geophysical and Socio-Economic Impacts

The second set of measurement assesses the whole community village in relation to bio-geophysical and socio-economic impacts such as measurement covers, access roads, land and land uses, public supplies and facilities, water drainage and also existing possibilities of flooding, landslides, mudflows, and health hazards under different scenarios. The scores obtained are added to the individual score obtained from the individual assessment exercise at different zones.

Information and data collected from: Mauritius Meteorological service, Mauritius Oceanography Institute, Albion fisheries Research Institute, Road Authority, existing map & aerial pictures, fisher's community, Community village Mapping, field visits, assessment and surveys. Data was also obtained from previous records and existing practices.

General information: Data is collected on: Number of houses, population, important buildings such as relief centers, hospitals, shops etc and total number of vehicles, fishers boats, people above 60 years of age, people with health problems as well as information on village supplies of water, electricity and communication.

1. Wind Exposure. The island receives the South-East trade winds during normal periods. In general, villages on the south, southeast coast are more exposed to wind.

Score	**0**	**1**	**2**	**3**	**4**	**5**
Wind exposure	low					High

2. Corral reef barrier. The island is almost encircled by a reef barrier except at some places and the mouth of rivers. The coral reef also has a number of passes. Data is collected on the thickness/ size, numbers of passes, distance from the lagoon and the general state of the coral reef barriers.

Key questions used: How do you describe the coral barrier in your locality? Are they healthy? How may passes are there?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Existing	Yes					No
Size	Large					Thin
Distance from shore	Far					Near
Passes	Nil					Many

3. Lagoon. The lagoon is measured on the type (health), size and dependency of the community. A small lagoon makes the coastal community highly vulnerable.

Key questions used: How often do you go fishing in the lagoon?

	0	1	2	3	4	5
Existing	Yes					No
Size	Large					Small
Community dependency	Low					High

4. Beach/beachfront. The beach/beach front is measured on type and amount of vegetation present. Casuarinas from Australia are very popular beachfront vegetations in Mauritius and are also important windbreakers. Dense vegetation along the shoreline would provide greater wind protection on the landward side.

Key questions used: How do you describe the beach/beach front of your village? What are the advantages or disadvantages of having such a beach/beach front?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Vegetation	High					low
Beach Topography	≥ 10m					≥ 1 m

5. Access road. The village is also assessed on the number of access roads based on a number of scenarios. The possibility to escape or have access to essential services is also taken into consideration. Most of the coastal villages are accessible only by the coastal road and if located at the foot of the mountain, landward movement is almost impossible and therefore this renders the costal dwellers highly vulnerable.

Key questions used: How many access roads are there in your village? Can you use the access road in a storm surge or sea level rise? Are there other roads to escape or use in case of emergency when you cannot use the access road?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Number	Many					Only one
Possibility to escape without using the main access road	Yes					No
In relation to high water mark (lowest point)	≥ 10m					≥ 1 m

6. Location of houses and buildings. The percentage of houses located within or below 3 meters from the high water marks is highly rated. Houses located at the foot of mountains are also highly rated because of possible floods and mudflows. In general, the village is divided into zones, sharing some particular characteristics associated with possible calamities associated with extreme events under different scenarios.

Key questions used: How many houses are below the 1-3m marks? How many important buildings are below 1-3m marks? What will happen if you have a storm surge above 5m marks?

Score	**0** **≤ 5 %**	**1** **10**	**2** **20**	**3** **30**	**4** **40**	**5** **≤ 50 %**
% of houses ≤ 1-3 m in relation to high water mark						
% of Important buildings ≤ 1m in relation to high water mark						

7. General state of houses/buildings. This assessment is a follow up of the question C 1 & 2 in the individual assessment sheet. It was necessary because many concrete houses were incomplete without proper doors and windows. These made the individual's highly vulnerable, however here the percentage of such houses in the village is rated together with other fragile metal and thatched buildings. These may include animal shed, car garage, stores, latrines etc.

Key questions used: How do you describe the houses in your village? Will all the houses in your village resist a severe cyclone? How many unfinished houses are there in the village? How many building are likely to be damaged in bad weather or be flooded during heavy rainfall?

Score	**0** **≥90 %**	**1** **70**	**2** **50**	**3** **30**	**4** **20**	**5** **≤ 5 %**
% of houses/buildings Concrete completed						
% of houses/buildings Concrete incomplete	≤ 5 %	20	30	50	70	≥90 %
% of houses Metal sheets	≤ 5 %	20	30	50	70	≥90 %
% of houses/ buildings thatches	≤ 5 %	20	30	50	70	≥90 %

8. Village services. All the available services are rated such as the police, National Coast guard, and fire service. Scores were given to availability, intervention time and also capacity to intervene; i.e., the necessary equipment to intervene such as, vehicles or sufficient officers.

Key questions used: Does your village possess all the services? Like Police, National Coast Guard and Fire service? In case of a problem, in how much time do you expect to have the help of a service? Do these services have the necessary tools to intervene?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Police Available	Yes					No
Intervention time	≤ 30					≥ 1 Hrs
Capacity for intervention	High					low

Score	**0**	**1**	**2**	**3**	**4**	**5**
National Coast Guard Available	Yes					No
Intervention time	≤ 30					≥ 1 Hrs
Capacity for intervention	High					low

Score	**0**	**1**	**2**	**3**	**4**	**5**
Fire Services Available	Yes					No
Intervention time	≤ 30					≥ 1 Hrs
Capacity for intervention	High					low

9. Village facilities. Almost all the villages have a relief center which is equipped with the basic provision; however it was necessary to assess these centers in relation to capacity, position in relation to sea level and accessibility in case of flood and storm surges.

Key questions used: Does your village have facilities like relief centers and health services? Are you satisfied with the services? Are the services accessible in bad weather example flood or sea level rise?

Relief Centers	**0**	**1**	**2**	**3**	**4**	**5**
Number of relief centers	Sufficient					Insufficient
Position in relation to sea level	≥ 10 m	8	7	5	3-4	≤ 1-2 m
Access to centers in extreme events	Easy					Difficult

Health Services	**0**	**1**	**2**	**3**	**4**	**5**
Existing	Sufficient					Insufficient
Position in relation to sea level	≥ 10 m	8	7	5	3-4	≤ 1-2 m
Access in extreme events	Easy					Difficult
Treatment time	≤ 30					≥ 1 Hrs

10. Vehicles. It was necessary to assess the number of vehicles in the village as well as the type of vehicles. This exercise was necessary because taxi service is necessary during extreme events. Vehicles such as lorries and 4X4 can be used in pitted roads to escape in case of emergency. It was also necessary to know if the village possesses heavy earth-moving vehicles that can be used to clear roadblocks or open new access in case of road damage.

Key questions used: How many vehicles do you have in your village? Is it difficult to hire a taxi in bad weather? Are there sufficient vehicles that can be used in pitted roads? Are there any earth moving vehicles in your village that can clear roads or open new access in case of emergency?

Score	**0**	**1**	**2**	**3**	**4**	**5**
Cars/Taxi	Sufficient					Insufficient
Lorries	≥ 10					Nil
Van/ 4X4	≥ 5					Nil
JCB ,Tractor etc	Yes					Nil

11. Existing possibilities. This exercise is based on a number of scenarios such as flood, storm surges, high gust, or drought and the existing possibilities are rated.

Key questions used: In case of emergency, can the villagers move landward? Is there possibility of landslides, mudflows? Is there the possibility of access roadblocks? In how many places does water accumulate for a long period in the village? Is there the possibility of sewage contamination? Is there the possibility of inadequate safe drinking water? What will be the impacts of drought on the village farming?

Score	**0** No	**1**	**2**	**3**	**4**	**5** Yes
A. Landward movement						
B. Landslides						
C. Mudflows						
D. Access roadblocks						
E. Accumulation of Water causing health hazards						
F. Sewage Contamination						
G. Inadequate safe drinking water						
H. Impact on Agriculture						
I. Impact on farm animals						

4. Conclusions

Since all the villagers living in a coastal village have the same services, facilities and access roads etc. the village assessment scores are the same for all individuals living in that village and may differ from other villages.

The village assessment score is added to the individual score to give the vulnerability index. For individual assessment, the families are grouped in zones. A village may be demarcated in one, two or several zones depending on some specific peculiarities. For instance, people living on the seaward side in relation to the coastal road and less than 3m from the high water mark, or people living in a place where landslide is likely to happen, are rated together.

Individuals living in the same zone and in the same village can be compared; difference in scores would reflect variation in life style or exposure to potential immediate surrounding dangers. Here it is mostly the individual's effort that is required to improve status by bringing simple corrective measures to eliminate risks.

Variation in scores obtained in two or more zones in the same village would give an indication of the individual's life style, exposure and location in the village in respect to potential effects associated with natural calamities. Here the individual's effort as well as the authority may be involved to decrease risks where higher investment is required.

The average individual score of the village added to the village score can be used to compare vulnerability of individual living in different coastal villages. A priority list can be established and figures obtained herein can be used for national development process and policy making.

The colored stickers used in the vulnerability index give a general state of the individual's potential vulnerability. Highly vulnerable individuals may be asked to improve status by decreasing risks. The colored stickers may also be used for other purposes, e.g., to decide if sufficient space and provision is available in relief centers of the village or whether the authority may decide to move highly vulnerable families to relief centers well before an extreme event or establish a priority list for social help and assistance.

The results obtained for each village were publicized and findings not only highlighted potential dangers and risks but also included recommendations that encourage resilience by proposing a series of corrective and preparedness measures.

5. Results

The result of the assessment is given by the distribution of colored stickers to the individual family depending on the scored obtained as given in Annex 23.2. Findings obtained on the general state of the village are drafted into an Adaptation Strategy Plan (ASP) and reported to the public. The ASP includes a series of short-, medium- and long-term strategies to mitigate the effects of climate change as well as to adapt so as to face severe extreme events.

Results obtained from two coastal villages, namely Quatre Soeurs and Cotteau Raffin, are herewith annexed as reported by the local press (the website links, quoted at the end of this chapter, provide additional evidence and analysis)

Annex 23.1
Village Assessment Sheet: Quatre Soeurs (QS) /Cotteau Raffin (CF)

Questions	1	2	3	4	5	6	7	8	9	10	11	12	Max. Score	Total Score CF	Total Score QS
1. Wind Exposure		-	-	-	-	-	-	-	-	-	-	-	5	3	4
2. Corral reef barrier					-	-	-	-	-	-	-	-	20	5	5
3. Lagoon				-	-	-	-	-	-	-	-	-	15	8	6
4. Beach/ Beach front			-	-	-	-	-	-	-	-	-	-	10	9	8
5. Access Road				-	-	-	-	-	-	-	-	-	15	14	15
6. Location of houses and buildings			-	-	-	-	-	-	-				20	9	9
7. General state of houses/ buildings					-	-	-	-	-	-	-		20	17	12
8. Village services													45	44	41
9. Village Facilities													35	31	27
10. Vehicles					-	-	-	-	-	-			20	19	14
11. Existing possibilities										-	-	-	45	36	40
TOTAL													250	195	181

Annex 23.2
Average Individual Assessment: Quatre Soeurs (QS) /Cotteau Raffin (CF)

Questions	1	2	3	4	5	6	7	8	9	10	Max. Score	CF Score	QS Score
FAMILY STATUS	4	4	4	4	5	4	4	-	-	-	35	29	29
IN HOUSE PROVISION	4	4	5	4	-	-	-	-	-	-	20	20	17
HOUSE STRUCTURE	4	4	-	-	-	-	-	-	-	-	10	10	8
YARD/COMPOUND	5	5	5	4	5	5	-	-	-	-	30	24	29
HOUSE SUPPLIES	4	5	4	4	4	4	4	4	4	4	50	46	41
TOTAL											145	129	124

Total maximum score: 145+250 = 395

Vulnerability Index:

Slightly Vulnerable White	Moderately Vulnerable Green	Vulnerable Blue	Vulnerable Yellow	Highly Vulnerable Red
0-79	80-158	159-237	238-316	317-395

Result : Cotteau Raffin Village scored: 324-Red
Quatre Soeurs Village Scored: 305-Yellow

La Gaulette Village:
http://www.lexpress.mu/archive_semaine/display_article_sup.php?news_id=101996

Quatres Soeur Village:
http://www.lexpress.mu/archive_semaine/display_article_sup.php?news_id=92125

24

Lessons Learned from Participatory Vulnerability Assessments in Nepal

Ram Chandra Khanal

1. Introduction

Climate Change

Since the industrial revolution, human beings have been emitting high amount of green house gases into the atmosphere, potentially resulting in higher global temperature, changed hydrological regime and increased climatic variation. These are responsible for global climate change. Stern (2006) suggested that the impacts of climate change affect the most vulnerable developing countries and the poorest communities since they do not have sufficient resources to adapt. People living in fragile environments in developing countries are at higher risk of climate change impacts such as floods, droughts, infrastructure damage and diseases.

The challenges of climate change are at the centre of international dialogue. The debate about climate change has tended to primarily focus on mitigation of green house gas emissions. While this is an important area, most developing countries can do better in preparing to adapt the adverse impacts from climate variability and climate change. In all cases, both mitigation and adaptation measures, where and when possible, are inevitable to combat the adverse impacts of climate change not only for the poor and vulnerable communities but equally important for all human beings to strike a balance between humans and nature sustainably. It is urgent that national and international actors learn from the past to devise new mechanisms and share globally to offset the adverse impacts of climate change. In this regard, participatory evaluation could play a very significant role. However, evaluation of climate change and development is a new and emerging area of work both at the international and national levels. Participatory evaluation learning from natural resource and disaster management areas could be adapted for climate change and development projects, shared nationally and internationally to facilitate community adaptation processes.

Vulnerability

Vulnerability has been understood in different ways by different disciplines. The growing body of literature on vulnerability contains confusing words and meanings: vulnerability, risk, resilience, sensitivity, adaptive capacity, hazard, coping and so on. Jefrey et al. (2001) analyzed different views of vulnerability and found that practitioners from different disciplines use different meanings and concepts of vulnerability.

According to Robert Chamber (1989), vulnerability is a high degree of exposure to risks, shocks and stress, and proneness to food insecurity. Chamber has focused more on the external risks whereas Ellis (2000) viewed that it has the dual aspect of external threats to livelihood security due to risk factors such as climate, markets or sudden disaster, and internal coping capabilities determined by assets, food stores, support from kin or community and so on. Davies (1996) introduced livelihood vulnerability as a "balance between the sensitivity and resilience of livelihoods systems." This definition captured the idea of external risks and response through system approach that includes social, economic and bio-physical factors of certain locations.

The study related to vulnerability of human and natural systems to climate change and variability is a relatively new field of research. According to the IPCC Third Assessment Report (TAR), vulnerability is described as:

> The degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001, p. 995).

Literature review on vulnerability has shown many ideas and perspectives that can be grouped under three elements to facilitate better understanding. Those elements include *exposure* to risk, *sensitivity*, and *resilience*. Exposure to risk includes the severity and frequency of a function, including possible number of persons exposed to a function. Sensitivity is the magnitude of a system's response to an external event, whereas resilience is the ability of an ecological and livelihood system to "bounce back" from stress or shocks. As part of resilience, community adapts different actions as "response." "Response" are actions by a person, household and community individually or collectively to increase resilience, hence avert the risks.

Climate Change and Vulnerability Assessment

The assessment of vulnerability from climate change impacts and climate variability on the people's livelihoods is a new area of study in development discourse. Even as the climate change theme has been introduced in some of the development projects recently, a detailed analysis and systematic study related to vulnerability assessment has not been developed yet.

A study in Ilam Siwaliks of Nepal by Khanal (2007) revealed that change in precipitation patterns over the last few years in the project area has caused adverse impacts on agriculture, water resources, and livelihoods of subsistence rain-fed farmers in the area. This has increased vulnerability level both at the household and community levels.

While there are competing and widely divergent views on vulnerability, its assessment has increasingly become a difficult task. The Participatory Vulnerability Assessment (PVA) method and associated tools provide an effective approach for assessing vulnerability from climate change and climate variability at the community level. PVA is a systematic process of examining potential risks, making local community aware and educating them to manage the adverse impacts from climate change and climate variability by involving local community and stakeholders. PVA is rooted in a people-centered approach to analyzing qualitative information. This has been a proven as an "action and learning" tool in order to integrate strong community adaptation measures and manage adverse impacts.

2. Objectives

This chapter attempts to explore strengths and effectiveness of selected participatory evaluation tools for vulnerability assessment in climate change and development projects in Nepal through a Participatory Vulnerability Assessment (PVA) method. The knowledge generated through this process would help to understand climate change and development evaluation.

3. Study Methods, Framework, and Site

This action research study was carried out through a consultative process of community groups, natural resource management experts and local level project staff. As evaluation tools for climate change and development are in an evolving stage, the study was mainly based on experts' inputs, field level discussions, and joint work with the community group. Knowledgeable experts on climate change and development participated in a Focused Group Discussion (FGD) held in Kathmandu and provided their feedbacks on evaluation tools and proposed some guidance notes for group exercises. Later, two FGDs and participatory field exercises were carried out to test the participatory tools of their applicability to assess community vulnerability. Some field observations and verifications were also carried out jointly.

The main steps of PVA and their specific methods of analysis were:

i) *Situation analysis*: To understand the situation related at the community level and assess the vulnerability, some specific questions were posed: To *what* is your community at risk? *When* does it happen? *Where* are the risk prone areas? *Who* is mostly affected from flood? A ranking matrix, seasonal calendar and social and resource map, Focus Group Discussion (FDG) and Key Informant Survey (KIS) were used to answer the questions "what, when, where and who."
ii) *Cause-effect analysis*: In order to analyze the cause-effect relations of climate change, its impacts and vulnerability, FDG and the Driving force–Pressure–State–Impact–Response (DPSIR) method was used.
iii) *Community response*: Community adaptation measures practiced by the community were collected through FDG.
iv) *Vulnerability assessment and mapping*: This was carried out based on FDG with community members and use of researchers' own knowledge.

Study Sites

Jugedi village of *Kabilas* VDC (Figure 24.1) is located in Chitwan District, southern Nepal. This village is 130 km from Kathmandu—the capital city of Nepal. The main occupation in this area is agriculture followed by livestock husbandry. Farmers cultivate maize, rice and millet as the main crops along with vegetables. Although the primary occupation of the community is farming, the village food supply is not secure. About 45 percent, of households have food sufficiency for less than 3 months; 50 percent of farmers have food sufficiency for 6 months, and only 5 percent of households are food secure year round. There are about 25 landless houses. The altitude of this village stretches from 400 to 800 meters above sea level and is composed of mixed ethnicity, culture and tradition. The highest population is from *Gurung* (65 percent) followed by *Tamang* (15 percent), and *Brahmin, Chhetri/Newar* (15 percent) and

Figure 24.1
Study Site-Jugedi Village, Chitwan, Nepal

the remaining population were from *Chepang* and *Dalits*. Literacy rates among women are low (10 percent) compared to men (45 percent) (Group discussion, 2008).

A group, *Jalbayu Paribartan Ka Asar tatha Prakop Byabasthapan* (Climate Change Impacts and Disaster Management Group—CCIDMG), was established in 2006 as a federation of five community groups from five hamlets.

Framework of the Study

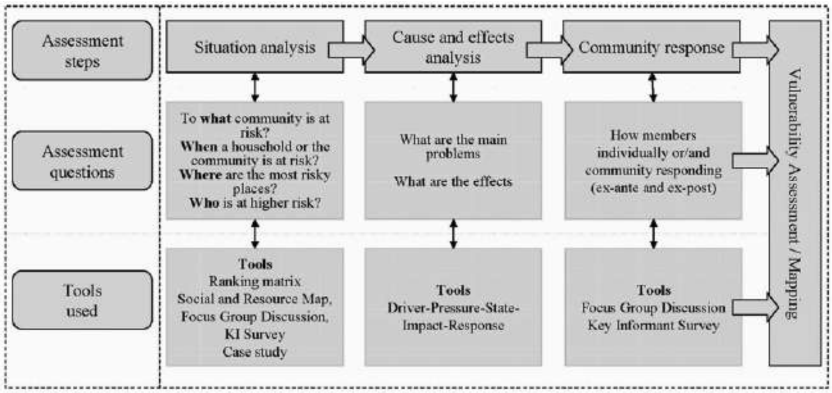
In order to analyze the situation, obtain information and making more systematic research, following study framework was developed and used:

4. Results and Discussions

Situation Analysis

Situation analysis provides an understanding of area, context and present condition of the local community in relation to climate-induced vulnerability, its impact on the livelihoods of people and how those impacts were linked with development.

Table 24.1
Framework of the Study



Four major questions were posed and information was collected by using participatory evaluation tools in order to comprehend the study site situation. The questions were: "*to what*" is the community at risk?—by using a ranking method; "*when*" is a household or community at risk?—by using seasonal calendar; "*where*" are the most risk prone places?—by using social and resource mapping; and "*who*" is affected mostly?—by using Focus Group Discussion and Key Informant Survey. Besides these, historical trend analysis was also used.

a. To What Community Is at Risk?

In order to identify climate change impact areas responsible for higher degree of vulnerability at the community level, a simple ranking matrix was used. Ranking is an important tool to identify and prioritize the preference of local people with respect to specific issues. At the very outset, the community group used this tool to identify a list of major areas of risks created by climate change and ranked them according to the extent of vulnerability exerted in people's livelihoods.

Based on the discussion, major areas of climate change at local level were identified and selected for further scrutiny. Those include unprecedented floods, prolonged drought period, change in temperature, change in carbon dioxide levels and water-borne diseases. Then community members discussed, identified and prioritized vulnerability levels of those selected areas. Finally, the community group identified that unprecedented floods during monsoon was the biggest problem and caused the highest level of vulnerability at the community level.

After that, the group members identified possible but specific impacts of floods on their livelihoods, agriculture and water resources. Those impacts include agricultural land cutting, landslides, destruction of irrigation canals, damage to the drinking water supply system, loss of house and other physical infrastructures. For further assessment of vulnerability, some parameters for risk and sensitivity were identified through group discussion (Figure 24.2). The parameters were used to assess the extent of risk created by floods. Based on those parameters, the community group finally prioritized specific area of impacts with justifications. A detailed procedure of carrying out ranking has been outlined in Annex 24.1 and a brief process is presented below:

1. Identify major areas of impact or events that are most at risk from floods;
2. List vulnerability parameters which the community see as important and are responsible for community vulnerability;
3. Cluster them according to "risk" and "sensitivity" category;
4. Ask community members to provide their preference (requested to provide no. of X based on the severity that can yield higher risk, high no. of X for high level of vulnerability) on those impacts or events; and

Figure 24.2
Community Risk Analysis at *Jugedi* Village, Nepal

RANKING MATRIX

Parameters	Agriculture Land Cutting	Landslides	Loss of house	Irrigation Canal damage	Drinking water Supply System damage
Risk:					
Scale/extent/Severity	XXXXX	XXX	XXX	XXXX	XXX
Probability/frequency of happening	XXXXX	XXX	XX	XXX	XX
No. of Persons affected	XXX	XX	XX	XXX	XX
Sensitivity					
Fragility	XXXX	XXXXX	XXX	XXX	XX
Slope/Land Cover	XXX	XXXX	XX	XXX	X
Lack of awareness and early warning Systems	X	X	X	X	X
Severity of Risk	I (21)	II (18)	IV (13)	III (17)	V (11)

X-Shows Level of Problem

5. Count the parameters and prioritize those more critical to higher level of vulnerability and discuss them.

The group exercise revealed (Figure 24.2) that clearing land for agriculture was the most severe problem in the community, and had made the community more vulnerable than any other area of impacts. The second and third severe problems were landslides and destruction of irrigation canals, whereas demolishing house came as the fourth most severe problem.

b. "When" Is a Household or a Community at Risk?

A seasonal calendar was used to identify the most vulnerable time from floods. A seasonal calendar is a simple tool that helps to depict the time of flood risk in a year. Detail of methodology of using this tool is provided in Annex 24.2 and brief steps adopted for this exercise are stated below.

1. List some activities/events from community members with reference to floods that might induce risk to the community;
2. Ask the community to select main activities or events among many;
3. Ask the community members which activities or events occur during which time of month and also request them to depict the time of occurrence in the diagram;
4. Once all events and their respective occurrence are reflected in the diagram, discuss with the participants which time of a year is most risky from the point of view of floods and request them to provide ranking for different months; and
5. Identify which time of a year is most risk prone and discuss with the participants.

The discussion revealed the most vulnerable month for the community was *Bhadra* (Aug./Sept.) whereas *Shrawan* (July/Aug.) and *Ashwin* (Sept./Oct.) were second and third most vulnerable months respectively. According to the participants, they received heavy rain within a short period of time, especially during the first and second week in *Bhadra*. *Shrawan* was also very sensitive month and they experienced such incidents in this month as well (Figure 24.3). The national data and the meteorological station nearby *Jugedi* recorded that the total amount of rainfall was higher in the month of *Shrawan* but intensity of rainfall on daily basis was high during early *Bhadra.*

Figure 24.3
Risk Analysis in *Jugedi* Village

c. "Where" Are the Most Risk Prone Places in the Community?

In order to identify the most flood-affected areas, a social and resource map was used. The map provided detailed information of areas where there was higher risk from floods. A social and resource map is a participatory visual diagram that shows location of different kinds of natural resources and other features (infrastructure and social facilities) in the village.

The following methods were adopted to identify the flood prone areas in the village. Detail methodology of using this tool is given in Annex 24.3.

1. Draw a social and resource map showing all social information and natural resources;
2. Identify flood-prone areas such as irrigation canal, drinking water, agricultural land and human settlement based on the types of floods (small, medium and heavy);
3. Ask the participants which is the most flood-prone area and also ask why they think it is more important than others; and
4. Mark them on the social and resource map.

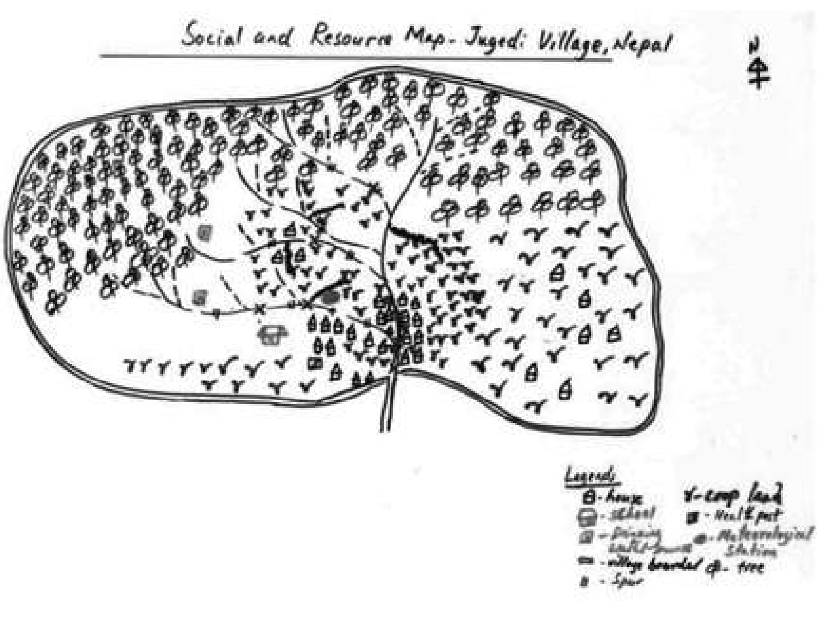
After the discussion, participants identified areas damaged by floods. Those were agricultural land lying adjacent to *Jugedi Khola* (which is the main *Khola* with 4 main rivulets) and settlements nearby the river. Besides these, farmers in the upstream suggested that irrigation canals originated from small rivulets (mainly *Iste* and *Kusum*) were also very prone to flood. Likewise, other group members also mentioned that a drinking water tank in upstream of *Daletar Bharland* and *Bharlang* rivulets (Figure 24.4) was also at higher risk.

d. Who Is Most Affected?

The FDG method, was used to discuss and identify the most vulnerable group in the community. Although it is difficult to clearly say which group in the community was more at risk than others as the floods affect irrespective of gender, ethnicity and poverty, the group concluded that the poor and women were comparatively at higher risk from floods as they had either inadequate knowledge on floods or fewer resources to adapt to the adverse impacts of floods.

Group participants said, “women generally go to flood-prone areas to collect grass, firewood and agricultural work. They are, therefore, more prone to natural disasters.” Other participants also shared that women have

Figure 24.4
Analysis of Flood-Prone Areas in *Jugedi* Village



the tendency of protecting and gathering their belongings in the secure places at the time of flood, which was one of the reasons of being caught more by floods. One woman (Box 24.1) was swept away by floods while collecting her belongings from her house whereas her husband and sons managed to escape. Besides these, compared to men, fewer women could swim; hence women were more vulnerable from floods.

Likewise, poor people were more vulnerable to floods as they generally did not have sufficient resources (i.e., shelter, land and social capital) to move away from flood affected areas, and limited access to resources and capacity to respond to the risks affecting them. In *Jugedi*, there are about 25 landless households who were settling on the bank of river and were very prone to flood risk whereas rich families had already abandoned that flood prone area. Children and elderly members of these poor families were even more vulnerable during daytime when other members of the families were out for work.

Cause-Effects Relation Analysis

It was difficult for the community to provide the reasons behind the change in climate in general and precipitation patterns and increasing trend of floods in specific areas. However, they believed it is all due to changing human behavior, consumption pattern and greed. According to them, people are using resources more than needed and emitting wastes (such as gas) that are responsible for these kinds of development problems, including climate change.

Box 24.1
Case Study—Maya Devi Khatiwada

On 14th of Shrawan 2060 (2003) around midnight, a heavy flood came in the Jugedi river and people near the river woke up and prepared to escape. Maya Devi Khatiwada (45 yrs) went to inform her neighbor about the floods and came to her house. Her husband warned her to abandon the house immediately, but she tried to gather some utensils, property and her children. The flood came and Maya Devi and a child, along with the house, were swept away. Her husband and her sons managed to escape from this catastrophic event.
(from Bhov Bahadur Gurung- Secretary-CCIDMG)

In order to understand the reasons why this area was more flood-prone compared to other villages, a Driving force–Pressure–State–Impact–Response (DPSIR) model was used to understand and elaborate the cause and effect relations of environmental related issues. Generally, the driving force consists of broader causes (economic, social, or human activities) that generate stress related environmental, social, and economic issues (Pressures) that influence the current condition of sustainability variables (States). The effects of changes of state (Impacts) finally require efforts by society to move towards resolving some problems (Responses).

The model was used to analyze the causes and their effects with special reference to floods through the Focus Group Discussion. It was realized that adequate knowledge, time and understanding related to natural resource management and other environmental issues was needed among the participants in order to understand the logic and to get sufficient information. This exercise helped the community members to understand and visualize the cause-effect relation of floods in a logical manner. The outcome of the exercise is described below:

The exercise revealed that increasing risk and vulnerability by flash floods during the month of early *Bhadra* was due to increased climatic variability in the recent past. In addition, the geology of the mountain was young and fragile and there was higher chance of landslides due to the nature of mountain. Besides this, the national forest cover—both area and canopy—was decreasing over the years, which also contributed to

Table 24.2
Increased Risk and Vulnerability: Cause and Effect Relation in *Jugedi* Village

Drivers	Change in climatic variability Fragile ecosystems (uncovered land, steep cultivation) Weak geo-physical setting Floods	**Response** - Local group to address issues jointly - Spur (physical/ biological) formation - Change cropping pattern - Shifting temporarily during the period of flood - Start income generation activities (e.g., vegetable production) - Out-migration
Pressures	Excessive agricultural land cutting Loss of life Loss of physical property	
State	Destroyed productive and fertile land Polluted drinking water Reduced livelihoods asset base	
Impacts	Increased food insecurity Insecure livelihoods—bio-physical (floods/landslides), economically (loss of property: house/livestock/land)	

the flash floods. It was also revealed that upland farming was practiced in some areas where the slope of the land was more than 60 percent. Inadequate knowledge of floods, weak governance structure, lack of response from within the community, and inadequate support from external sources were other problems. All those factors were responsible for devastating floods in *Jugedi* village.

Community Adaptation Measures

In order to increase adaptive capacity of poor communities to respond the impacts of climate change, the community developed a community-based disaster preparedness plan for adaptation including sustainable technologies adaptation for natural resource management, water conservation and agriculture and capacity building to cope with the impacts of flash floods.

Below is a brief summary of community response to adverse impacts of floods:

1. *Spur construction*: After an exposure visit in the nearby districts by the community group, the group came to realize that impacts from floods at the downstream could not be checked by creating a dam. They realized this would, in fact, be more dangerous and could create bigger problems when accumulated water at the downstream explodes at once. So, they developed a strategy of constructing small spurs (both physical and biological) in the upstream to manage the rivulets properly so that downstream land and human settlement would be safer. The community managed four such rivulets while creating more than 15 small spurs. Group members mentioned that this was the main reason that the floods in 2063 BS (2006) did less damage than the floods in previous years.
2. *Plantation in the riverbank*: In order to protect lands and to regulate the velocity of floods, the community planted trees along the bank of rivulets and river. Though the trees were not big enough, they believed that those trees in future would protect their land and other properties.
3. *Temporary migration away from flooding areas during rainy seasons*: Some of the families that lived near the river shifted to safer area during rainy season to be safe from floods.
4. *Changes in agricultural practices*: Due to prolonged drought and lack of irrigation facility in time, some farmers started cultivating banana instead of paddy whereas other farmers changed their crop varieties and crop sowing times.
5. *Income generation activities*: A lack of financial resources was one of the reasons why people were more vulnerable. Farmers in the study area started cultivating off-season vegetables. As there was a market

access, farmers had fetched good income from vegetables. This income was used for the different measures to reduce flood risks.

6. *Capacity building through training/general awareness raising and exposure visits*: Knowledge and understanding of climate change, vulnerability, possible risks from floods, adaptation measures etc, were important for farmers. With the support from project, the group organized training and exposure visits (knowledge, management and income generation activities) to manage adaptation measures against the adverse impact from climate change.

Vulnerability Assessment and Mapping

Participatory exercises and FDGs with the community members revealed that the community experienced greater risks from floods in the form of higher degree of severity, increased number of occurrences per year and affecting a higher number of persons over the last 5-6 years. These exposures of risks were further accelerated by local level bio-physical and social conditions. Those conditions are mainly fragile geology, steep slope, and denuded land, which increased the risk from floods. Government support was also found very minimum. The study found that attempts were made to minimize the impacts of floods and to increase resilience by the community themselves.

> The PVA showed that vulnerability is a function of exposure to risk from floods, the degree of sensitivity determined by bio-physical and socio-economic conditions and level of resilience facilitated by knowledge, skill, governance structures, and social and financial resources owned by the community.

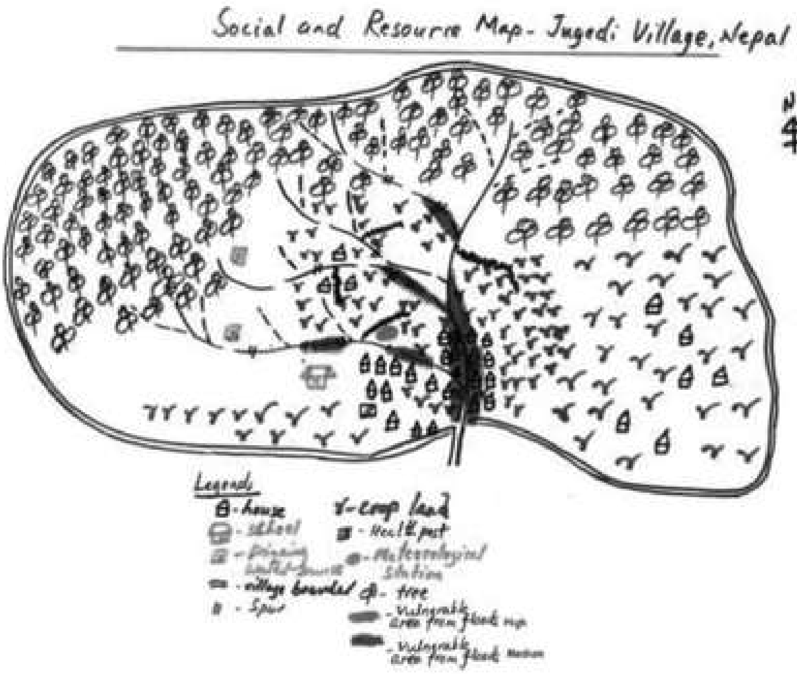
Based on all these exercises and observation, vulnerability at the community level was assessed and most vulnerable areas were identified (Figure 24.5). A brief method of vulnerability mapping is presented below:

Methods of vulnerability mapping

1. Discuss and explain risks, resilience and sensitivity at community level;
2. Ask the community to identify the possible risks, scale of resilience and the sensitivity of certain areas in the community;
3. Agree among the community which areas and why these areas are more vulnerable than others (link the risk and adaptive measures); and
4. Locate those on the social and resource map.

After a long discussion, the group came to a conclusion that the agricultural land nearby *Jugedi* Khola and human settlement was the most vulnerable area. After that, irrigation canals originating from *Iste* and *Kusum* rivulets were ranked second.

Figure 24.5
Vulnerability Mapping of *Jugedi* Village



Participatory Tools, Effectiveness, Challenges and Prospects for Scaling Up

Segregating the impact of climate change and assessing vulnerability at the community level was very complex. As communities witnessed a rapid change in climatic patterns and other socio-economic factors, working in the area of vulnerability from climate change is complex and uncertain. Inadequate awareness and information, insufficient attention from the government and weak political will to address these issues were also observed.

Despite all these challenges, the culture of participatory resource management and development process at the community level was present and active, illustrating that participatory tools are effective in capturing local issues, values and knowledge that are available at the community level. Those tools and processes of vulnerability assessment could be managed by local people themselves. There was high tendency of acceptance of processes and findings from the community, which helped to own the process at the local level. Besides these, participatory tools were very efficient to capture qualitative attributes and need less time and cost in order to carry out the inquiry. The participatory processes and tools were proven learning tools for the community themselves which was seen as a great achievement in the development planning and management.

The PVA method could also be used for generating knowledge related to climate change adaptation and identifying both reactive and anticipatory adaptation actions to reduce the climate risks at community level. This would also support more reliable, cost-effective and people-owned adaptation measures to reduce the impacts of climate change. In the context of fragmented information and nascent stage of evaluation of climate change at the local and national levels, this inquiry revealed the strong possibility of scaling up of this initiative both horizontally—by developing mechanisms to disseminate these learning, and vertically—by integrating these issues at policy measures and ensuring appropriate financing mechanisms.

5. Conclusion

The study revealed that some participatory tools such as participatory ranking, seasonal calendar, and social and resource mapping can be useful for vulnerability assessment. Vulnerability mapping caused by climate change and variability at the community level was also found to be a very useful tool for this. In addition, these participatory tools were also proven to be self-learning process to the communities and greatly helped to adjust their adaptation actions to minimize the climate change impacts at the local level. Community-level research and information is inadequate in this area, however the study revealed the possibility of scaling up this experience both vertically and horizontally.

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Annexes

Annex 24.1
Ranking Matrix

Major areas	**Description**
Brief Description	Ranking matrix is a participatory method of analyzing preferences and prioritizing them
Purpose	To assess the preference and opinions of people and, compare and rank among climate change impacts on their livelihoods
Outputs	A problem ranking matrix with extent of vulnerability level for the participants or community
Methods	Ensure clear understanding and methodology of matrix exercise; Discuss and make consensus among participants which items to rank or score; Describe "how to" carry out matrix analysis; Prepare criteria and identify merit/demerit or strength/weakness of those parameters; Ask participants to give appropriate number of "stones" according to the severity of risk/uncertainty (highest risk/uncertainty—5 stones and lowest risk—1 stone); List down the reasons why people rank low or high; Count all stones and give final score based on the number of stones that one parameter receives; Discuss with participants and ask once again whether they agree on final results; and Ask how participants are going to use this information
Strengths	Help to compare different parameters and rank among them according to specific issues; Easy to make lively discussion among participants; Easy to take decision
Weaknesses	Chance of dominance by elites and leaders; Chance of misleading in decision-making processes
Participants	Need mix groups (male/female and other mix groups) to provide diverse perspective; About 10-12 persons
Facilitator	Facilitator should have a very good understanding on the issues; Good facilitation skills; Manage groups and conflicting situation well
Time	About 4 hours depending on the issues and types of participants

Annex 24.2
Seasonal Calendar

Major areas	Description
Brief Description	
Purpose	To know most vulnerable time from the climate change impact for the participants/community over the seasons
Outputs	
Methods	List out some activities/events from community members with reference to floods that might induce risks to the community; Ask community members to select main activities or events (5-8) among many; Ask community members which activities or events fall under which time of the month and also request them to depict the time of occurrence in the diagram; Once all events and their respective occurrence time is reflected in the diagram, discuss with the participants which time of the year is most risky from the point of view of floods and request them to provide ranking; and Identify which time of the year is most risky.
Strengths	Help to compare different parameters and rank among them according to specific issues; Easy to make lively discussion among participants; Easy to take decision
Weaknesses	Chance of dominance by elites and leaders; Chance of misleading in decision-making processes
Participants	Need mix groups (male/female and other mix groups) to provide diverse perspectives; About 10-12 persons
Facilitator	Facilitator should have a very good understanding on the issues; Good facilitation skills; Manage groups and conflicting situation well
Time	About 4 hours depending on the issues and types of participants

Annex 24.3
Social and Resource Map

Major areas	Description
Brief Description	This is a visual method of depicting social parameters, community infrastructure and natural resources in the diagram. The diagram generally shows location of households, settlements, school, health post and other major infrastructures, forest, types, rivers, mining area, wetland and water resources and other valuable assets.
Purpose	To provide status, location and distribution of social parameters, community infrastructures, natural resources and other features of specific area
Outputs	A visual diagram showing details of natural resources and other features
Methods	Clear objective and identify types of information needed Informing local participants about the objective of social and resource map; Ask local person to prepare their own community map (this can be done on the ground or community can use paper); While one person is making a map, request other person to support him and help him or her to identify different social parameters, community infrastructures and resources to depict in the map; Ensure all persons (women and other disadvantaged members of the community) also equally participate; Once the community map is prepared, ask members if anything important is left; and Ask them what they "like" or understand from the map
Strengths	This is a visual tool and helps locals to realize that they can prepare a map of their own community. This apart, they know what resources they have and how wealthy they are in terms of natural and social capital.
Weaknesses	May take longer time to draw a diagram. Initially, difficult for locals to start drawing (shyness) and sometimes community members may lose concentration while making diagrams.
Participants	8-10 persons
Facilitator	Facilitator should have a very good understanding on the issues Good facilitation skills Manage groups and conflicting situation well
Time	About 5 hours depending on the issues and types of participants

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Evaluation of Adaptation to Climate Change and Climate Risk Screening

Sreeja Nair, Thomas Tanner, and Suruchi Bhadwal

1. Risk, Vulnerability, and Adaptation

Understanding the risks associated with short-term and long-term changes in the climatic variables forms a good starting point for devising and deploying suitable risk reduction and response strategies. Better understanding of the climate system based on current and projected scenarios along with experiences gained over time allow biophysical and socio-economic systems to respond automatically to changes in the environment (including climate). Such knowledge forms the foundation for planned adaptation.

For disaster risk reduction, it is essential to understand the nature of risk, systems, communities, groups at risk, and the current capacities of these vulnerable entities to absorb the risk. The Adaptation Policy Frameworks for Climate Change Developing Strategies, Policies and Measures (2005)[1] defines risk as the combination of the probability of occurrence and the impacts of an climatic extreme event and describes two major approaches for climate risk assessment: a natural hazards-based approach (Risk = Probability of climate hazard x Vulnerability) and a vulnerability-based approach depending on the whether the starting emphasis is on the biophysical or the socio-economic aspect of climate-related risk (Risk = Probability of exceeding one or more vulnerability criteria).

Vulnerability is defined by IPCC as "the degree to which a system is susceptible to or unable to cope with the adverse effects of climate change." Further, IPCC also mentions vulnerability as a function of extent to which a system is exposed to the stressor, its sensitivity, and its ability to adapt to the impacts. Communities in most regions face multiple stresses that define their ability to respond to specific climate stresses. Climate change can add to the existing vulnerabilities of populations having a low coping capacity and high dependence on climate-sensitive sectors such as agriculture, water and forests for livelihoods and sustenance.[2] Hence, measures to enhance adaptive capacities often need to be integrated with developmental efforts towards livelihood enhancement, water resource management, coastal protection and disaster risk reduction inter alia.

A range of structural and non-structural measures can contribute towards decreasing the vulnerability associated with changes in the climate—either by reducing the risks directly or indirectly by enhancing the resilience of the communities to cope with these risks. Further, many strategies can over the time, enable vulnerable communities to adapt to anticipated changes in the climate. A study by TERI, IISD and CICERO explored the vulnerability of the Indian agriculture to the dual challenge of climatic changes as well as economic changes. The study assumed that certain biophysical (such as soil conditions and groundwater availability), social (such as percentage of workers employed in agriculture, landless laborers, literacy levels, etc.), and technological factors (such as communications, education, health, transport, irrigation, banking, and energy infrastructure) contribute towards enhancing the capacities of farmers to respond to these changes. Three indices[3] were constructed to represent these biophysical, social and technological factors and enabled identification of high and low vulnerable regions based on these parameters (Figure 25.1).

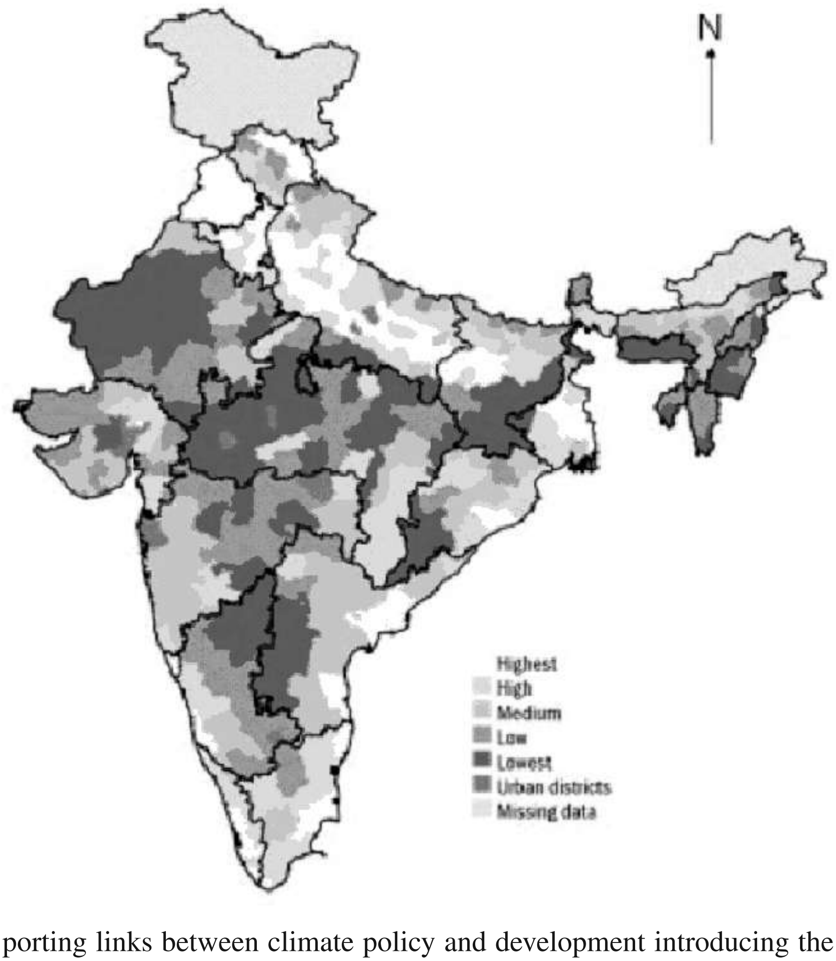
The adaptive capacity profile was then combined with a national level climate change profile generated by studying sensitivity to climate change using regional circulation model outputs. The study highlighted that the districts with the highest climate sensitivity under exposure to climate change are not necessarily the most vulnerable, and vice versa. This reinforces the concept of differential vulnerability due to differential exposure, sensitivity and adaptive capacities.

2. Climate Risk Screening: Assessment of Risk Reduction and Adaptation Options

Portfolio Screening

Climatic extreme events pose major risks to developmental investments made by governments and developmental agencies. The World Summit on Sustainable Development in Johannesburg in 2002 focused on sup-

Figure 25.1
Adaptive Capacity Profile for the Agricultural Sector Generated by Integration of Biophysical, Social, and Technological Profiles



porting links between climate policy and development introducing the concept of "mainstreaming." Mainstreaming is defined as the integration of climate-related policies and measures into the developmental planning process and decision-making for sustainable development.[4] Several developmental agencies have performed screening exercises for their project portfolios. Portfolio screening of an agency involves analysis of the portfolio of projects or programs in order to identify entry points in the current projects and/or programs to address climate change and risk reduction and explore opportunities for incorporation of climate change concerns in future projects or programs.

Portfolio screening also involves analysis of risk posed by climate change to the developmental activities (such as poverty reduction, institutional development and capacity building) of implementing institutional entities. The importance of conducting such screening exercises in a developing nation such as India that is also highly vulnerable to climatic extremes like India is pivotal owing to heavy dependency on climate sensitive sectors for livelihoods and sustenance and lack of adequate financial, institutional and technological capacity.[5]

"Risk proofing" of developmental activities faces several obstacles, one of them being accounting for the uncertainty regarding the impact of human-induced climate change and the degree of change in climatic variables on both spatial and temporal scale. Burton and Van Aalst (1999) examined six World Bank-funded projects across six countries spanning a wide spectrum of climatic risks, regional diversity and developmental status. It was found that climate risks were rarely mentioned during the initial phases (even in the high risk areas) and often emerged in implementation documents, which could be because climate is "seen as a risk to project implementation rather than to long-term sustainable operation." Klein (2001) reviewed projects in Africa pertaining to natural resources management to identify the level to which climate risks are being incorporated into projects and the scope for adaptation. It was found that none of the project documents referred explicitly to climate change, and attention to weather and climate-related stresses was found to be low and primarily reactive. The study concluded, " limited consideration of climate-related stress is striking in light of the intricate balance between the productivity of Africa's natural resources and prevailing climate conditions." A review by Eriksen and Næss (2003)[3] for the Norwegian Agency for International Development (NORAD) aimed at assessing the current level of consideration to climate change within Norwegian development policies and strategies, identifying linkages and entry points at the strategic and operational level, as well as recommending strategies for future integration. Overall, the direct reference to climate change in development policies and strategies was found to be negligible, and largely framed as a mitigation concern.

The Development and Climate Change project of OECD seeks to identify synergies and tradeoffs involved in mainstreaming climate change in development efforts. Key findings were that reference of climate risks and climate change is largely missing in project documents, despite the fact that a significant proportion (commonly 20-30 percent or more of the monetary value and number of projects) was considered to being affected by climate risks. Key recommendations included, first, that adaptation should be part of the "core development activity" rather than financed separately from the climate regime and secondly, adaptation needs to move beyond improving the ability to adapt to current weather extremes and climate variability.

An assessment of the potential effects of projects and programs financed by the Swiss Agency for Development Co-operation (SDC) on vulnerability and adaptation to climate change and climate identified three thematic areas in which it is needed to undertake clear action: institutional development for adaptation, the role of technology transfer in adaptation, and capacity building for affected groups. At the level of implementation of adaptation measures the report underlined the importance of promoting pilot experiences that include activities on both the natural and the social system and encouraged the empowerment of local communities. Such a screening exercise seeks to form one of the inputs for a climate risk screening process designed to help integrate climate change and climatic disaster risk management into regular program activities of developmental organizations.

3. Methodology

ORCHID: A Climate Risk Screening Process

The approach to assessing climate risks in the context of development assistance portfolios followed for this study presented here was developed with DFID-Bangladesh and is known as ORCHID (Opportunities and Risks of Climate Change and Disasters) Process. Climate risk assessment differs from the regular practice of screening for environmental impacts. The latter considers the impacts of the project on the environment, while the former also considers the impacts of the environment on the project's goals and objectives. It is essential to view climate change from an integrated perspective because climate risks may not be the most important constraint on poverty reduction and development so an all-encompassing approach is necessary. Furthermore, climate risk management expands the understanding on how developmental best practices can contribute towards reducing vulnerability to climate change in terms of relevant parameters such as scalability, long-term benefits, replicability, cost-effectiveness, practicality, and barriers to the adoption and implementation of potential risk management measures.

Ten high-priority DFID-India programs were selected for climate risk screening based on a checklist of criteria, mentioned below:

a. Operate in climate-sensitive sectors such as water, livelihoods, health, and urban services;
b. Contain significant investments in infrastructure;
c. Can introduce activities that could significantly impact the capacity to cope with and adapt to climatic extremes
d. Presence of favorable practical considerations such as data availability, local-level partners and practical entry-points within current program profile.

Following this initial screening process, the ten DFID-I high-priority programs that were selected for climate-risk screening have been listed in Table 25.1.

The climate-risk screening process includes a series of guiding questions in discussions with program staff in order to identify the major risks to the program objectives, identify current risk management practices within the program and potential risk reduction and adaptation options. Since adaptation forms a continual process hence the importance of the risk screening process in raising awareness about climate change risks and their management cannot be overlooked. The detailed steps involved in the risk screening process include understanding of (Figure 25.2)[6]:

a. An overview of the program objectives and activities;
b. The current and likely future impacts of climate change on the achievement of the program goals;
c. The ways in which the program activities currently contribute to vulnerability reduction and build of adaptive capacity;

Table 25.1
List of High-Priority DFID Programs Selected for Climate-Risk Screening Process

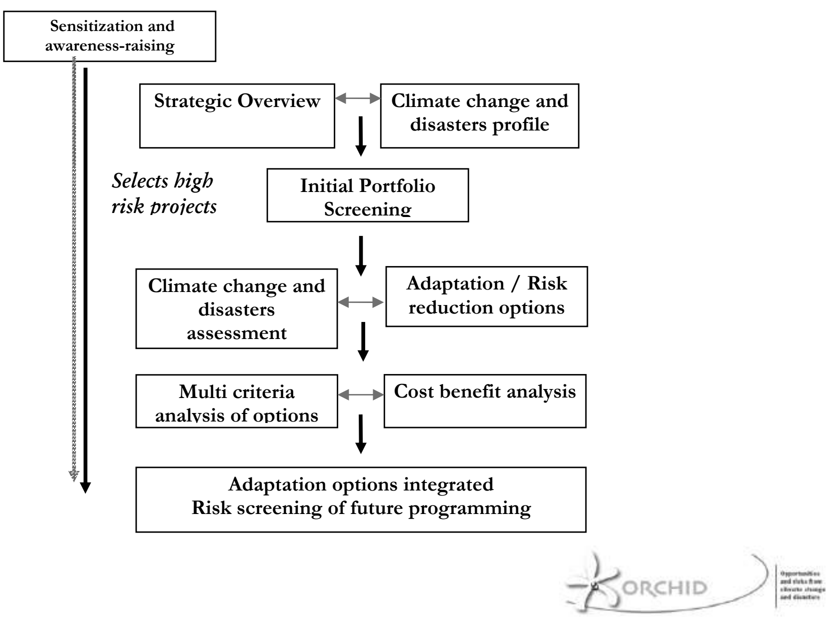
DFID-I Program Area	No.	Intervention for Assessment
National		
	1.	Water and Sanitation Program
	2.	Sarva Shiksha Abhiyan- Elementary Education Program
	3.	Reproductive and Child Health Program Phase II
West Bengal	4.	Kolkata Urban Services for the Poor
	5.	WB Support to Rural Decentralization
	6.	WB Health Systems Development Initiative
Andhra Pradesh	7.	AP Rural Livelihoods Program
Madhya Pradesh	8.	MP Rural Livelihoods Program
	9.	MP Urban Services for the Poor
Orissa	10.	Western Orissa Rural Livelihoods Program

d. The extent to which the current program already addresses and manages climatic risks, and whether these are explicitly referred to in program documents;
e. Identification of opportunities to incorporate further climate risk management into the program through both disaster risk reduction and climate change adaptation activities;
f. Prioritization of the selected adaptation options based on a range of criteria (multi-criteria analysis);
g. Development of cost-benefit analyses for a select number of adaptation options where sufficient data is available.

A crucial element in monitoring and evaluation of adaptation in this context becomes documentation of the additionality of the future work of each program. This is done by a comparison of three scenarios that include:

- No Program Scenario. This is the condition when there is no program and it is assumed that there are several climatic risks that remain un-addressed in the absence of the program.
- Program Scenario. This is the condition when the program operates in business as usual mode.

Figure 25.2
The ORCHID Process[5]



- Program "Plus" (+) scenario (when the program addresses many more components than the business as usual).

4. Ways Forward

Given that the impacts of climate variability and change will be felt differentially across regions and systems with the poorest bearing the brunt the most; adaptation initiatives need to be integrated along with developmental strategies towards poverty alleviation and maintaining resilience. The climate screening exercise highlights the opportunities where synergies can be drawn between the developmental program and disaster risk reduction activities in areas exposed to extreme events. The prioritization of adaptation options based on the multi-criteria analysis is a critical step in the risk screening process, hence the selection of these criteria requires utmost importance.

There is a need for integrated vulnerability assessments to identify suitable win-win adaptation measures. There is also a need to identify and foster linkages of developmental activities with the existing policies and building scope for enhancing, modifying, strengthening in the light of unanticipated changes in the climate. Governance at all levels has a crucial role to play, as it is important to incorporate the ground conditions, interest and aspirations. Experiences that are successful can be replicated and adapted to suit local conditions.[7] In this context, information sharing and dissemination as well as "learning by doing" are crucial.[8]

Barriers to Implementation

Few barriers that need to be understood and accounted during climate-risk screening processes have been listed below.

- Scale differences between macro or national level and micro or sub-national level need to be considered while understanding the nature of current and future vulnerabilities and coping capacities.
- Better prediction models are required to reduce the uncertainties associated with future climate change projections in order to base long-term planning and decision-making.
- Cost-benefit analysis of adaptation options is often faced with data and methodological difficulties.
- There are few sectoral studies exploring the impact of climate change using scenario-based modeling approaches, however very few studies combine climate model outputs with the concept of vulnerability and adaptive capacity. There is hence a need for an integrated approach for a holistic view on vulnerability analysis and identification of suitable strategies for intervention to strengthen adaptation.

Annex 25.1

Example of climate-risk screening process for the National level Elementary Education Programme/National Sarva Shiksha Abhiyan (SSA) [5]

1. Programme Description and Objectives:

SSA seeks to overcome the barriers to education based on social, regional and gender disparities and encourages community-ownership of the school system. DFID gives sector budget to SSA for institutional reforms at the central and the state level in order to improve efficiency of the education delivery mechanisms and institutional structures for the management of elementary school education across the country for all children in the age group between 6 to 14 by the year 2010.

SSA broadly involves an objective assessment of the current education system including educational administration, achievement levels in schools, financial issues, decentralization (via involvement of women's groups and members of Panchayati Raj Institutions) and community ownership, recruitment of teachers and focus on education of girls, scheduled tribes and castes, and other disadvantaged groups.

SSA adopts the SWAp or the Sector-Wide Approach. SWAp is a process in which funding for the sector supports a single policy and expenditure program, under government leadership, and adopting common approaches across the sector. This approach seeks to buttress government's role in decision-making and improve coordination between relevant policy stakeholders.

2. Identified Climate Risks

The key risks that the program faces due to climate-related extreme events are either in terms of children dropping out of school or discontinued education because of damage to school infrastructure. Areas exposed to extreme events are those under high risk. This is because of loss of livelihoods, owing to which children are often forced to drop out from school and engage in labor activities to add to the household income. Damage to school infrastructure and drop in the health of school-going children due to extreme events, are also some associated risks.

3. Existing Climate Risk Management Measures

i. Provision of rainwater harvesting to provide schools with water for drinking and other purposes.

ii. Environmental safeguards have been developed by National Technical Support Group in certain drought-prone areas of the country to be considered during construction and maintenance of school buildings. In areas prone to extreme events special care is taken to ensure that the buildings are designed to withstand such adverse situations. Few examples have been listed below:

   a. The schools in the riverine areas of Assam have been designed as partially pre-fabricated structures that can be dismantled and shifted to a new location on inundation of the land area.
   b. Schools in the coastal areas of Orissa have been designed to function as shelters during floods and cyclones.
   c. Design of all buildings, both schools and resource centers, in the seismic areas of Gujarat, North Bihar and Uttaranchal incorporate all the remedial measures recommended in the Indian Standard Codes.

iii. The SSA is also linked with several rural development programs such as water and health programs such as Swajaldhara and vaccination programs respectively that seek to enhance the well-being of the communities (contributing to improved adaptive capacities).

4. Additional Opportunities for Climate Risk Management and Adaptation

i. Though, across the country there are many examples under the SSA that promote climate risk management measures such as rainwater harvesting structures in schools in Rajasthan, use of solar passive technology in school buildings in Himachal Pradesh, raised school building plinths in flood prone areas of Orissa, earthquake resistant features in Gujarat and Orissa, SSA needs to explore the scope for replicability of such measures across the country, on a need basis.
ii. Though SSA often works in coordination with several other programs, however synergies with disaster mitigation and management programs need to be bolstered.
iii. Coordination with local governance bodies such as the Panchayati Raj Institutions for responsibilities such as ensuring that grain storage facilities are present within the school building. This would also involve associated management issues (such as grain collection, storage, inventory, etc.)

iv. Once proper consideration is given to "climate-proof" construction of the school structures, these structures could be used as spaces for alternate income generation activities, beyond school hours, for households living in the vulnerable areas.[9] This is essential to ensure that the livelihoods of the households are not compromised during times of climatic stress.[10]

5. Insights from Multi-Criteria Analysis

Ensuring replicability of climate-risk management activities of SSA takes top priority because of several successful models that have worked across the country by making best use of available resources and feasibility of applicability of the model in that area. The next 2 options, however require a high degree of institutional coordination and require regular follow-ups and monitoring of progress. The last option is ranked lowest because the focus of SSA should not shift from education per se and there are issues of ownership and authority of the school building being questioned, with additional persons working in the school premises.

6. Programme Risk Screening

Identified climate risks	**Climate Risk management and adaptation**	
	Current practices	**Additional opportunities**
• Increase in school-drop outs • Declining health status of children (due to water-borne diseases, malnutrition)	• Synergies with other programs on livelihood-based initiatives • Rainwater harvesting and water purification techniques to assure quantity and quality supply of water	• Need to foster linkages with disaster mitigation and management programs • Using school space for alternate employment generation
• Damage to school infrastructure	• Environmental standards exist for school buildings adjusted to occurrence of extreme events (pre-fabricated structures, cyclone shelters as schools, building codes)	• Replication of need-based and region-specific initiatives for school infrastructure across the country

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9. The National Programme for Education of Girls at Elementary Level under the SSA seeks to improve the quality of education through various interventions and stresses upon the relevance and quality of girls' education for their empowerment (promotes skill development of the girls studying in the school).
10. However it is essential to ensure that education still remains the first priority within the SSA program.

Part VI

The Road Ahead

26

The Future of Evaluating Climate Change and Development

Rob D. van den Berg and Margaret A. Spearman

From among a rich array of disciplines and regions of the world, over 200 participants, dozens of which presented their research and findings, gathered to share their expertise and perspectives at the International Conference on the Evaluation of Climate Change and Development in May 2008 at the Bibliotheca Alexandrina in Egypt. A powerful and encouraging message emerged, which was summarized at the close of the conference.

Some of the highlights in terms of mitigation were that evaluations have shown a success rate of more than 80 percent in development co-operation, and some efforts, such as energy efficient light bulbs, have managed to change markets permanently. In addition, achieving up to 160 percent more reductions than promised, carbon trading has proven most effective in methane emissions from landfills. However, transport and wind energy have underachieved and only delivered 30 percent of expected emission reductions.

While preventative measures in carbon emissions reductions have demonstrated success stories, the evaluation of adaptation efforts are becoming integrated into the policies and priorities of the countries most vulnerable to the impacts of climate change. Developing frameworks for monitoring and evaluation and emerging methodologies should continue to inform decision-makers and local communities as they cope with continued transformation.

1. Challenges for Developed and Developing Countries

Despite indications that progress is being made, far greater emissions reductions are still needed; the burden of which cannot fall on the developing world. Furthermore, although permanent market transitions toward energy efficiency has shown some promising results, these successes must be scaled up and replicated to avoid the perpetuation of climate change as what Sir Nicholas Stern referred to as "greatest market failure ever."

On adaptation the international consensus is that developing countries, which emit the lowest amounts of green house gasses, will actually bear the greatest costs of dealing with the effects of climate change. How will developing countries face the onslaught of higher temperatures, rising sea levels, changing waterfall patterns and increasing natural disasters? Societies will have to reduce the vulnerability to these changes, and the conference has shown that there is a richness of efforts to address vulnerability in a systematic manner, in such a way that governments and local communities will better understand what is happening. Societies can then cope with these changes through adapting to them. This conference has also made available a rich variety of methods to assess adaptation through monitoring and evaluation, but it is clear that these methods are not yet fully developed.

Vulnerable local communities suffer financial, social, and environmental stresses, such as loss of biodiversity and ecosystem services, and increased occurrences of extreme weather events, while often lacking the means for an adequate response and also the institutional support for monitoring and evaluation programs. In this sense, Robert Picciotto suggested "human security" as a framework for evaluation, which would be vested in, and applicable to broader criteria that must be addressed by climate change and development professionals, such as food security, trade, and poverty.

2. Networking and Community of Practice

One of the most critical issues raised by the conference was that of knowledge-sharing and regional networking. With the highest rate of attendance, and animated discussions, the evaluation and regional networking session sparked fruitful exchanges on the strengths and weaknesses of various associations and partnerships in the greater community of climate change and development evaluation professionals. A common sentiment was that there are significant challenges to overcome in laying the groundwork for sharing results, and developing best practices. The degree to which communities are fractured by their respective incentives and capacities, so too will be guidelines and frameworks for evaluating climate change and development.

In order to better focus on follow-up activities, the Evaluation Office of the GEF issued a post-conference survey on regional networking, which collected data from over 500 professionals, including members of dozens of regional and international networking associations. It showed an overwhelming level of interest in fulfilling the networking and knowledge-sharing potential presented at the conference, and to address this strong desire for more regional and international collaboration, a three tiered-response to build on the momentum of the conference was developed.

The first avenue is to continue to update and improve the existing electronic repository of climate change evaluations, which was commissioned as scoping work in preparation for the conference. The GEF Evaluation Office is preparing a revised repository, with browsing and searching capabilities, in partnership with the World Bank Library and the Bibliotheca Alexandrina. The second road to explore is the building of a virtual community of practice, which will be linked to the electronic repository, and provide a forum for discussions and potential platform for sharing lessons learned, reactions to recent news and reports, developing best practices across regions and sectors.

The third effort is this publication based on a selection of the conference presentations corresponding to a wide variety of keynote and break-out session speakers. The conference was the first step in opening a dialogue on the cross-cutting issues and remaining gaps in the practice of evaluating climate change and development projects and programs. As we move forward, this book encapsulates both a response to the demand for increased collaboration and knowledge-sharing, and also a representation of existing best practices, lessons learned and other findings that emerged throughout the conference. Our hope is that this volume will be a promising addition to the nascent body of evaluations on climate change and development, and an inspiration to join this burgeoning community of practice.[1]

Note

1. Additional information on the conference, presentations, and networking survey results, as well as the start-up of the community of practice, can be found at: www.esdevaluation.org.

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