Assessments of Impacts and Adaptation to Climate Change

Summary of the Final Report of the AIACC Project

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November 2007

A Global Environment Facility
Enabling Activity in the Climate Change Focal Area
Project No. GFL-2328-2724-4330

Submitted by:

The International START Secretariat, Washington DC, USA and
The Academy of Sciences for the Developing World, Trieste, Italy

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Cover design by Sandra Stowe. Cover photo courtesy of Paul Desanker

Copies of this report are available from: www.aiaccproject.org and
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United Nations Environment Programme, Nairobi, Kenya

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The AIACC project and its publications were made possible with the financial support of the following:

The Global Environment Facility;

The Government of Canada, provided through the Canadian International Development Agency (CIDA);

The Government of the United States of America, provided through the U.S. Agency for International Development and the U.S. Environmental Protection Agency; and

The Rockefeller Foundation.

Acknowledgements

Implementation of the project Assessments of Impacts and Adaptations to Climate Change (AIACC) benefited from the collaboration and support of numerous persons and organizations. A tremendous debt of gratitude is owed to Robert Watson who, as Chair of the Intergovernmental Panel on Climate Change (IPCC) during the Third Assessment Report, was a primary catalyst for developing and championing the proposal that led to the AIACC project. The insights and guidance of Osvaldo Canziani and James McCarthy, co-chairs of Working Group II of the IPCC during the Third Assessment Report, were also critically important in forming and launching the project. Rajendra Pachauri, current Chair of the IPCC, and Martin Parry, who has joined Dr. Canziani as co-chair of Working Group II for the Fourth Assessment Report, continued the productive and nurturing relationship between the IPCC and AIACC.

AIACC benefited from the valuable and enthusiastic assistance of Ian Burton, Max Campos, Paul Desanker, Alex De Sherbinin, Tom Downing, Hideo Harasawa, Bruce Hewitson, Mike Hulme, Saleemul Huq, Jill Jaeger, Roger Jones, Richard Klein, Murari Lal, Xianfu Lu, Jose Marengo, Linda Mearns, Isabelle Niang-Diop, Carlos Nobre, Anand Patwardhan, Cynthia Rosenzweig, Robert Scholes and Penny Whetton who served on the project technical committee or acted as technical advisors. While all of these persons gave generously of their time and expertise, particular thanks are owed to Tom Downing and Ian Burton for helping to provide the guiding vision for the project, to Saleemul Huq for generously increasing the visibility of AIACC by inviting our participation in the annual Adaptation and Development Days events, to Mike Hulme, Bruce Hewitson, Xianfu Lu and Jose Marengo for their assistance with climate scenario training, data and analysis, and to Hassan Virji for his constant advice and encouragement. We are also indebted to a long list of persons who gave their time to peer-review papers from the project and assist with training and capacity building efforts.

Bonizella Biagini of the Global Environment Facility Secretariat, who has been uwavering in her support of the project, made valuable contributions to the assessment and, most particularly, to the synthesis of adaptation lessons. Ravi Sharma, the United Nations Environment Programme task manager for the project, very ably guided the project through its initial phases, as did Mahendra Kumar and Liza Leclerc when they took over this role in later stages of the project. Martha Perdomo, formerly with the Secretariat of the United Nations Framework Convention on Climate Change, was instrumental in helping us to forge links with national communication processes. Ko Barrett of the U.S. Agency for International Development and Avis Robinson of the U.S. Environmental Protection Agency were also very supportive and helpful.

Patricia Presiren of the Academy of Sciences of the Developing World (TWAS) and Sara Beresford, Laisha Said-Moshiro, Jyoti Kulkarni, Kathy Landauer and Clark Seipt of START gave excellent support for the administration and execution of the project. Most importantly, thanks are owed to the investigators and other participants in the climate change assessments executed under the AIACC project. The achievements of AIACC are largely due to their efforts.

Finally, we thank the agencies that funded the project and gave us the opportunity to execute this unique project. Primary funding for AIACC came from the Global Environment Facility. Funding from the Canadian International Development Agency, the U.S. Agency for International Development, the U.S. Environmental Protection Agency and the Rockefeller Foundation allowed for us to build upon the core project activities with additional capacity building, stakeholder engagement and synthesis activities.

Professor Mohamed Hassan, Executive Director, TWAS
Professor Roland Fuchs, Director, START
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The Report in Brief

The project Assessments of Impacts of and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC) was implemented over the period 2001-2007. The project had three objectives: Enhance scientific capacity in developing countries to assess climate change impacts, vulnerability, and adaptation; Advance scientific understanding of these issues; and Improve links between climate change science and policy communities to enable adaptation planning and action.

Twenty-four assessments were executed in Africa, Asia, Latin America and Small Island States. Multi-institutional teams of more than 300 scientists, stakeholders and students from 50 developing countries conducted the assessments. The teams were supported by a capacity building program that included 'learning-by-doing', technical assistance, training workshops, regional science and policy workshops and engagement in international science and policy activities. Outcomes of the project include:

- More than 100 peer-reviewed publications, 2 books and more than 100 other publications that advanced knowledge;
- Participants taking leadership roles in international science activities;
- More than 100 citations of AIACC publications in the IPCC 4th Assessment Report;
- Outputs being used in National Communications;
- Working relationships established among scientific and stakeholder organizations;
- Enhanced capabilities of the 24 assessment teams; and
- Catalyzed south-south training activities.

> "The Fourth Assessment Report [of the IPCC] advances our understanding on various aspects of climate change based on new scientific evidence and research. A major contribution in this regard has come from the work promoted under the project Assessments of Impacts and Adaptation to Climate Change (AIACC)."
>
> "The record and outputs of the AIACC are impressive. . . The quality of the assessments is demonstrated by the more than 100 peer-reviewed publications produced, which benefited substantially the IPCC's Fourth Assessment Report. In view of this success, it is imperative that we build on the experience and achievements of AIACC and develop the next phase of such work to help advance new knowledge for a possible Fifth Assessment Report of the IPCC."
>
> R.K. Pachauri, Chairman, IPCC

Selected findings from the assessments include:

- Climate variability, extremes and change are a danger now, not just in the distant future;
- The danger is greatest where natural systems are severely degraded and human systems are failing;
- Critical concerns include heightened water scarcity; increased flood risks; exacerbation of land degradation; threats to food security of rural poor; multiple pressures that converge in coastal zones; adverse health impacts where health care systems are weak; and ecosystem change and species loss;
- There is evidence of an adaptation deficit in all the AIACC study regions;
- Adaptation is needed now to close the deficits and is an essential first step towards adapting to climate change;
- Numerous obstacles impede adaptation and action is needed to enable adaptation processes;
- Recommendations for enabling adaptation include integrating adaptation with development; increasing awareness and knowledge; strengthening institutions; rehabilitating and protecting natural resources; providing financial assistance; involving those at risk; and using place-specific strategies.

The AIACC project was funded by the Global Environmental Facility, the Canadian International Development Agency, the United States Agency for International Development, the United States Environmental Protection Agency and the Rockefeller Foundation. The global change SysTem for Analysis, Research and Training (START) and the Academy of Sciences for the Developing World (TWAS) were the executing agencies for the project and the United Nations Environment Programme (UNEP) was the implementing agency. The project was sponsored by the Intergovernmental Panel on Climate Change (IPCC).

Summary of the Report

Introduction

The project Assessments of Impacts of and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC) was conceived and implemented to address gaps in knowledge and scientific capacity in developing countries identified by the Intergovernmental Panel on Climate Change (IPCC) in its Third Assessment Report. The project had three objectives:

- Enhance scientific capacity in developing countries to assess climate change impacts, vulnerability, and adaptation;
- Advance scientific understanding of these issues; and
- Improve links between climate change science and policy communities to enable adaptation planning and action.

The AIACC project was funded by the Global Environmental Facility (GEF) as an enabling activity in the climate change focal area with a grant of US$7,5000,000. Financial support was also received from the Canadian International Development Agency (US$100,000), the United States Agency for International Development (US$300,000), the United States Environmental Protection Agency (US$50,000) and the Rockefeller Foundation (US$25,000). Participating developing country institutions provided in-kind co-funding valued at US$1,800,000.

AIACC Outcomes

Capacity building

24 assessment teams established
>300 participants from 50 developing countries gained experience in climate change assessment
>100 persons trained in AIACC training workshops
5 teams organized South-South training workshops
25 student theses supported and completed
Participants taking leadership roles in international science activities (e.g. IPCC, CCAA, ACCCA, START)
30 participants are authors of IPCC 4th Assessment Report
Successful new grant applications by many of the teams

Scientific knowledge

24 climate change assessments completed
>100 peer-reviewed publications
2 books published
>100 other publications
>100 citations of AIACC publications in IPCC AR4

Links between science and policy communities

Working relationships established by all 24 teams with stakeholder organizations
Scientific outputs being used in National Communications
Most teams engaged in National Communications activities
AIACC teams contributed to numerous national and international policy activities

The project was implemented over the period 2001-2007. Outcomes of the project are outlined in the box above and elaborated in the report. The global change SysTem for Analysis, Research and Training

(START) and the Academy of Sciences for the Developing World (TWAS) were the executing agencies for the AIACC project and the United Nations Environment Programme (UNEP) acted as the implementing agency. A project steering committee, chaired by the IPCC Chairman and composed of representatives of the GEF Secretariat and Scientific and Technical Advisory Panel; the UNFCCC Secretariat, Subsidiary Body on Implementation (SBI) and Subsidiary Body on Scientific and Technological Advice (SBSTA); the UN Development Program; and the World Bank, provided general oversight of project implementation. Scientific and technical advice for the execution of the project was provided by a project Technical Committee.

The primary activity of the AIACC project was the execution of twenty-four regional and national assessments of climate change impacts, vulnerabilities, and adaptation in Africa, Asia, Latin America, and islands of the Caribbean, Indian, and Pacific Oceans. Multi-institutional teams of developing country scientists, stakeholders and students conducted the assessments. The assessments were selected through merit review of submitted proposals and received endorsements from relevant GEF national focal points. Topics covered by the assessments include agriculture, forestry, fisheries, water resources, coastal systems, food security, rural livelihoods, human health and biodiversity (see Tables 1 through 4). More than 350 scientists, stakeholders and students from 150 institutions in 50 developing countries and 12 developed countries participated in the assessments. A list of institutions and countries is provided in Annex B of the full report.

The assessments were launched in 2002 and completed in 2005. The assessment teams were supported with grant funds and a comprehensive program of capacity building and networking that included 'learning-by-doing', technical assistance, training workshops, regional science and policy workshops, and engagement in international science and policy activities. The teams also participated in synthesis activities in 2006-2007 to compare results and derive common lessons. Through execution of the assessments and participation in project capacity building and networking activities, the participating institutions and individuals gained scientific and technical capacity, advanced scientific understanding and forged links between scientific institutions, key stakeholder organizations, and agencies responsible for policies related to climate change and the management of climate hazards.

This summary of the AIACC final report provides overviews of the findings from the assessments and project performance and presents recommendations for management of future assessments. The full report presents a synthesis of findings about climate change vulnerability (chapter 2) and adaptation (chapter 3), summaries of the objectives, approach and results of each of the 24 regional and national assessments (chapters 4 through 7), capacity building and networking outcomes (chapter 8), project outputs and their uses (chapter 9), a detailed assessment of project performance (chapter 10), and conclusions and recommendations (chapter 11).

The final report represents only one of the many outputs of the AIACC project. More than 200 papers, technical reports and student theses have been produced from the AIACC assessments, of which more than 100 have been published in peer-reviewed journals, books and the on-line *AIACC Working Papers*.[1] Many of these outputs are available online at www.aiaccproject.org.

Findings from AIACC

The AIACC project's 24 regional and national assessments investigated climate change vulnerabilities and adaptation response options in selected developing countries. The studies vary in their objectives, methods, systems, sectors, and locations. But most share an approach to the investigation of climate risks that emphasizes the integration of human and biophysical dimensions of vulnerability. Many also draw on the range of practices currently in use for managing present day climate risks to provide insights about adaptive capacity and potential strategies for adapting to future climate change.

[1] AIACC publications are listed in Annex A of the report.

While climate change vulnerability and adaptation are highly context-specific, a number of general lessons have been developed through comparison and synthesis across the AIACC studies. The general lessons are identified below and are elaborated in chapters 2 and 3 of the full report. More complete treatments of the context specific details and lessons from the individual assessments can be found in *Climate Change and Vulnerability* (Leary et al, 2008a) and *Climate Change and Adaptation* (Leary et al, 2008b).

Lessons about Climate Change Vulnerability

The propensity of people and systems to be harmed by stresses, referred to as vulnerability, is determined by their exposure to stresses, their sensitivity to the exposures, and their capacity to resist, cope with, exploit, recover from and adapt to the impacts. The AIACC regional assessments illustrate that vulnerability to adverse impacts from climate variation and change has multiple causes. The causes include climatic stresses as well as stresses that derive from interactions among environmental, demographic, social, economic, institutional, cultural, and technological processes. The state and dynamics of these processes differ from place to place and generate conditions of vulnerability that differ in character and degree. Consequently, populations that are exposed to similar climatic phenomena are not impacted the same. The most severe impacts that are of greatest concern generally are not expected to arise from climate stresses alone. Instead, such impacts are more likely when multiple stresses (climatic and non-climatic) interact to create conditions of high vulnerability. Some of the potential outcomes identified as high-level concerns and factors found to give rise to differences in vulnerability are described below.

Climate variability, extremes and change are a danger now, not just in the distant future. In each of the AIACC study areas, climate variations and extremes are immediate sources of risk. Climate hazards cause substantial damages such as loss of food and water supplies, reduced incomes, damaged homes and infrastructure, disruption of economic activity, degraded natural resources, disease outbreaks and loss of life. Global climate change is already occurring, has impacted natural and human systems, and now threatens to amplify the dangers (IPCC, 2007a and 2007b).

The danger is greatest where natural systems are severely degraded and human systems are failing. Natural resource systems that are severely degraded from overuse are highly sensitive to climate variations and have diminished resilience. Climate shocks can cause large and persistent losses of the goods and services from these degraded systems. Failing social, economic and governance systems typically cannot respond effectively to manage pressures on natural resources, cope with the impacts of climate and other shocks on their resource base, or adapt to the changing conditions. It is in contexts such as these, exemplified by AIACC case studies in Sudan (Osman-Elasha and Sanjak, 2008) and Nigeria (Nyong et al, 2008), in which the state of natural and human systems combine to create conditions of high vulnerability. Communities that are highly dependent on degraded resources and for which human systems are in or near a failed state are at greatest risk of worst-case outcomes such as collapse of rural livelihoods, deepening and widening poverty, displacement of population, hunger and famine, epidemics and violent conflict.

A corollary to this finding is that restoring and protecting natural systems and improving the performance of human systems can reduce vulnerability. The AIACC studies suggest that the potential severity and risk of many climate change outcomes are less where social, economic, and governance systems function in ways that enable effective responses to prevent, cope with, recover from and adapt to adverse impacts. Optimism ought to be tempered, however, by the reality of how challenging it has been to achieve even minimal progress where key human systems are dysfunctional.

Both heightened water scarcity and increased flood risks are critical concerns. Population and economic growth are increasing water demands and many parts of the world are expected to face water stresses that will constrain their development to an increasing degree. Climate change could either relieve or exacerbate water stress, depending on location and season, by increasing or decreasing water balances. While robust results for changes in annual and seasonal precipitation are emerging from climate models for some regions, for much of the world there continues to be high uncertainty about precipitation changes in the future. Given this uncertainty, results from AIACC studies are indicative of sensitivities and vulnerabilities to changes in water balances, but firm conclusions about likely outcomes require further study for most regions.

Climate change projections indicate the potential for drier future climates in AIACC study areas in southern Africa (Dube and Sekhwela, 2008; von Maltitz and Scholes, 2008), the Sudano-Sahel zone (Osman-Elasha and Sanjak, 2008; Nyong et al, 2008) and central Asia (Batima et al, 2008a; Yin et al, 2008a) that would negatively impact water supplies, ecosystems, biodiversity, food security, rural economies, human health and economic development. These impacts, if sufficiently severe, would retard progress toward Millennium Development goals. Vulnerability to adverse impacts from reduced water balances depends on many factors including the level and growth rate of water demand relative to reliable supply; water and land use policies; planning and management; water infrastructure; and the distribution and security of water rights.

In contrast, increases in average precipitation are suggested by many of the climate models for study sites in southeastern South America (Barros et al, 2008; Travasso et al, 2008), the lower Mekong River basin (Chinvanno et al, 2008a), the Philippines and Indonesia (Pulhin et al, 2008). For these areas, climate change may relieve water stress. But higher average rainfall, coupled with increases in intense rainfall events, also pose greater risks of flooding. Factors that exacerbate flood risks include growth in population and infrastructure in flood prone locations; exposure to coastal storm surge; poorly managed land use change; clearing of vegetation; filling of wetlands; and ineffective disaster prevention, preparedness, warning and response systems.

Land degradation may worsen in regions that become drier. Land degradation, an amplifier of vulnerability to climate change, is also a potential outcome of climate change. It is already a problem on intensively used marginal lands in AIACC study areas in arid parts of northwestern China (Yin et al, 2008a), Mongolia (Batima et al, 2008a), Mexico (Conde et al, 2008; Eakin et al, 2008; Wehbe et al, 2008), Botswana (Dube and Sekhwela, 2008), Nigeria (Nyong et al, 2008), South Africa (von Maltitz and Scholes, 2008) and Sudan (Osman-Elasha and Sanjak, 2008). Land use pressures from population growth and economic forces will build if current land use policies and incentives continue unchanged. If combined with a drier climate and increased frequency, severity and duration of droughts, the likelihood of more widespread and persistent land degradation would be high. Exacerbation of land degradation by climate change would harm human well-being and pose obstacles to development by decreasing land productivity, diminishing incomes, depleting resources for coping and adapting and eroding the resilience of the land and land-based livelihoods.

The livelihoods and food security of the rural poor are threatened by climate change. Rural economies, which are based on and dominated by agricultural, pastoral and forest production, are highly sensitive to climate variations and change. So too are the livelihoods and food security of those who participate directly in these activities, supply inputs to them, or use their outputs to produce other goods or services. The productivity of farm fields, pastures, and forests will be impacted by changes in water balances, temperatures, and climatic extremes, as well as by the beneficial effects of increased carbon dioxide concentrations. Although climate change can and will have both positive and negative impacts on rural economies and livelihoods, predominantly negative effects are expected in developing countries.

The AIACC studies demonstrate that systems with similar exposures to climate stimuli can vary considerably in their vulnerability to damage from the exposures. Factors both internal and external to the household determine its vulnerability to climate change. External factors found to increase the vulnerability of rural households include a high proportion of households engaged in subsistence or small scale farming or herding on marginal lands; scarcity of water and other resources; rapidly growing population; poorly diversified income opportunities in the local economy; high poverty rates; inadequate health, education and other services; lack of social safety nets; gender inequality; declining local authority; governance failures; violent conflict; and competition from market liberalization (Adejuwon, 2008; Batima et al, 2008a; Chinvanno et al, 2008a; Eakin et al, 2008; Dube and Sekhwela, 2008; Nyong et al, 2008;Osman-Elasha and Sanjak, 2008; Ziervogel et al, 2008). Internal factors are addressed by the next lesson.

A household's access to water, land, and other resources is an important determinant of its vulnerability. The sensitivity of a household's livelihood and food security to changes in climate and land productivity and its capacity to respond are shaped to a significant degree by the resources available to it. Findings from case studies of rural communities in southern Africa, the Sudano-Sahel zone, South America

and Southeast and Central Asia reveal that internal characteristics of households that are determinants of their vulnerability include access to safe water and sanitation; security of water rights; land-tenure status; farm size and soil quality; number of animals owned; quantity and quality of household labor supply; ownership of farm equipment; amount and diversity of household income; financial savings; access to credit; food stores; health status of household members; and gender of household head (Batima et al, 2008a; Chinvanno et al, 2008a; Eakin et al, 2008; Nyong et al, 2008;Osman-Elasha and Sanjak, 2008; Pulhin et al. 2008; Ziervogel et al, 2008).

Multiple factors converge to make the people inhabiting coastal zones and small islands highly vulnerable. Coasts and small islands are highly exposed to a variety of climate hazards that may be affected by global climate change. The climatic hazards converge with local and regional human pressures to create conditions of high vulnerability, particularly in areas with high concentrations of people and infrastructure along low-lying coasts. Climate factors that influence the vulnerabilities of coasts and small islands include sea-level rise; the frequency and intensity of tropical and extra-tropical storms; changes in winds, water temperatures, and freshwater inflow to estuaries and coastal waters; ENSO and monsoon variability; and water balances. Non-climate drivers include land use planning and management; flood and erosion control; health of wetlands, reefs, and other natural barriers; systems for disaster prevention, preparedness, warning, and response; dependency on tourism; and pollution.

Along the Argentine coast of the Rio de la Plata, projected changes in sea level are expected to increase the area and population affected by recurrent flooding from storm surges – hundreds of thousands of additional people are estimated to be at risk during the 21st century (Barros et al, 2008). Acceleration of coastal erosion due to climate change is a concern in Fiji and the Cook Islands (Mataki et al, 2005). In the Seychelles, coral bleaching has reduced the ability of reefs to dissipate wave energy, accelerating beach erosion, reef degradation, and damage to coastal infrastructure (Sheppard et al, 2005). The islands' strong dependency on tourism and the high sensitivity of their tourism attributes (e.g., beaches, hotels) to climate hazards creates conditions of high socioeconomic vulnerability to climate change (Payet, 2008).

Vulnerability to adverse health impacts is greater where health care systems are weak and programs for disease surveillance and prevention are lacking. Many vector-borne infectious diseases are climate sensitive and epidemics of these diseases can occur when their natural ecology is disturbed by environmental changes. Projected changes in rainfall and temperature have the potential to expose more people to vector-borne diseases, such as malaria in the highlands of East Africa and dengue fever in the Caribbean, by expanding the geographic range of vectors and pathogens into new areas, increasing the area of suitable habitat and the numbers of disease vectors in endemic areas, and extending the length of transmission seasons (Heslop-Thomas et al, 2008; Wandiga et al, 2008). Changes in the incidence, extent, and severity of disease epidemics depend on more than climate stresses and disease ecology, however. Demographic, social, economic and other factors also determine exposure, transmission, infection, treatment, and prognosis. Vulnerability to severe health outcomes is greatest where health care systems are degraded; where large numbers of people lack access to health care; where a population's immunity, nutrition, and general health status is low; and where effective programs for disease surveillance, vector control, and prevention are lacking. Where the converse of these conditions holds, the likelihood of severe health outcomes is much diminished.

Some ecosystems and many of their species may be lost to climate change. Climate change is already having observable impacts on ecosystems and by the end of the 21st century may become the dominant driver of ecosystem change and biodiversity loss. The vulnerability of ecosystems and species to climate change is influenced by the specificity of their climate requirements, the change in spatial extent of areas that match those requirements, the degree of connectivity between suitable areas, the rates at which suitable climates move across the landscape, and the rates at which different species can migrate. Vulnerability is also shaped by other human-caused pressures that weaken ecosystem resilience and by land uses that fragment the landscape and pose barriers to species migration.

An AIACC study of ecosystem responses to climate change in South Africa finds that the Succulent Karoo biome, an arid ecosystem rich in biodiversity and high in species endemism, could disappear almost entirely, resulting in extinction of many of the species endemic to the biome (von Maltitz and Scholes,

2008). Also vulnerable, but likely less so, is the fynbos biome, which is the major vegetation type of the highly diverse Cape Floral Kingdom. Many fynbos species are projected to be able to migrate with climate driven shifts in their habitats, but some will not and will be lost. The savannas are found to be the least vulnerable of the South African biomes studied. In the Philippines, increasing temperature and rainfall are projected to cause dry and moist forest types to disappear and be replaced by wet forests and rainforests (Lasco et al, 2008). The transition would likely result in the loss of many dry and moist forest species.

Lessons about Climate Change Adaptation

Adaptation to climate is not new. People, property, economic activities and environmental resources have always been at risk from climate hazards and people have continually sought ways of adapting. Broadly speaking, we are adapted to cope with a wide range of climatic conditions and stresses. But variations and extremes do regularly exceed coping ranges, too often with devastating effect. While climate impacts can never be reduced to zero, the heavy and rising toll of weather-related disasters and the burden of less severe variations indicate that we are not as well adapted as we might or should be. There is, at present, an adaptation deficit (Burton, 2004).

All the AIACC case studies find evidence of an adaptation deficit in their study areas. But they also find and document a variety of adaptive practices in use that have reduced vulnerability to climate hazards. In most cases these have been adopted in response to multiple sources of risk and only rarely to climate risk alone. General strategies in use in the study areas include increasing the capacity to bear losses by accumulating food surpluses, livestock, financial savings and other assets; hedging risks by diversifying crops, income sources, food sources and locations of production activities; reducing exposures to climate hazards by relocating, either temporarily or permanently; spreading risks through kinship networks, pooled community funds, insurance and disaster relief; reducing the sensitivity of production and incomes derived from natural resources by restoring degraded lands, using drought resistant seed varieties, harvesting rainfall, adopting irrigation and using seasonal forecasts to optimize farm management; preventing climate impacts through flood control, building standards and early warning systems; and increasing the capacity to adapt through public sector assistance such as extension services, education, community development projects, and credit services.

These and other strategies in use are evidence that the vulnerable can and do act to reduce their vulnerability to climate hazards. They also provide a rich base of experience on which to build for adapting to future climate change. But climate change is altering exposures to climate hazards. The frequency, variability, seasonal patterns, spatial distribution and other characteristics of climate events and phenomena are changing. The changes will push future climate variations and extremes outside the bounds of what people have been exposed to and had to cope with in the past. An implication is that current practices, processes, systems and infrastructure that are more or less adapted to the present climate will become increasingly inappropriate and maladapted as the climate changes. That is, the adaptation deficit is likely to grow. Fine-tuning current strategies to reduce risks from historically observed climate hazards would not be sufficient in this dynamically changing environment. More fundamental adjustments will be needed. This will require recognizing what changes are happening, anticipating the range of likely future changes, understanding the vulnerabilities and potential impacts, identifying appropriate adjustments, and mobilizing the resources and will to implement them.

Following are lessons from the AIACC studies that can help to guide a transition from coping with current climate hazards to adapting to future climate change. They are formulated as recommendations for action.

Adapt now! The current deficit in adaptation makes it imperative to adapt now. Doing so would have immediate benefits in reduced weather-related impacts and increased human welfare. The need to adapt is made more urgent by climate change, which is now upon us and is widening the deficit. Numerous practices currently in use, some identified by the AIACC studies, but many others as well, can be expanded and replicated to reduce climate risks. Adapting to better manage current climate risks is an essential step towards adapting to future climates.

Create conditions to enable adaptation. Vulnerable people have a strong self-interest in adapting. But numerous obstacles impede adaptation, constraining what people can and are observed to do. Common impediments include competing priorities; poverty; lack of awareness, information and knowledge; uncertainty; weak institutions; degraded natural resources; eroded social capital; inadequate infrastructure; insufficient financial resources; distorted incentives; and poor governance. Interventions are needed to create conditions that enable people to surmount the obstacles and take actions to help themselves. Indeed, enabling the *process* of adaptation is the most important adaptation that the public sector can make. Interventions to enable adaptation are exemplified in the lessons and examples that follow.

Integrate adaptation with development. The goals of climate change adaptation and development are strongly complementary. The impacts of current climate hazards and projected climate change threaten to undermine development achievements and stall progress toward important goals. Adaptation can reduce these threats. In turn, development, if appropriately implemented, can help to enable climate change adaptation. Integrating adaptation with development planning and actions can exploit the complementarities to advance both adaptation and development goals. To be effective, integration needs to engage ministries that are responsible for development, finance, economic sectors, land and water management, and provision of public health and other services. It is in agencies such as these that key decisions are taken about the allocation of financial and other resources. And it is within these agencies and among their stakeholders where much of the sector-specific expertise resides that must be engaged.

Increase awareness and knowledge. Nearly all of the case studies highlighted lack of knowledge as a critical constraint on adaptation and rank efforts to increase and communicate knowledge as a high priority. Stakeholders complain of limited to no access to information about historical climate and future climate change projections; estimates of climate impacts and risks; causes of vulnerability; and risk management technologies and practices. The AIACC study in Tunisia, for example, indicates that local farmers are reluctant to modify traditional agricultural practices because they lack the knowledge and education to evaluate and implement new methods (Mougou et al, 2008). Similarly, smallholder farmers in Tamaulipas, Mexico, lack the know-how for adopting potentially beneficial irrigation strategies (Wehbe et al, 2008). Artisanal fishers of the La Plata estuary need information about the effects of climate variations on fish stock movement and fish catch, forecasts of fishing conditions, and methods and technologies for managing climate variability (Nagy et al, 2008). Herders in Mongolia voiced a strong need for education and training in methods for improving the resilience of their pastures and livestock with respect to climate extremes (Batima et al, 2008b). Evidence of information problems within the AIACC case studies demonstrates the need for programs that help advance, communicate, distribute, interpret, and apply knowledge for managing climate risks.

Strengthen institutions. Institutions are found to play important roles for enabling adaptation. Local institutions, including community organizations, farmer associations, local government agencies, informal associations, kinship networks and traditional institutions, serve functions in communities that help to limit, hedge and spread risks. They do this by sharing knowledge, human and animal labor, equipment and food reserves; mobilizing local resources for community projects and public works; regulating use of land and water; and providing education, marketing, credit, insurance and other services. Provincial, national and international institutions aid by providing extension services, training, improved technologies, public health services, infrastructure to store and distribute water, credit, insurance, financial assistance, disaster relief, scientific information, market forecasts, weather forecasts and other goods and services.

In many of the AIACC case studies, key functions of risk management are inadequate or absent due to weaknesses in supporting institutions. The institutions are often poorly resourced, lacking in human capacity, overloaded with multiple responsibilities, and overwhelmed by the demands of their communities. In some instances, traditional institutions have been diminished in role by socioeconomic changes and government policies. For example, in Botswana's Limpopo Basin, traditional institutions such as the *Kgotla*, a forum for local decision-making and justice, family-based land rights and the *mafisa* system of cattle lending historically played important roles in limiting the local community's vulnerability to climate and other hazards (Dube and Sekhwela, 2008). But these institutions were weakened during the 20th century. As a result, the capacity to adapt decreased and vulnerability increased as community members were alienated from decisions about their local resources, poverty deepened, and dependence on

government interventions increased. Strengthening institutions to fill strategic functions in support of adaptation is needed in many vulnerable communities.

Protect natural resources. A high proportion of livelihoods, economic activities, and national incomes in developing countries are dependent on climate-sensitive natural resources. Too often, the resources are degraded by the pressures of human use and climatic and environmental variations and change. As noted in the previous section, their degraded state makes the resources, and the people who are dependent on them, highly vulnerable to future damages from climate change.

Rehabilitating and protecting natural resources is a focus of adaptation strategies in contexts as varied as crop farming and livestock systems in the African Sahel (Dabi et al, 2008; Osman-Elasha et al, 2008), the South American Pampas (Wehbe et al, 2008), central Asia (Batima et al, 2008b; Yin et al, 2008b) and the lower Mekong basin (Chinvanno et al, 2008b); malaria control in the East African highlands (Yanda et al, 2008); biodiversity conservation in southern Africa (von Maltitz et al, 2008); fisheries in the Rio de la Plata (Nagy et al, 2008); watershed management in the Philippines (Lasco et al, 2008b); tourism in the Seychelles (Payet, 2008); and coastal townships in Fiji (Mataki et al, 2008). Progress in many of these contexts will require changes in incentives; reforms of tenure to land, water, and natural products; education; training; and more vigorous enforcement of regulations. These, in turn, are dependent on strong institutions and access to financial resources.

Provide financial assistance. Stakeholders in the AIACC study areas commonly cite lack of financial resources as a major obstacle to adaptation. The constraint is particularly binding on the poor and very poor, who are typically among the most vulnerable to climate change. Poor households, small-holder farmers and small business owners often lack access to formal credit markets and insurance. They resort to community funds and informal networks for credit to recover from losses or make investments that reduce risks. Private sector innovations in micro-credit and micro-insurance have increased access to financial resources and could play a role in financing adaptation. Some national governments assist with direct financial payments and with subsidized credit and insurance, but the assistance directed toward the rural and urban poor is diminishing in many places (Eakin et al, 2008). At the international level, financial assistance is provided through the Global Environmental Facility and international aid agencies. International funding is acting as a catalyst for raising adaptation awareness, building capacity, improving understanding of risks and response options, engaging governments in prioritizing and assessing options and, to a limited extent, implementing selected adaptation measures. Nevertheless, the financial needs of adaptation are far greater than current funding. Additional financial resources are necessary. Ultimately, adaptation financing must come from multiple sources, including those internal to developing countries.

Involve those at risk. Involving persons at risk in the process of adaptation, the intended beneficiaries, can increase the effectiveness of adaptation to climate change. Many of the AIACC case studies involved at-risk groups in assessment activities. In the Argentina-Mexico study, the participation of at-risk farmers and water managers provided guidance on risk perceptions and information needs that contributed to brochures for public education and led to development of practical options for water and agricultural practices and policy. The AIACC study in Zimbabwe, Malawi, and Zambia employed a focus group approach that brought together analysts, stakeholders, and local and national policymakers to examine impacts of prolonged drought and coping strategies. The focus groups identified a number of intervention strategies that meet local needs. In Sudan, a variety of participatory methods were used to engage community members and learn their perspectives about the effectiveness of past development projects for improving livelihoods and reducing vulnerability to drought. The participatory activities in Sudan identified financial capacity, access to low-tech tools and materials and development and improvement of local infrastructure as key factors for building resilience to climate variation and change. In Mongolia, herders, authorities from local and national offices and scientific experts participated in workshops to develop criteria for evaluating adaptation options and to rank options by applying the criteria. Measures that generate near-term benefits by improving capacity for reducing the impacts of drought and harsh winters, as well as measures that produce long-term benefits by restoring and improving pastures, emerged as priorities.

These and other experiences demonstrate the potential of participatory approaches for focusing attention on risks that are priorities to the vulnerable, learning from risk management practices currently in use,

identifying opportunities and obstacles, applying evaluation criteria that are relevant and credible to at-risk groups, drawing on local knowledge and expertise for identifying appropriate strategies, and gaining local ownership for proposed options. A common result of involving those at risk is that it forces climate risks to be examined in context with other problems that are priorities for the community and gives emphasis to solutions that can be combined to attain multiple objectives. This can help mobilize local support and resources that are necessary for successful adaptation.

Use place-specific strategies. Adaptation is place-based and requires place-specific strategies. Although the climate change adaptation lessons discussed in these pages are useful, they oversimplify the rich, detailed stories of the AIACC case studies. This ninth lesson thus confirms that many more adaptation lessons were learned from the AIACC studies, many of which are specific to the particular contexts of particular places. For instance, two AIACC case studies – one based in Jamaica (Taylor et al, 2008), the other in the highlands of Lake Victoria (Yanda et al, 2008) – investigate health risks from climate-influenced, mosquito-borne diseases. In each context, however, responses to the diseases differ as a function of differences in public health infrastructure and access to health care. While general lessons can be applied across different settings to help guide adaptation strategies, the characteristics of the local context will always determine the specific approaches and practices that will function most effectively.

Capacity Building and Networking

Capacity building was a primary emphasis of the AIACC project. While each of the assessments was executed by a very capable team that possessed strong scientific expertise in the disciplines relevant to the systems investigated, the teams had varying degrees of experience and familiarity with the assessment of climate change impacts, vulnerability, and adaptation. Few had extensive experience with multidisciplinary research or assessment that encompassed physical, biological, and social sciences. For many of the participants, the AIACC case studies marked their first direct participation in a multi-sector, multidisciplinary project.

The AIACC project used an innovative approach that integrated learning-by-doing, technical assistance, training, and networking activities. Each of these components is described below. This comprehensive package of capacity building activities yielded near- and long-term benefits. In the near-term, the activities helped to assure the success of the 24 AIACC regional assessments. For the longer-term, the activities enhanced capacity for (i) more comprehensive and more advanced future assessments that will add to the scientific knowledge base, (ii) science-stakeholder linkages to develop and apply the knowledge base to support adaptation, (iii) contributions to national communications and adaptation planning, (iv) contributions to international science activities such as the global assessments of the IPCC, and (v) participation in international environmental policy processes such as negotiations under the UNFCCC.

Learning-By-Doing

More than 350 scientists, stakeholders and students actively participated in the AIACC regional and national assessments. By collaborating with others with diverse backgrounds and areas of expertise, the participants learned essential skills for integrated assessment. Learning by doing, the scientists developed skills for coordinating work by different disciplinary experts, recognizing and accounting for cross-system interactions and feedbacks, integrating results across multiple sectors and scales, and synthesizing findings in ways that are useful for adaptation planning by stakeholders. The most important capacity building occurred in the opportunities to work in multi-disciplinary, multi-institutional, and multi-country teams to undertake highly integrated assessments of coupled biophysical and human systems.

Technical Assistance

A technical advisor was assigned to each regional study team as a project resource. The advisors were available to provide guidance on project design, objectives, implementation, methods and tools. The advisors assisted with data access, construction of regionalized climate change scenarios and the application of different methods and tools to assess vulnerability to climate change, evaluate adaptation options, and to engage stakeholders. They reviewed and provided feedback to project teams on papers,

reports and other outputs of their assessments. The AIACC technical advisors were drawn from the IPCC and included experts from developing and developed countries.

Training

Training activities were carried out on multiple, reinforcing levels. These include global training workshops organized by the executing agencies, training activities organized and executed by the assessment teams themselves, and south-south training activities in which assessment teams provided training to other teams in the AIACC network.

During the first year of the project, three global training workshops were hosted for participants from all 24 of the regional assessments. The first, a project kick-off workshop held at UNEP Headquarters in Nairobi, Kenya, provided an introduction and broad overview of climate change assessment methods and was an opportunity for the teams to learn from one another and refine their project work plans. The second global workshop was co-organized and hosted by the Tyndall Centre for Climate Change Research at the University of East Anglia. It provided training on methods and tools for the design and application of climate scenarios in the regional assessments. The third global training workshop, organized in collaboration with the Stockholm Environment Institute – Oxford and hosted by TWAS in Trieste, Italy, focused on methods for vulnerability and adaptation assessment.

A supplemental grant program provided resources to the assessment teams for capacity building needs not met by the global workshops and also for stakeholder engagement activities. The program awarded small grants to the teams that were used for further training and capacity building in climate modeling and scenario construction, water balance modeling, watershed management, crop system modeling, and GIS tools and methods. Small grants were also used for a variety of stakeholder and policy workshops.

Several AIACC assessment teams implemented south-south training activities with and for other teams in the AIACC network. For example, the climate analysis group at the University of Cape Town held a workshop on regional climate modeling for researchers from other AIACC projects in Africa. The workshop was organized in collaboration with the Hadley Centre and with AIACC support. CPTEC-INPE and the Hadley Centre conducted a similar workshop in Brazil in which several of the AIACC projects in Latin America participated. The assessment team for the lower Mekong basin project provided training in hydrologic modeling at Chulalongkorn University to members of an AIACC assessment in the Philippines. In turn, the Philippines project conducted training workshops for scientists in Vietnam, Lao PDR, and Cambodia and used a portion of its grant to help its neighboring scientists implement mini-assessments of their own. An AIACC assessment led by CSIR in South Africa implemented a training course on biodiversity conservation in a changing climate for resource and wildlife managers from across Africa. The course is now being offered via the internet by the University of the Western Cape. These examples of south-south transfers of capacity are a very encouraging sign that the capacity being established through AIACC is not only sustainable – it is also extending beyond the project's direct participants.

Networking

The AIACC project established networks that link scientists across disciplines, institutions across institutional boundaries, countries across borders, and scientists with stakeholders. The networks established and nurtured by AIACC are a critically important form of capacity needed to comprehensively understand climate change vulnerabilities, evaluate adaptation strategies, and share knowledge and perspectives across stakeholder groups. Scientists from different disciplines and institutions have built a foundation for future scientific collaboration on climate change. Scientists and stakeholders from various parts of civil society are collaborating to consider the risks of climate change and how to adapt to those risks. Multi-country AIACC projects have also resulted in significant inter-country collaborations in Eastern, Southern and Northern Africa; Southeast Asia; and South America.

Six regional workshops were organized by the AIACC project, two each in Africa, Asia-Pacific, and Latin America-Caribbean. The workshops brought together AIACC investigators and members of the science and policy communities of the different regions to learn from one another about ongoing research and assessment, methodological issues, regional concerns, informational needs, and capacity building needs. At

the second workshop in each region, stakeholders associated with each of the regional/national assessments were invited to participate. The workshop interactions led to a number of cross-project initiatives to share expertise, including the south-south training activities described in the previous section.

Important connections with international organizations have been enhanced by the AIACC project. The IPCC requested AIACC's advice to identify developing country scientists to involve in the planning of the 4th Assessment Report (AR4) and subsequently to be authors of the report. As a result of these consultations, a dozen AIACC participants were engaged in planning the AR4 and more than 30 are authors of report. Involvement with the IPCC has helped the scientists to develop professional relationships with leading researchers from around the world. AIACC scientists have also been invited to be authors for the Millennium Ecosystem Assessment (MEA) and the International Assessment of Agricultural Science and Technology (IAAST). AIACC has organized sessions and facilitated presentations by project scientists at numerous international conferences, including those of the International Human Dimensions Programme, the Earth System Science Partnership, UNEP, the Stanford Energy Modeling Forum, the UK Met Office, the Chinese Academy of Sciences, expert meetings of SBSTA and IPCC, and side events at UNFCCC Conferences of the Parties (COP). In addition, many AIACC participants are now active in the START and TWAS networks.

Project Outputs and their Use

Major outputs of the AIACC project can be grouped into three categories: regional climate change assessments, human and institutional capacity, and scientific knowledge.

Regional Climate Change Assessments

Twenty-four climate change assessments were completed under the AIACC project. Technical reports from each of the assessments are available at www.aiacproject.org. The assessments are currently being used to:

- Provide a stronger scientific basis for the vulnerability and adaptation assessments of countries' National Communications to the UNFCCC;
- Inform national delegations to the UNFCCC COPs about key issues;
- Raise the awareness of stakeholders and the general public about climate change vulnerability and adaptation;
- Advance scientific understanding and inform the 4th Assessment Report of the IPCC on these issues as they pertain to developing countries; and
- Inform the consideration and development of adaptation strategies at local and national scales.

All 24 AIACC teams established contacts and shared scientific outputs with entities responsible for National Communications and National Adaptation Programs of Action (NAPA). Many of the teams have been asked to formally contribute to National Communications and NAPAs and several are in key leadership roles for planning and preparing their countries' 2nd National Communications. Interactions between AIACC teams and stakeholder groups are continuing and contributing to adaptation planning. Selected examples of how AIACC outputs are contributing to National Communications, NAPAs and other activities are described in Chapter 9 of this report. Additional examples can be found in the summaries of the regional assessments (presented in Chapters 4-7) and in their technical reports.

Human and institutional capacity

A second important output of the AIACC project is enhanced capacity that enables scientists, technical experts, and scientific institutions of developing countries to:

- Undertake comprehensive, advanced climate change assessments and add to the climate change knowledge base;
- Link science and stakeholder communities to develop and apply this knowledge to support adaptation;

- Contribute to national communications and adaptation planning;
- Contribute to international science activities such as the IPCC assessments;
- Participate in international and national environmental policy processes; and
- Transfer capacity to others.

Evidence of the enhanced capacity and its uses are multiple. The substantial output of peer-reviewed scientific publications, described in the next section, demonstrates the high scientific capacity of the project participants for research and assessment that have expanded the knowledge base. Almost all of the teams established working relationships with stakeholder groups that have yielded common understanding of climate change vulnerabilities and adaptation options. These working relationships, documented in the final reports of the regional assessments, represent important capacity for continued application of scientific knowledge to support adaptation and National Communications. The participation of 30 AIACC scientists as authors of the IPCC AR4 and other activities amply demonstrate the use of AIACC capacity in international science activities. The various south-south training activities that were spawned by AIACC give evidence that capacity developed by the project is being transferred to others.

AIACC capacity contributed to the development of the NAPA guidelines and has also been applied in NAPA preparations in Sudan, Malawi, Mozambique, Zambia and the Gambia. Several AIACC investigators, drawing on their AIACC experiences, co-authored technical papers for UNDP's Adaptation Policy Framework. AIACC investigators have used capacity developed in the project to contribute to and present at policy conferences such as Adaptation and Development Days held annually at UNFCCC COPs; the UNEP/SEI/IIED Adaptation Research Workshop in New Delhi, 2004; the Adaptation Science and Policy Conference in Beijing, 2004; expert workshops of SBSTA; and numerous national policy dialogues (e.g. Mongolia, Mexico, Argentina and South Africa). A presentation was made to SBSTA in May 2007 on how the achievements of AIACC can help advance the goals of the Nairobi Work Programme (NWP) and action pledges have been made to draw on the experiences of AIACC to support the NWP.

Several of the teams have succeeded in new grant applications from Climate Change Adaptation in Africa (CCAA), Advancing Capacity to Support Climate Change Adaptation (ACCCA) and others, demonstrating that they have gained important capacity and are applying it to the problems of climate change research and adaptation. A number of the participants are taking up leadership roles in the global change science community, including membership on the science committee of the CCAA program, the project management team for the ACCCA project, the IPCC Task Group on Data Scenario Support for Impact and Climate Analysis, the Pan-African Committee of START, and the steering committee for AFRICANESS.

Scientific knowledge

Substantial in number, the scientific publications from AIACC exceed what is achieved by comparable projects. The publications help to fill important gaps in the scientific literature on climate change vulnerability and adaptation in developing countries that were identified by the IPCC Third Assessment Report. As of the writing of this report, more than 200 papers, reports, books and student theses have been produced by the AIACC project. More than 100 of these are peer-reviewed, including over 60 papers published in peer-reviewed journals and books and more than 40 in the peer-reviewed *AIACC Working Papers* series (available online; see www.aiaccproject.org). Journals in which AIACC papers have been published include *Ambio, Climate Research, Conservation Biology, Geophysical Research Letters, Global Environmental Change, International Journal of Climatology, Journal of Climate, Journal of Environment and Development, Journal of Geophysical Research, Mitigation and Adaptation Strategies for Global Change* and *Theoretical and Applied Climatology*. A list of publications can be found in Annex A of the full report. The number of peer-reviewed publications, and the more than 100 citations to AIACC publications in the new IPCC AR4, is evidence of the high quality and impact of the scientific output of the project.

Chairman of the IPCC, Dr. R.K. Pachauri, gives the following assessment of the impact of the AIACC project on the IPCC assessment: "The Fourth Assessment Report advances our understanding on various aspects of climate change based on new scientific evidence and research. A major contribution in this regard has come from the work promoted under the project Assessments of Impacts and Adaptation to

Climate Change (AIACC). . . The record and outputs of the AIACC are impressive. . . The quality of the assessments is demonstrated by the more than 100 peer-reviewed publications produced, which benefited substantially the IPCC's Fourth Assessment Report. In view of this success, it is imperative that we build on the experience and achievements of AIACC and develop the next phase of such work to help advance new knowledge for a possible Fifth Assessment Report of the IPCC."[2]

Conclusions and Recommendations

Conclusions about scientific findings of the AIACC project were summarized in Section 2. This closing section presents conclusions and recommendations about project implementation.

Achievements and remaining gaps. The AIACC project made important progress on the objectives of advancing knowledge, enhancing scientific capacity and improving links between science, policy and stakeholder communities, as documented in this report. However, substantial gaps remain. Some of the important gaps in knowledge include:

- Characterization of the range of future exposures to climate hazards at regional and finer spatial scales that are important for adaptation decisions;
- Identification and prioritization of climate hazards that are of highest concern for different sectors, systems, places and groups and investigation of how these hazards will change with human-caused climate change;
- Measurement of vulnerability of different groups, empirical validation of the measurements, and attribution of differences in vulnerability to proximate and underlying causes;
- Decision processes of different classes of actors for managing climate risks, the information needed to make good decisions, and how climate change information can be integrated into decision making processes;
- The role of institutions (rules, processes and organizations) in facilitating or limiting adaptation to climate hazards;
- Identification of effective strategies for enabling adaptation and lessons about how strategies that are successful in one context can be expanded in use or transferred to other contexts; and
- The benefits and costs of adaptation.

It is not unexpected that gaps remain. After all, despite global change research budgets of several billion dollars per year in the developed countries, there remain important gaps in knowledge, capacity and linkages in those countries as well. Making progress on filling these gaps is critically important for managing and reducing climate risks in the developing countries, and most particularly in the least developed countries. The AIACC project has demonstrated that a well designed project of relatively modest scale that invests in developing country science can yield substantial benefits. More projects of this type are needed. The remaining conclusions address lessons from AIACC for the design of effective projects for advancing knowledge, building scientific capacity and linking science, policy and stakeholder institutions.

Peer-review and scientific quality. The AIACC regional and national assessments were selected through peer-review of the scientific merit of proposals submitted in response to an open call. This process resulted in the selection of a very high quality set of climate change assessments and was an important contributor to scientific success and productivity of the project. However, it was also recognized that a purely scientific-merit approach to selecting projects would exclude institutions and countries in greatest need of scientific capacity development. To mitigate this outcome, weight was given in the review process to proposals from countries with low capacity that were basically sound in their objectives and general approach, that included appropriate types of institutions and participants, but for which the then existing capabilities of the proposal team were potentially lacking in some areas. A number of such proposals were selected and their successful execution was supported by the various capacity building activities of the AIACC project. The performance of these projects demonstrated that the selections were wise, that the

[2] From the foreward to *Climate Change and Vulnerability*, Leary et al, 2007a.

approach to capacity building was effective, and that the approach can be used as a model for engaging institutions from the least developed countries in climate change assessment.

Flexible, bottom-up management. Management of the project devolved considerable responsibility to the developing country teams that executed the assessments. Objectives, methods, tools and scenarios were not dictated to the teams by the project; nor were the sectors and systems to be investigated. The Technical Committee, composed of highly capable and dedicated individuals with internationally recognized expertise, provided guidance to the assessment teams as well as to the AIACC management team. But the teams were given wide latitude to set their specific objectives, focus on sectors and issues of their choosing and select the methods and tools to be applied. This allowed for a high degree of innovation and matching of the focus and design of each assessment to the priorities, capabilities and interests of the teams. During the execution of the assessments, in response to stakeholder feedback, many of the teams recognized that their assessments gave insufficient attention to use of their scientific findings by stakeholders and policy makers. Management of the project adapted to the shifting priorities by allowing and supporting the assessment teams to revise their work plans and budgets and also by leveraging new funding to expand stakeholder activities. The flexible and 'bottom-up' approach to project management created good working relationships and respect among the participating institutions and was a key factor in the overall performance of the project.

Coordination of multiple assessments. Execution of multiple climate change assessments under the umbrella of a larger project produced substantial synergistic benefits. The AIACC project provided numerous opportunities for the different assessment teams to interact with each other through regional workshops, synthesis activities, joint training activities, peer-review of each others work, and electronic communications. As noted below, these interactions made important contributions to capacity building. Executing a group of assessments together also made it possible for investigators from multiple projects of broadly similar design to compare results from across the projects and to identify and synthesize common lessons.

Multiple, reinforcing activities for capacity building. A comprehensive program of learning-by-doing, technical assistance, group training, self-designed training and networking was demonstrated to be effective at building capacity. Learning-by-doing through substantive involvement in the execution of a climate change assessment was the most important component of the capacity building activities. Efforts were made to utilize the expertise of developing country participants to assist with training and capacity transfers to their colleagues. This worked well and even led to a number of training workshops organized by some of the teams for colleagues in other projects. A substantial portion of the capacity building resulted from the cross-project learning and sharing of methods, expertise, data and experiences.

Sustainable yet vulnerable capacity. The individual and institutional capacities built by AIACC show signs of being sustainable as all the teams are continuing to engage in the climate change issue. A number of factors contribute to this sustainability. First, the climate change assessments were executed by scientific institutions that have long-term commitments to research, education, and training related to climate change hazards and therefore possess a strong self-interest to further invest in and use the capacities enhanced by the AIACC project. Second, individual capacity building and training efforts were targeted to early-career scientists. As they develop capabilities to excel in this field, it is expected that many will focus future research, assessment, and policy activities to address problems of climate change. Third, the success that AIACC has found in developing cross-institutional collaborations and engagement of participants with IPCC, MEA, IAAST, and the global change research programs has developed networks that will serve to keep the individuals and institutions that participated in AIACC engaged in climate assessment work.

However, despite these positive signs, the enhanced capacity yielded by the project is vulnerable. Some of the assessment teams have succeeded in securing resources to continue working together on the problems of climate change and adaptation, and this will help to sustain their capacity. But many more have not. Without new resources to fund new efforts, the institutions that participated will invest their energies in pursuing opportunities in areas other than climate change; they will lose persons with relevant knowledge and skills; and their relationships with other institutions working on climate change will weaken from disuse. Further investments are needed by projects similar to AIACC to nurture and sustain the capacity in

developing countries for advancing knowledge about climate change risks and applying new knowledge to better management of the risks.

Some new investments that build on the AIACC experience have already emerged. Advancing Capacity to Support Climate Change Adaptation (ACCCA) is bringing together scientists and stakeholders to communicate and apply knowledge of climate change risks in planning adaptation. Several of the AIACC teams are helping to provide the technical support for execution of the project. The ACCCA project is a joint initiative of START, the United Nations Institute for Training and Research and the Stockholm Environment Institute and is funded by the European Commission – EuropeAid Cooperation Office, the UK Department of Environment, Food and Rural Affairs, the International Development Research Centre (IDRC) and the ETC Foundation of the Netherlands. On a larger scale, the new Climate Change Adaptation in Africa (CCAA) program managed by IDRC is applying a model similar to AIACC to promote 'action research' that will build capacity for adaptation in Africa.

More investment is needed in developing country science. While new programs like ACCCA and CCAA are encouraging, a great deal more still needs to be done in developing countries to advance scientific knowledge about climate change vulnerability and adaptation. Progress will require further enhancement of scientific capacity in the developing world, both of institutions and people. But this need tends to fall between the responsibilities of development and science funding agencies. Bilateral and multilateral development assistance agencies, which have in the past supported science in developing countries related to climate change and global environmental change, are increasingly emphasizing adaptation projects that deliver tangible 'on the ground benefits' and are limiting research to very policy focused applications. Initiatives for tangible adaptation projects and highly policy focused research, while important and needed, allocate relatively small resources to expanding scientific knowledge and building scientific capacity. Meanwhile, science-funding agencies provide some support for science in developing countries, but have generally considered the development assistance agencies to have the primary responsibility in this area. There is a danger of a growing gap in funding for the underlying science and scientific capacity in developing countries that are essential for sustainable progress on reducing environmental and climate change threats. The International Group of Funding Agencies (IGFA) for global change research is aware of this gap and has initiated discussions with the development assistance community. But at present the prospects for adequate support of science capacity building do not look good.

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Table 1: AIACC Climate Change Assessments in Africa

Project No.	Project Title	Administering Institution and Principal Investigator	Countries	Award Amt. (US$)	Co-funding (US$)
AF04	Impacts and Adaptations to Climate change in the Biodiversity Sector in Southern Africa	CSIR, Division of Water, Environment and Forest Technology, South Africa. Dr. Robert Scholes.	South Africa	195,000	104,200
AF07	High Resolution Regional Climate Change Scenarios for Sub-Saharan Africa	Climate System Analysis Group, Univeristy of Cape Town, South Africa. Dr. Bruce Hewitson.	South Africa, Ghana, Nigeria, Senegal, Zambia and Zimbabwe (scenarios developed for Sub-Saharan Africa)	169,995	
AF14	Environmental Strategies to Increase Human Resilience to Climate Change: Lessons for North and East Africa	Higher Council for Environment and Natural Resources, Sudan. Dr. Balgis Osman-Elasha and Nagmeldin Goutbi Elhassan.	Sudan	150,000	12,000
AF20	Assessing Global And Regional Climate Change Scenarios for West Africa	Laboratory for Atmospheric Physics, Cheik Anta Diop University, Senegal. Dr. Amadou Gaye.	Senegal (scenarios developed for West Africa)	100,000	15,000
AF23	Food Security, Climate Variability and Climate Change in Sub-Saharan West Africa	Department of Geography, Obafemi Awolowo University, Nigeria. Dr. James Adejuwon.	Nigeria	180,000	56,000
AF38	Integrated Assessment of Miombo Region: Exploration of Impacts and Adaptation Options in Relation to Climate Change and Extremes	Centro Nacional de Cartografica e Teledeteccao, Mozambique. Dr. Manuel Ferrao and Dr. Paul Desanker.	Malawi, Mozambique, Zambia, Zimbabwe	215,628	37,000
AF42	Impacts of Climate Change, Vulnerability and Adaptation Capacity in the Limpopo Basin of Semi-Arid Land Southern Africa: The Case of Eastern Botswana	Department of Environmental Science, University of Botswana. Dr. Pauline Dube.	Botswana	195,000	
AF47	Estimating Costs and Benefits of Adaptation Projects: Examples from South Africa and the Gambia	Energy and Development Research Center, University of Cape Town. Dr. J.C. Nkomo and Dr. Bubu Jallow.	South Africa and The Gambia	150,000	105,000
AF90	Assessment of Impacts, Adaptation and Vulnerability to Climate Change in North Africa: Food Production and Water Resources	Central Laboratory for Agricultural Climate, Egypt. Dr. Ayman Abou-Hadid.	Egypt and Tunisia	190,000	
AF91	Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region	National Academy of Sciences of Kenya. Dr. Shem Wandiga.	Kenya, Tanzania and Uganda	225,000	
AF92	Rural Households and Drought in the Sahel Region of West Africa: Vulnerability and Effective Mitigation Measures	Center for Environmental Resources and Hazards Research, Department of Geography and Planning, University of Jos, Nigeria. Dr. A.A. Adepetu and Dr. Anthony Nyong.	Mali, Nigeria	224,500	50,000

Table 2: AIACC Climate Change Assessments in Asia

Project No.	Project Title	Administering Institution and Principal Investigator	Countries	Award Amt. (US$)	Co-funding (US$)
AS06	Climate Change Vulnerability and Adaptation in the Livestock Sector of Mongolia	Institute of Hydrology and Meteorology, Mongolia. Dr. Punsalmaa Batima.	Mongolia	210,000	99,958
AS07	Rain-fed Rice Farming, Climate Change and Climate Extremes in Southeast Asia	Southeast Asia START Regional Center, Chulalongkorn University, Thailand. Dr. Anond Snidvongs.	Thailand, Lao PDR and Vietnam	158,000	49,000
AS12	Assessment of the Impacts of and Adaptations to Climate Change in the Coconut and Tea Plantation Sectors	Sri Lanka Association for the Advancement of Science, Sri Lanka. Dr. Janaka Ratnasiri.	Sri Lanka	194,985	90,000
AS21	An Integrated Assessment of Climate Impacts, Adaptations, and Vulnerability in Watershed Areas and Communities in Southeast Asia	University of the Philippines at Los Banos, College of Forestry and Natural Resources, Philippines. Dr. Rodel Lasco.	Philippines and Indonesia	150,000	87,120
AS25	Vulnerability and Adaptation to climate Variability and change in Western China	International Earth System Sciences Institute at Nanjing University, PR of China, and Sustainable Development Research Institute at the University of British Columbia, Canada. Dr. Yongyuan Yin.	People's Republic of China	185,000	238,000

Table 3: AIACC Climate Change Assessments in Latin America

Project No.	Project Title	Administering Institution and Principal Investigator	Countries	Award Amt. (US$)	Co-funding (US$)
LA06	Impacts and Adaptation to Climate Change and Extreme Events in Central America	Laboratory for Atmospheric and Planetary Research, School of Physics, University of Costa Rica, Costa Rica. Dr. Walter Fernandez.	Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica and Panama	195,000	50,000
LA26	Global Climate Change and the Coastal Areas of the Río de la Plata	Department of Atmospheric and Ocean Sciences, University of Buenos Aires, Argentina. Dr. Vicente Barros.	Argentina and Uruguay	100,000	100,000
LA27	Climate Change and Variability in the Mixed Crop / Livestock Production Systems of the Argentinean, Brazilian and Uruguayan Pampas	Instituto Nacional de Investigacion Agropecuaria, Uruguay. Dr. Agustin Gimenez.	Uruguay, Argentina and Brazil	274,370	228,000
LA29	Vulnerability and Adaptation to Climate Variability and Change: The Case of Farmers in Mexico and Argentina	Center for Atmospheric Sciences, Autonomous National University of Mexico, Mexico. Dr. Carlos Guy and Dr. Cecilia Conde.	Argentina and Mexico	210,000	176,100
LA32	Vulnerability and Adaptation of Estuarine Systems of the Río de la Plata	Department of Ecology, University of the Republic, Uruguay. Dr. Gustavo Nagy.	Uruguay and Argentina	100,000	60,000

Table 4: AIACC Climate Change Assessments in Small Island States

Project No.	Project Title	Administering Institution and Principal Investigator	Countries	Award Amt. (US$)	Co-funding (US$)
SIS06	The Threat of Dengue Fever in the Caribbean	Department of Physics, University of the West Indies, Jamaica and the Caribbean Epidemiology Center, Trinidad and Tobago. Dr. Anthony Chen and Dr. Samuel Rawlins.	Jamaica, St. Kitts and Nevis, Trinidad and Tobago and of the members of the Caribbean Epidemiology Center	218,250	86,000
SIS09	Modeling Climate Change Impacts on Viti Levu (Fiji) and Aitutaki (Cook Islands) (SIS09)	Pacific Center for Environment and Sustainable Development, University of the South Pacific. Dr. Kanayathu Koshy.	Fiji and Cook Islands	220,000	150,000
SIS90	Impact of Climate Change on Tourism in Seychelles and Comoros (SIS90)	Climate Centre, Ministry of Environment, Seychelles. Dr. Rolph Payet.	Seychelles and Comoros	224,984	30,000

AIACC Outputs

Outputs of the AIACC project include papers and chapters in peer-reviewed journals and books, the on-line peer-reviewed *AIACC Working Papers* series, final reports of the regional climate change assessments, student theses, other non-peer reviewed papers and books, and on-line and CD training course materials.

Following is a listing of publications and other outputs of the project.

Peer Reviewed Publications

Peer-reviewed publications forthcoming in 2008

1. Leary, N., C. Conde, J. Kulkarni, A. Nyong and J. Pulhin, editors. 2008a. *Climate Change and Vulnerability*. Earthscan, London, UK. (A collection of papers from the AIACC regional assessments)
2. Leary, N., J. Adejwon, V. Barros, I. Burton, J. Kulkarni and R. Lasco, editors. 2008b. *Climate Change and Adaptation*. Earthscan, London, UK. (A collection of papers from the AIACC regional assessments)

Peer-reviewed publications in 2007

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2. Magrin, G O., M I Travasso, W E. Baethgen and R T. Boca. 2007. 'Improving applications in agriculture of ENSO-based seasonal rainfall forecasts considering Atlantic Ocean surface temperatures.' In M. Sivakumar and J. Hansen (eds*), Climate Prediction and Agriculture. Advances and Challenges*. Springer, Heidelberg, Germany. (AIACC Project No. LA27).
3. Olago, D., M. Marshall, S. Wandiga, M. Opondo, P. Yanda, R. Kangalawe, A. Githeko, T. Downs, A. Opere, R. Kabumbuli, E. Kirumira, L. Ogallo, P. Mugambi, E. Apindi, F. Githui, J. Kathuri, L. Olaka, R. Sigalla, R. Nanyunja, T. Baguma, and P. Achola. 2007. Climatic, socio-economic and health factors affecting human vulnerability to cholera in the Lake Victoria basin, East Africa. *Ambio*.36(1): 1-10. (AIACC Project No. AF91).
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5. Peiris, T.S.G., J. Hansen, L. Zubair. 2007. Use of Seasonal Climate Information to Predict Coconut Production in Sri Lanka, *International Journal of Climatology* (in Press). (AIACC Project No. AS12).
6. Peiris, T.S.G., and J.D.J. Kularatne. 2007. 'Trends and changes in rainfall and temperature (1950-2001) in Hambantota.' Journal of the National Science Foundation of Sri Lanka (accepted for publication). (AIACC Project No. AS12).
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8. Wijeratne, M.A., J. Ratnasiri, and E.W.T.P. Premathunga. 2007. Effect of CO_2 fertilization on growth and yield of mature tea in the low country wet zone of Sri Lanka, *Journal of Plantations Crops* (Accepted for publication). (AIACC Project No. AS12).
9. Yin, Y. Y., P. Gong, and Y. H. Ding. Forthcoming 2007. Integrated assessments of vulnerabilities and adaptation to climate variability and change in western region of China. In SCOPE/START, *Changes in Human-Monsoon system of East Asia in the Context of Global Change*, Islands Press. (AIACC Project No. AS25)

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2. Adejuwon, J.O. and T. O. Odekunle. 2006. Variability and the severity of the "Little Dry Season" in southwestern Nigeria. *Journal of Climate,* 19(1): 483-493. (AIACC Project No AF23)
3. Adejuwon, J.O and O.O. Ogunkoya (eds). 2006. *Climate Change and Food Security in Nigeria*. Obafwmi Awolowo University Press, Ile-Ife 270 pp. (AIACC Project No. AF23)
4. Chadee, D. D., B. Shivnauth, S. C. Rawlins and A. A. Chen. 2006. Climate variability, mosquito indices and epidemiology of dengue fever in Trinidad (2002-2004): A prospective study. *Annals of Tropical Medicine and Parasitology* 100(6):1-9. (AIACC Project No. SIS06).
5. Mataki, M., K. Koshy and M. Lal. 2006. Baseline climatology of Viti-Levu (Fiji) and current climate trends. *Journal of Pacific Science*, 60 (1): 49-68 (AIACC Project No. SIS09).
6. Odekunle, T.O. 2006. 'Determining rainy season onset and retreat over Nigeria from precipitation amount and number of rainy days, *Theoretical and Applied Climatology* 83:193-201.
7. Tadross, M.A., Gutowski W.J. Jr., Hewitson B.C., Jack C.J., New M. 2006. 'MM5 simulations of interannual change and the diurnal cycle of southern African regional climate.' *Theoretical and Applied Climatology*, 86, 63-80. (AIACC Project No. AF07).
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2. Cavazos, T. and B. Hewitson. 2005. Performance of NCEP-NCAR reanalysis variables in statistical downscaling of daily precipitation. *Climate Research,* 28: 96-107. (AIACC Project No. AF07)
3. Conde, C. and K. Lonsdale. 2005. Engaging stakeholders in the adaptation process. In B. Lim and E. Spanger-Siegfried (Eds.), *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, United Nations Development Programme. Cambridge University Press, 47-66. (AIACC Project No. LA29)
4. Del Ponte, E. M., J. M. C. Fernandes and C.R. Pierobom. 2005. Factors affecting density of Gibberella zeae inoculum. *Fitopatologia Brasileira*, 30(1): 55-60 (In Portuguese). (AIACC Project No. LA27)
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6. Fenech, A., D. MacIver, H. Auld, B. Rong, and Y. Y. Yin (Eds.). 2005. *Climate Change: Building the Adaptive Capacity*. Environment Canada, Toronto, Ontario. 426 pp. (Multiple papers from AIACC Project No. AS25)
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11. Nagy, G., D. Severov, V. Pshennikov, M. Santos, J. Lagomarsino, K. Sans and E. Morozov. 2005. Rio de la Plata System: Relationship between river flow and frontal variability. Advances in Space Research, Elsevier. (AIACC Project No. LA32)
12. Payet R.A. 2005. Climate policy implications of the recent ENSO events in a small island context. In Pak Sum Low (Ed.), *Climate and Africa*, Cambridge University Press, 229-237. (AIACC Project No. SIS90)
13. Rawlins, S. C., A. Chen, J. M. Rawlins, D. D. Chadee and G. Legall. 2005. A knowledge, attitude and practices study of the issues of climate change and public health in two Caribbean countries. *West Indian Medical Journal,* 54 (Suppl 2): 78-79. (AIACC Project No. SIS06)
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2. Adejuwon, J. 2004. Assessing the suitability of EPIC crop model for use in the study of impacts of climate change in West Africa. *Singapore J of Tropical Geography,* 24: 44-60. (AAICC Project No. AF23)
3. Adejuwon, J. and T. Odekunle. 2004. Skill assessment of the existing capacity for extended range weather forecasting in Nigeria. *International Journal of Climatology,* 24: 1249-1265. (AAICC Project No. AF23)
4. Callaway, J. M. 2004a. Adaptation benefits and costs: are they important in the global policy picture and how can we estimate them. *Global Environmental Change,* 14: 273-282. (AIACC Project No. AF47)
5. Callaway, J. M. 2004b. Chapter 4: The benefits and costs of adapting to climate variability and change. In *The benefits and costs of climate change policies: analytical and framework issues,* Paris: OECD Press, 111-158. (AIACC Project No. AF47)
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7. Escobar, G., W. Vargas and S. Bischoff. 2004. Wind tides in the Rio de la Plata estuary: meteorological conditions. *International Journal of Climatology* 24(9): 1159-1169. (AIACC Project No. LA26)
8. Kang, E. S., G. D. Cheng, K. C. Song, B. W. Jing, X. D. Liu and J. Y. Wang. 2004. Simulation study of energy and water balance in soil-vegetation-atmospheric system in the Heihe mountainous area of Hexi Corridor. *Science in China D: Earth Sciences,* 34(6): 544-551 (In Chinese). (AIACC Project No. AS25)

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AIACC Working Papers

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The papers are available at: http://www.aiaccproject.org/working_papers/working_papers.html.

- Working Paper No. 1: Conservation management in a changing world. Albert S. van Jaarsveld, Guy F. Midgley, Robert J. Scholes and Belinda Reyers. December 2003. (AIACC Project No. AF04)
- Working Paper No. 2: Extreme discharge events in the Paraná River and their climate forcing. Inés A. Camilloni and Vicente R. Barros. December 2003. (AIACC Project No. LA26)
- Working Paper No. 3: Developing perturbations for climate change impact assessments. Bruce Hewitson. December 2003. (AIACC Project No. AF07)
- Working Paper No. 4: Trends in river and lake ice in Mongolia. Batima Punsalmaa, Batnasan Nyamsuren and Bolormaa Buyndalai. May 2004. (AIACC Project No. AS06)
- Working Paper No. 5: Assessing the suitability of the EPIC crop model for use in the study of impacts of climate variability and climate change in West Africa. James O. Adejuwon. May 2004. (AIACC Project No. AF23)
- Working Paper No. 6: Skill assessment of the existing capacity for extended range weather forecasting in Nigeria. James O. Adejuwon and Theophilus O. Odekunle. May 2004. (AIACC Project No. AF23)
- Working Paper No. 7: Impact of a possible local wind change on the wave climate in the upper Rio de la Plata. Walter C. Dragani and Silvia I. Romero. July 2004. (AIACC Project No. LA26)
- Working Paper No. 8: Wind tides in the Rio de la Plata estuary: Meteorological conditions. Gustavo Escobar, Walter Vargas and Susana Bishcoff. June 2005. (AIACC Project No. LA26)
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- Working Paper No. 10: Carbon budgets of terrestrial ecosystems in the Pantabangan-Carranglan watershed. Rodel Lasco et al June 2005. (AIACC Project No. AS21)
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- Working Paper No. 12: Climatic and socio-economic influences on malaria and cholera risks in the Lake Victoria region of Tanzania. Pius Yanda et al June 2005. (AIACC Project No. AF91)
- Working Paper No. 13: Observed climate change in Mongolia. Punsalmaa Batima et al June 2005. (AIACC Project No. AS06)
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- Working Paper No. 28: Adaptation measures for maize and soybean in Southeastern South America. M. I. Travasso and others. June 2006. (AIACC Project No. LA27)
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- Working Paper No. 46: 'Extended-range weather forecasting in Sub-Saharan West Africa: assessing a potential tool for adapting food production to climate variability and climate change. Adejuwon, J.O., T.O. Odekunle and M.O. Omotayo. March 2007. (AIACC Project No. AF23).

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Final Reports From AIACC Regional Assessments

Final reports from the AIACC project are available at:
http://www.aiaccproject.org/FinalReports/final_reports.html

1. Final Report Project No. AF04 (2006): Impacts and Adaptations to Climate Change in the Biodiversity Sector in Southern Africa.
2. Final Report Project No. AF 07 (2006): The Development of Regional Climate Change Scenarios for Sub Saharan Africa.
3. Final Report Project No. AF 14 (2006): Environmental Strategies to Increase Human Resilience to Climate Change: Lessons for Eastern and Northern Africa.
4. Final Report Project No. AF 20 (2007): Assessing Global and Regional Climate Change Scenarios for West Africa.
5. Final Report Project No. AF 23 (2006): Food Security, Climate Variability and Climate Change in Sub Saharan West Africa.
6. Final Report Project No. AF 38 (2007): Integrated Assessment of Miombo Region: Exploration of Impacts and Adaptation Options in Relation to Climate Change and Extremes.
7. Final Report Project No. AF 42 (2007): Impacts of Climate Change, Vulnerability and Adaptation Capacity in the Limpopo Basin of Semi-Arid Land in Southern Africa: The Case of Eastern Botswana
8. Final Report Project No. AF 47 (2006): Estimating and Comparing Costs and Benefits of Adaptation Projects: Case Studies in South Africa and The Gambia.
9. Final Report Project No. AF 90 (2006): Assessment of Impacts, Adaptation, and Vulnerability to Climate Change in North Africa: Food Production and Water Resources.
10. Final Report Project No. AF 91 (2006): Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region (Wandiga, Shem O.)
11. Final Report Project No. AF 92 (2007): Rural Households and Drought in the Sahel Region of West Africa: Vulnerability and Effective Mitigation Measures.
12. Final Report Project No. AS 06 (2006): Climate Change Vulnerability and Adaptation in Livestock Sector of Mongolia.

13. Final Report Project No. AS 07 (2006): Vulnerability to Climate Change Related Water Resource Changes and Extreme Hydrological Events in Southeast Asia
14. Final Report Project No. AS 12 (2007): Assessment of the Impacts of and Adaptations to Climate Change in the Coconut and Tea Sectors of Sri Lanka.
15. Final Report Project No. AS 21 (2006): An Integrated Assessment of Climate Change Impacts, Adaptations and Vulnerability in Watershed Areas and Communities in Southeast Asia.
16. Final Report Project No. AS 25 (2006): Vulnerability and Adaptation to Climate Variability and Change in Western China.
17. Final Report Project No. LA 06 (2007): Impacts and Adaptation to Climate Change and Extreme Events in Central America.
18. Final Report Project No. LA 26 (2005): Global Climate Change and the Costal Areas of the Rio de la Plata.
19. Final Report Project No. LA 27 (2006): Climate Change and Variability in the Mixed Crop/Livestock Production Systems of the Argentinean, Brazilian and Uruguayan Pampas.
20. Final Report Project No. LA 29 (2006): Vulnerability and Adaptation to Climate Change: The Case of Farmers in Mexico and Argentina.
21. Final Report Project No. LA 32 (2006): Vulnerability and Adaptation of Estuarine Systems of the Rio de la Plata.
22. Final Report Project No. SIS06 (2006): The Threat of Dengue Fever in the Caribbean: Impacts and Adaptation.
23. Final Report Project No. SIS 09 (2007): Modeling Climate Change Impacts on Viti Levu (Fiji) and Aitutaki (Cook Islands).
24. Final Report Project No. SIS 90 (2007): Impacts of Climate Change on Tourism in Seychelles and Comoros

Workshop Reports

It's Raining, Its Pouring,...It's Time to be Adapting: Report of the Second AIACC Regional Workshop for Latin America and the Caribbean, Buenos Aires, Argentina, 24-27 August 2004.

Messages From Dakar: Report of the Second AIACC Regional Workshop for Africa and the Indian Ocean Islands, Dakar, Senegal, 24-27 March 2004.

1st AIACC Asia Pacific Region Open Meeting and Workshop, Bangkok, Thailand, 24-27 March 2003.

1st AIACC Africa Region (Including Indian Ocean Islands) Open Meeting and Workshop, Hartebeespoortdam, South Africa, 12-13 March 2003.

AIACC project development workshop: Climate Change Vulnerability and Adaptation, Hosted by the Third World Academy of Sciences, Trieste, Italy, 3-14 June 2002.

AIACC project development workshop: Development and Application of Scenarios in Impacts, Adaptation and Vulnerability Assessments, Hosted by the Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK, 15-26 April 2002.

Other Outputs And Related Activities

For Whom the Bell Tolls, Vulnerabilities in a Changing Climate: A Summary of Lessons from the AIACC Project. (2005). Brochure distributed at the COP-11, Montreal, Canada. International START Secretariat, Washington, USA.

A Stitich in Time, Adapting to a Changing Climate: A Summary of Lessons from the AIACC Project. (2005). Brochure distributed at the COP-11, Montreal, Canada. International START Secretariat, Washington, USA.

AIACC: Climate change and conservation planning – This online training course, aimed at the management of biodiversity, is an output of the AF04 project designed for students in the Biodiversity and Conservation Biology (BCB) honors program at the University of the western Cape, South Africa. The scope of the course includes familiarization with current climate change scenarios and equipping learners with the analytical skills necessary for identifying impacts of climate change on biodiversity; identifying adaptation options for mitigation of impacts; and informing conservation planning. Course materials are available at: http://planet.uwc.ac.za/nisl/AIACC/

Climate Change: Health and Economic Development in Sub-Saharan Africa (EMS SC 100S: Section 009): Undergraduate course conducted at Penn State University by Prof. Rob Crane at the Department of Geography. Course curriculum to include selected AIACC case studies in the area of climate change adaptation strategies for food security, infectious diseases, ecosystems and water.

Compact Disc: 1st Latin America and Caribbean Regional Workshop, San Jose, Costa Rica, 27-30 May 2003.

Compact Disc: Climate Change Vulnerability and Adaptation Assessment Methods Training Course. Course materials compiled by the Stockholm Environment Institute (SEI), Oxford, from the AIACC sponsored training workshop hosted by the Third World Academy of Sciences (TWAS) in Trieste, Italy, June 2002.

Compact Disc: AIACC Scenario Workshop, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK, 15-26 April 2002, May 2002 version

Compact Disc: AIACC Africa station and guided perturbation data sets. Produced by the Climate Systems Analysis Group (CSAG), University of Cape Town, South Africa, as a part of the AIACC project, August 2003.

Compact Disc: AIACC Africa Climate Change Scenarios. Produced by the Climate Systems Analysis Group (CSAG), University of Cape Town, South Africa, as a part of the AIACC project, December 2002.

Participating Institutions of the AIACC Project

The regional assessments of AIACC encompassed 46 developing countries. More than 350 scientists, experts, stakeholders and students from over 150 institutions in 50 developing and 12 developed countries participated in the project. The partial listing of participating institutions is given below.

Argentina

Instituto Nacional de Tecnologia Agropecuaria
Universidad de Buenos Aires, UBATEC
Universidad Nacional de Río Cuarto
Universidad Nacional de La Plata

Australia

APSRU
Australian National University
Commonwealth Scientific and Industrial Research Organisation (CSIRO) - Australia
GCTE-Australia

Barbados

Caribbean Institute of Meteorology and Hydrology

Belize

Hydrological Department, Met Service

Botswana

University of Botswana

Brazil

Escola Nacional de Saude Publica
Empresa Brasileira de Pesqur isa Agropecuaria (EMBRAPA)
Centro de Prevsao de Tempo e Estudos Climaticos (CPTEC/INPE)

Cambodia

Ministry of Environment

Cameroon

Applied Physics Research Center

Canada

University of British Columbia
University of Toronto

Chile

Universidad de Chile

China

Gansu Grassland Ecological Research Institute
International Institute for Earth System Science (ESSI), Nanjing University
Cold and Arid Regions Environmental & Engineering Research Institute (CAREERI), Chinese Academy of Sciences

Comoros

Ministere de La Production et de L'Environnement

Cook Islands

Environment Service

Costa Rica

Central American Integration System, Comite Regional de Recursos Hidraulicos (CRRH)

University of Costa Rica

Cuba

Instituto de Meteorologia

Denmark

UNEP Collaborating Centre on Energy and Environment

Egypt

Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Center

El Salvador

Met Service

Fiji

University of the South Pacific

The Gambia

Department of Water Resources

Germany

Potsdam Institute for Climate Impact Research
University of Bonn

Ghana

National Center for Mathematical Sciences

Guatemala

Climate Department – INSIVUMEH

Honduras

Climate Change Program-Honduras

Italy

International Center for Theoretical Physics

India

Indian Institute of Technology – Bombay

Indonesia

Bogor Agricultural University
International Center for Research in Agroforestry
Institute Pertanian Bogor

Jamaica

University of the West Indies, Mona

Japan

National Institute for Environmental Studies

Kenya

Drought Monitoring Center - Nairobi
Kenya Medical Research Institute
Kenya National Academy of Sciences
University of Nairobi

Laos PDR

Department of Meteorology & Hydrology
National University of Laos

Malawi

Christian Service Committee
Malawi Met Service
SADC Forestry

Mali

Institute of Rural Economy (IER)

Mongolia

Center for Policy Research
Institute of Animal Husbandry
Institute of Geography
Institute of Meteorology and Hydrology
International Institute for the Study of Nomadic Civilization
Mongolian Academy of Sciences

Mexico

Universidad Nacional Autonoma de Mexico (UNAM)
Universidad de Tamaulipas

Morocco

Direction de la Météorologie Nationale

Mozambique

Nacional Centro Nacional De Cartografica e Teledeteccao (CENACARTA)
Ministry of Environment
Mozambique Met Service
University of Mondlane

New Zealand

International Global Change Institute (IGCI), University of Wakaito

Nicaragua

Climate Change Program - Nicaragua

Niger

EAMAC School of Meteorology

Nigeria

Obafemi Awolowo University
University of Jos
University of Lagos

Panama

Canal Zone Commission

Philippines

Department of Environment and Natural Resources
University of the Philippines at Los Banos
National Irrigation Administration
National Power Corporation

Samoa

South Pacific Regional Environment Programme

Senegal

Environnement et Développement du Tiers-Monde (ENDA)
L'Institut de Recherche pour le Developpement (IRD)
Laboratoire de Physique de l'Atmosphere
Simeon Fongang, Universitie Cheikh Anta Diop
Service Meteorologique

Seychelles

Seychelles Climate Centre, Ministry of Environment
National Meteorological Service

Singapore

National University of Singapore

South Africa

Climate System Analysis Group, University of Cape Town
Council for Scientific and Industrial Research (CSIR) – South Africa
Energy and Development Research Center, University of Cape Town
National Botanical Institute
South African National Parks Board
University of Pretoria
University of Witwatersrand

Spain

University Politecnica de Madrid

Sri Lanka

Coconut Research Institute
Meteorology Department
Sri Lankan Association for the Advancement of Science (SLAAS)
Tea Research Institute

Sudan

Higher Council for Environment & Natural Resources
UNDP/GEF Climate Change Enabling Project

Sweden

University of Kalmar

Tanzania

University of Dar-es-Salam

Thailand

Southeast Asia START Regional Center
Chulalongkorn University
Chiengmai University
Maheidol University
Sukhothai Thammathirat University

Trinidad and Tobago

Caribbean Epidemiology Center (CAREC)

Tunisia

Ministère de l'Agriculture de Tunisie

Uganda

Makere University

United Kingdom

Hadley Center for Climate Prediction and Research, Met Office
International Institute for Environment and Development (IIED)
King's College
Stockholm Environment Institute – Oxford
Tyndall Centre
University of East Anglia
University of Ulster

United States of America

Center for Disease Control
Clark University
Climate Diagnostics Center, NOAA
Columbia University
International Research Institute for Climate Prediction (IRI)
Goddard Institute for Space Studies, NASA
Howard University
Iowa State University
Johns Hopkins University
Lawrence Livermore National Laboratory
Michigan State University
National Center for Atmospheric Research
Natural Resources Ecology Laboratory, University of Colorado
Pennsylvania State University
Stockholm Environment Institute – Boston
University of Arizona
University of California – Berkeley
University of Colorado
University of Oklahoma

University of Michigan
University of Washington
Wesleyan University

Uruguay

IFDC
Instituto Nacional de Investigacion Agropecuaria
Universidad de la Republic
Uruguayan Navy Oceanograhic Bureau

Vietnam

Center for Education and Development

Zambia

University of Zambia
Zambia Met Services

Zimbabwe

Drought Monitoring Center – Harare
Minerals and Energy Policy Center
University of Zimbabwe

International

Global Change SysTem for Analysis Research and Training (START)
Third World Academy of Science (TWAS)
UN Environment Programme (UNEP)

Twenty-four assessments of climate change vulnerability and adaptation were executed in Africa, Asia, Latin America and Small Island Developing States under the AIACC project. Developing country teams of scientists, technical experts, stakeholders and students from more than 150 institutions and 50 countries conducted the assessments. Outcomes of the project include:

- Advanced knowledge about climate change, climate risks, and adaptation options in developing countries (the Fourth Assessment Report of the Intergovernmental Panel on Climate Change cites AIACC publications more than 100 times);
- Communicated knowledge to stakeholders for adaptation planning and use in National Communications to the UNFCCC;
- Published more than 200 papers, reports and books, of which more than 100 passed scientific peer-review;
- Enhanced capabilities of the 24 assessment teams;
- Established working relationships among numerous scientific and stakeholder organizations for continued collaborations to respond to climate change;
- Facilitated greater participation in and leadership of international science activities; and
- Catalyzed new activities to advance adaptation and capacity building.

Praise for the AIACC project:

> "The record and outputs of the AIACC are impressive" and "benefited substantially the IPCC's Fourth Assessment Report. In view of this success, it is imperative that we build on the experience and achievements of AIACC and develop the next phase of such work to help advance new knowledge for a possible Fifth Assessment Report." (R.K. Pachauri, Chairman, IPCC.)

> "Sound and solid case studies of vulnerability and adaptation have been woefully lacking" . . . the studies from AIACC "begin to bridge the gap . . . they can assist in not only helping countries and communities to climate proof economies but also put the spotlight on the much needed investments that are urgently required to reduce vulnerability." (Achim Steiner, Executive Director, UNEP.)

> "The new knowledge acquired in this project is extensive" and publications from AIACC "are important reading for students and practitioners alike." (Martin Parry, Co-Chair, Working Group II of IPCC.)

> "An excellent addition to the body of knowledge on adaptation to climate change from the developing world." (Saleem Huq, Director, Climate Change Programme, IIED.)

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