

*"No man is an island, entire of itself; every man is a piece of the continent, a part of the main. If a clod be washed away by the sea, Europe is the less, as well as if a promontory were, as well as if a manor of thy friend's or of thine own were: any man's death diminishes me, because I am involved in mankind, and therefore never send to know for whom the bell tolls; it tolls for thee."*

John Donne, Devotions upon Emergent Occasions, Meditation no. 17, 1623.



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# **For Whom the Bell Tolls**

## **Vulnerabilities in a Changing Climate**

### **A Summary of Lessons from AIACC**



The climate is changing from human causes. Who is vulnerable to the changes and their impacts? For whom does the bell toll? We ask, against the advice of 17<sup>th</sup> century poet John Donne, because understanding who is vulnerable, and why, can help us to prevent our neighbor's home from falling into the sea, a family from suffering hunger, their child from being exposed to disease, and the natural world around us from being impoverished. All of us are vulnerable to climate change, directly and through our connections to each other.

To advance understanding of the risks and response options, Assessments of Impacts and Adaptations to Climate Change (AIACC) undertook regional assessments in Africa, Asia, Latin America and small island states. Lessons from the assessments about vulnerability are summarized in this pamphlet. Adaptation lessons are summarized in a companion pamphlet, *A Stitch in Time, Adapting to a Changing Climate*.<sup>1</sup>

Global Climate Change threatens to intensify exposure to climate stresses. The impacts will depend in part on the rate and severity of the changes in climate. They will also depend on social, economic, governance and other forces that determine who and what are exposed, the sensitivity of exposed people and systems, and their capacities to resist, cope with, exploit, recover from and adapt to the effects.

For some, the impacts may be beneficial. But predominantly harmful impacts are expected for much of the developing world where conditions that amplify vulnerability prevail: poverty, joblessness, landlessness, illiteracy, malnutrition, disease, rapid population growth, heavy dependence on farming for livelihoods, environmental degradation, and poorly performing institutions and economy.

1. The lessons are more fully detailed in two papers available from AIACC.

*Climate variability, extremes and change are important and immediate sources of risk.*

## The danger is now

Climate variability, extremes and change are important and immediate sources of risk. Climate hazards currently impose severe damages and hardship in all societies and all segments of societies. In developing countries, the losses are particularly severe; impeding development and poverty reduction. Now the climate is changing, as are the risks. Understanding who is vulnerable to present climate hazards and why will help to identify and protect vulnerable populations in the future.



## Degraded, failing systems in greatest danger

Climate change is most dangerous where natural systems are being severely degraded and social, economic, or governance systems are in or near a state of failure. Overuse of land, ecosystems and water resources causes degradation, loss of resilience and increased sensitivity to climate stresses. Climate shocks can cause large and persistent losses of the goods and services from these degraded natural systems. Failing social, economic and governance systems cannot respond effectively to manage these shocks and their consequences. It is in this context that communities are vulnerable to worst case outcomes such as collapse of rural livelihood systems, deepening and widening poverty, displacing populations, and causing famine, epidemics and violent conflict.

More optimistically, improving the performance of human systems and the management of natural systems can reduce vulnerability. The AIACC studies suggest that many climate change impacts are less severe where social, economic and governance systems function in ways that enable effective responses to prevent, recover from and adapt to adverse impacts. But optimism should be tempered by the reality of how challenging it has been to achieve even minimal progress where key human institutions have been dysfunctional.

*Failing Social, Economic and governance systems cannot make effective responses to cope with and manage climate risks.*



## Water scarcity will impede development

Heightened water scarcity would negatively affect water users and impede economic development in some regions. Water scarcity is an increasingly binding constraint as population and economic growth increase water demands. The supply side of the equation will also change as the climate changes. Scenarios of future climate change indicate that many of the AIACC study regions face a risk of reduced water supply, including much of Africa and parts of central Asia. In southeastern South America, the Philippines and Indonesia, scenarios suggest that increased water supply may be the more likely outcome. But predicting where water will become more or less

plentiful is hampered by large uncertainties. Vulnerability is greatest for water users in basins where there is heavy dependence upon a single water source, water demand is high and growing relative to reliable supply, water rights are insecure, and water-use planning and management are lacking.



## Land degradation may worsen

Where the climate becomes drier and more drought prone, land degradation and desertification would be exacerbated. Climate variations and human land use pressures have degraded an estimated 70% of drylands, directly affecting over 250 million people and placing one billion people at risk. AIACC studies for the Sudano-Sahel zone, southern Africa, western China and Mongolia suggest that these areas may become drier and experience more frequent drought. These arid and semi-arid areas already suffer widespread desertification. If their climates become drier, desertification may become more severe and erode the productivity and resilience of farming, grazing and forestlands. Vulnerability would be greater where

demographic, economic and other forces exert unmanaged pressures to intensify land use, clear vegetation, and extend cropping and grazing into more marginal areas.



*Water scarcity is becoming an increasingly binding constraint as population and economic growth increase water demands.*

*The Sudano-Sahel zone, southern Africa, western China and Mongolia may become drier and experience more frequent drought, increasing the potential for land degradation.*

*Vulnerability of the rural poor is particularly pronounced in dry, drought prone regions where water is scarce and lands are being degraded.*



*Worldwide trends are concentrating population and development along coasts that are highly exposed to climate hazards.*

## Rural poor are threatened

Livelihoods and food security of the rural poor are threatened by climate change. Households that earn their livelihoods by subsistence and small scale farming and herding, as well as landless laborers in rural economies, are among the most vulnerable to economic hardship, hunger and even starvation as a result of climate change. This vulnerability is particularly pronounced in dry, drought prone regions where water is scarce and lands are being degraded. Factors which add to the vulnerability of the rural poor include population growth outstripping growth of crop yields (Nigeria and Mali), declining local and traditional authority (Sudan, Botswana), declining social safety nets (Mexico and Argentina), violent conflict (Sudan), rural to urban migration (Nigeria, Sudan, and Philippines), gender inequality

(Nigeria, Mali, and Philippines), and competition from market liberalization (Mexico and Argentina).

Surveys conducted for several of the case studies have identified a number of household characteristics as amplifying the vulnerability of rural households to climate hazards. These include small holdings of low fertility lands or no landholdings, insecure water rights, lack of access to safe water and sanitation, reliance on family labor, large number of dependents per worker in the household, little or no animal labor and farm equipment, insufficient food stores to buffer against shocks, undiversified farm income, limited opportunities for off-farm income, lack of financial savings and lack of access to credit.

## Coasts and small islands are highly vulnerable

Multiple factors converge to make coastal zones and small islands highly vulnerable. Worldwide trends are concentrating population and development along coasts that are highly exposed to climate hazards. In the Seychelles, Fiji and the Cook Islands, rising sea level would increase coastal erosion and flooding and the number of people, assets and economic activities that are exposed to these hazards. Changes in ENSO and monsoon variability would raise concerns for water supplies and tourism. Along the Argentine coast of the Rio de la Plata, including the metropolitan area of Buenos Aires, rising sea level is estimated to increase by several-fold the populations that would be affected by

annual, 5-year and 100-year flood events. Efforts to prevent and respond to flood risks in Buenos Aires have been poorly coordinated among multiple institutions that have jurisdiction. Residents of poor neighborhoods have suffered the greatest impacts.



## Ecosystems and species would be lost

Climate change is likely to cause the demise of some ecosystems and widespread extinction of species. The habitat of the Succulent Karoo, an arid ecosystem of southwestern South Africa and southern Namibia that is rich in biodiversity and high in species endemism, is highly vulnerable. The Succulent Karoo could disappear almost entirely according to projections of future climate for a doubling of CO<sub>2</sub> concentration. In the Philippines, projected increases in precipitation would cause dry forests to completely disappear and possibly moist forests too as other forest types replace them. The warmer, wetter climate that is projected for the Philippines would

increase primary productivity of the forests and produce associated benefits, but the disappearance of dry and possibly moist forest types would result in losses of species from the region.



*The habitat of the Succulent Karoo could disappear almost entirely.*

## Human health is at risk

Vulnerability to adverse health impacts from climate change is greatest where health care systems are weak and programs for disease surveillance and prevention are lacking. Changes in climate have the potential to increase exposures to and epidemics of infectious diseases such as malaria in the highlands of East Africa and dengue in the Caribbean. In East Africa, degraded health care systems, lack of access to health care, low immunity and health status of the populations, expense of bed nets, and lack of knowledge about disease prevention make the region highly vulnerable to malaria epidemics. In Jamaica, a good quality health system and access to health care provide an important capacity for responding to

infectious disease risk, but lack of disease surveillance, prevention, vector control and education programs for dengue are a source of vulnerability.



*Vulnerability to adverse health impacts from climate change is greatest where health care systems are weak.*



## About AIACC

Assessments of Impacts and Adaptations to Climate Change (AIACC) enhances capabilities in the developing world for responding to climate change by building scientific and technical capacity, advancing scientific knowledge, and linking scientific and policy communities. These activities are supporting the work of the United Nations Framework Convention on Climate Change (UNFCCC) by adding to the knowledge and expertise that are needed for national communications of parties to the convention and for developing adaptation plans. AIACC also contributes to other international activities, for example the work of the Intergovernmental Panel on Climate Change and the Millennium Ecosystem Assessment.

Twenty-four regional assessments have been conducted under AIACC in Africa, Asia, Latin America and small island states. The regional assessments include investigations of climate change risks and adaptation options for agriculture, grazing lands, water resources, ecological systems, biodiversity conservation, coastal settlements, food security, livelihoods, and human health.

The regional assessments were executed over the period 2002-2005 by teams of developing country investigators. The teams, selected through merit review of submitted proposals, are supported by the AIACC project with funding, technical assistance, mentoring and training. More than 340 scientists, experts and students from 150 institutions in 50 developing countries and 12 developed countries participate in the project.

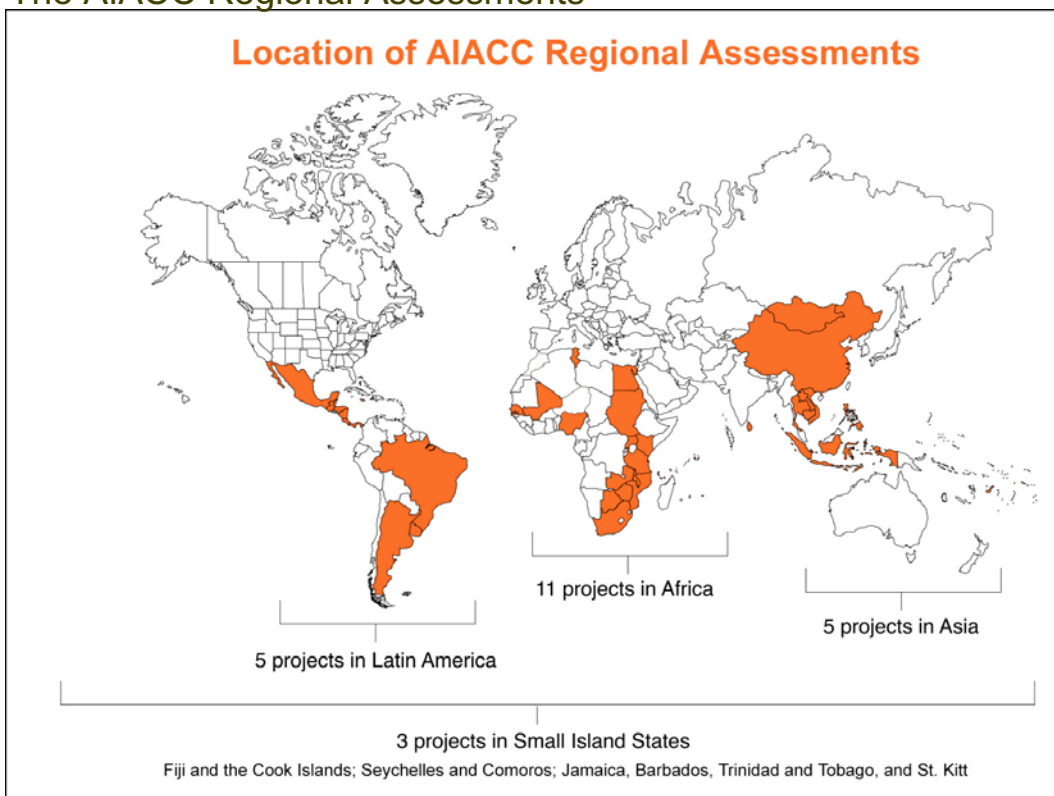
AIACC, a project of the Global Environment Facility (GEF), is implemented by the United Nations Environment Programme (UNEP) and is managed by the Global Change System for Analysis, Research and Training (START) and the Academy of Sciences for the developing world (TWAS). The primary funding for the project is provided by a grant from the GEF. AIACC also receives funding from the Canadian International Development Agency, the U.S. Agency for International Development, the U.S. Environmental Protection Agency, and the Rockefeller Foundation. The developing country institutions that executed the regional assessments provide substantial in-kind support.

Final reports from each of the regional assessments will be available beginning in late 2005. Results from the regional assessments can also be found in *AIACC Working Papers*, a peer-reviewed on-line publication ([www.aiaccproject.org](http://www.aiaccproject.org)), as well as in numerous publications from the project participants, including 48 articles in peer-reviewed journals as of October 2005.



*AIACC enhances capacities in the developing world for responding to climate change.*

## The AIACC Regional Assessments



The AIACC regional assessments are investigating climate change vulnerabilities and adaptation options in 45 developing countries. Information about the regional assessments, listed below, can be found at [www.aiaccproject.org](http://www.aiaccproject.org).

### Africa

- Conserving Southern African Biodiversity in a Changing Climate (AF04).
- Regional Climate Change Scenarios for Sub-Saharan Africa (AF07).
- Increasing Human Resilience to Drought and Climate Change in Sudan (AF14).
- Global and Regional Climate Change Scenarios for West Africa (AF20).
- Food Security and Climate Change in Sub-Saharan West Africa (AF23).
- Climate Change in the Miombo Region of Southern Africa (AF38).
- Climate Change in the Limpopo Basin, Botswana (AF42)
- Costs and Benefits of Adaptation, Case Studies in South Africa and The Gambia (AF47).
- Climate Change, Food Production and Water Needs in North Africa (AF90).
- Malaria, Cholera and Climate Change in the Lake Victoria Basin (AF91).
- Rural Households, Drought and Climate Change in the West African Sahel (AF92).

### Asia

- Climate Change, Grazing Lands and Pastoral Livelihoods in Mongolia (AS06).
- Climate Change, Water Resources and Rice Farming in the Lower Mekong River Basin (AS07).
- Plantation Production of Coconut and Tea in a Changing Climate (AS12).

*(List of regional assessments continued on next page).*





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*(List of regional assessments continued from previous page).*

- Climate Change Impacts and Community Responses in Selected Watersheds of the Philippines and Indonesia (AS21).
- Climate Change Vulnerability and Adaptation in the Heihe Basin of western China (AS25).

#### **Latin America**

- Water Sector Impacts and Adaptations in Central America (LA06).
- Climate Change and Sea Level Rise in the Rio de la Plata Basin (LA26).
- Mixed Crop and Livestock Production in the Argentinean, Brazilian and Uruguayan Pampas (LA27).
- Social Vulnerability and Adaptation to Climate Change Among Farmers in Mexico and Argentina (LA29).
- Climate Change and the Estuarine System of the Rio de la Plata (LA32).

#### **Small Island States**

- Climate Change and the Threat of Dengue Fever in the Caribbean (SIS06).
- Coastal Vulnerability and Adaptation to Climate Change in Pacific Island Countries (SIS09).
- Climate Change and Tourism in the Seychelles and Comoros (SIS90).

## About Our Organizations



UNEP – The United Nations Environment Programme collaborates with partners throughout the UN system and beyond to provide information on the state of the planet’s natural resources and their contribution to sustainable development. UNEP is the implementing agency of the AIACC project.



START – START builds scientific capacity and promotes research in developing countries on regional aspects of global environmental change through fellowship programs, training activities, and collaborative research and assessment activities implemented through a network of regional centers in Africa, Asia and Oceania. START is an executing agency of the AIACC project.



TWAS -- TWAS, the academy of sciences for the developing world, promotes scientific capacity and excellence for sustainable development in the South through fellowships, small grants, support for scientific meetings, and prizes to recognize scientific excellence. TWAS is an executing agency of the AIACC project.



GEF -- The Global Environment Facility helps developing countries fund projects and programs that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. A GEF grant provides the majority of funding for the AIACC project.