



Agriculture and the Environment

Partnership for a Sustainable Future



CGIAR

Consultative Group on
International Agricultural Research



**GLOBAL
ENVIRONMENT
FACILITY**

CGIAR: A Strategic Alliance for the 21st Century

The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance which brings together 62 Members, including developing and industrialized countries, Cosponsors and international organizations, with sixteen Future Harvest Centers and many hundreds of civil society organizations. The alliance mobilizes agricultural science to create agricultural growth, improve food security, foster human well-being and protect the environment.

The Centers' research is focused on increasing agricultural productivity; strengthening national agricultural research systems; protecting the environment particularly forests, soils and water; saving biodiversity, and improving policies that impact on agriculture.

The knowledge generated by the CGIAR is made freely available to all.

Agricultural science is a collaborative enterprise. The CGIAR's achievements would not be possible without the support and commitment of cosponsors, donors, farmers, scientists, and partner organizations in over 100 countries.

www.cgiar.org

GEF: Dynamic Partnerships, Real Solutions

The Global Environment Facility (GEF) channels multilateral funds into projects initiated by people in developing countries that create global environmental benefits. GEF has grown from a pilot program to the largest single source of funding for the global environment. In 2002, donor nations cast an extraordinary vote of confidence by replenishing GEF's trust fund by nearly \$3 billion—the largest amount ever.

GEF's third replenishment caps a decade of successful efforts to link global environmental benefits and sustainable development. Since its creation in 1991, the GEF has allocated \$4 billion in grants and leveraged an additional \$12 billion in co-financing from other sources to support more than 1,000 projects in over 140 developing nations and countries with economies in transition. In addition, GEF has made more than 3,000 small grants, up to \$50,000 each, directly to NGOs and community organizations.

GEF's mandate is to forge international cooperation and finance actions that address critical threats to the global environment: biodiversity loss, climate change, degradation of international waters, ozone depletion, desertification, and persistent organic pollutants. An independent assessment of GEF's performance found that it has "produced significant results" by "effectively using its resources for global environmental protection and sustainable development." One hundred and seventy three countries are GEF members.

www.gefweb.org

Message from Ian Johnson, Chairman, Consultative Group on International Agricultural Research (CGIAR) and Mohamed El-Ashry, Chairman and CEO, Global Environment Facility (GEF)

Agriculture and the environment are joined in a fundamental relationship. Each directly affects the other. Together, they affect the human family. Agriculture sustains life. Agricultural productivity depends on natural resources. Agricultural practices unfriendly to the environment can degrade and diminish natural resources such as land, fresh water, and biodiversity. Agricultural growth, a precondition for sustainable development, is then impeded and the beneficial contributions of agriculture to human development are reduced. Our two organizations, the Consultative Group on International Agricultural Research (CGIAR) and the Global Environment Facility (GEF), must therefore ensure that the agriculture-environment relationship is harmonious and productive. We are committed to meeting the challenge.

Today, almost half the world's population of 6 billion people lives on less than \$2 per day, and one-fifth of us, 1.2 billion people, live on less than \$1 a day. Over 800 million people do not have enough to eat. FAO has reported that 34 nations around the world face severe food shortages. Children are hit particularly hard. One-fifth of the children in the world's poorest countries die before they reach the age of five.

On the environmental side, whole ecosystems are under dire stress. Biodiversity is being lost at historically high rates, with potentially catastrophic consequences. Some 90 million hectares of forest were destroyed in the 1990s. Although public awareness about water scarcity has risen greatly, and corrective measures have been undertaken, a billion people still lack access to safe water. Nearly two-thirds of the world's population will live in water-scarce or water-stressed areas by 2025 unless current trends are reversed. The world's marine fisheries are over-exploited, and some fish farming practices are unsustainable. Climate change threatens the world, with adverse consequences predicted for developing countries. Extreme weather events such as droughts and floods are already more frequent and more intense in Africa and Asia causing untold misery for poor people.

How can we liberate millions from lives of deprivation and fulfill for them a vision of a world without poverty, hunger, and environmental degradation? Agriculture and rural development must be the starting points from which that vision is approached and fulfilled.

Agriculture is the single most important sector in the economies of most low-income countries, accounting for one-fourth to one-half of gross domestic product (GDP). Low productivity in agriculture is a major cause of poverty, food insecurity, and poor nutrition in low-income developing countries. Broad-based agricultural growth spurs overall economic development, since every dollar earned by farmers in low-income countries raises incomes in the economy as a whole by up to US\$2.60. A one percent increase in crop yields reduces the number of people living on under \$1 per day by six and a quarter million. Agricultural productivity is able to reduce poverty because it increases the incomes of poor farmers, and also increases the demand for off-farm goods and services. Urban poverty is positively affected in the process because improved conditions in rural areas reduce migrations to towns and cities.

In the recent past, research-based agricultural productivity helped to feed millions, and served as the basis of economic transformation in many poor countries. New crop varieties that increased productivity through intensification saved some 300 million hectares of land from being taken over by agriculture. This is the legacy of the “Green Revolution.” The need to repeat that achievement, while taking environmental costs into consideration, is even greater today. Growth in the agricultural sector must be environmentally responsible and socially acceptable. There will be more mouths to feed as the world’s population rises to 9.3 billion in 2050. Moreover, because land and water are becoming increasingly scarce, increased food supplies to feed a burgeoning population must come from increasing biological yields, not from area expansion, more chemicals, and more irrigation. Production on existing land will need to nearly double. The challenge of achieving sustainable production increases of this magnitude is formidable because the natural resources—biodiversity, land and water—on which productivity depends are already endangered.

The CGIAR was founded in 1971 to support international agricultural research that increases productivity thereby increasing incomes and reducing hunger in the world’s developing nations. The current goal of the CGIAR is to create science-based agricultural technology for sustainable development. The products of CGIAR-supported research are freely available as global

public goods. The CGIAR works through strategic alliances involving the 16 international agricultural research Centers it supports, national agricultural research and development programs, farmers, civil society, and advanced research institutions.

The GEF was launched in 1991 to finance and build partnerships among institutions addressing critical environmental concerns. The GEF's mission is to strengthen the links between sustainable economic cooperation and protection of the global environment, and between environmental security and a stable social order. The GEF assists developing countries to meet the objectives of the international agreements on biodiversity, climate change, desertification, international waters, stratospheric ozone, and persistent organic pollutants. GEF projects are carried out by a wide range of partners: national governments, civil society, international organizations, national institutions, and the private sector.

The strengths of the CGIAR and GEF are complementary. GEF works on a broader canvas, because it is the designated financial mechanism for international agreements, and provides leveraging as well as significant international linkages. GEF is a major catalyst for improving the global environment. It funds projects with practical solutions to environmental problems. The CGIAR is characterized by sharply focused research, connections with the global agricultural research community, on-the-ground implementation, and local connections. CGIAR Centers are fully engaged in efforts to implement key conventions that are within GEF's mandate.

Each of our institutions works through a set of partnerships that adds value to their own capacities. Bringing these two sets together creates a stronger partnership that enhances the effectiveness of collaborations already in place, and creates new ones. Collaboratively, a stronger partnership brings alive the development paradigm that emerged from the first Earth Summit in Rio and was reaffirmed at the World Summit on Sustainable Development in Johannesburg, requiring the integration of economic growth, social development, and environmental protection.

This is the basis of sustainable development that serves the needs of the present while preserving natural resources to serve the future. Sustainable development is not just some theoretician's "model." It is, says UN Secretary General Kofi Annan, a "life-or-death issue for millions upon millions of people, and potentially the whole human race."

This set of realities gives some flavor of the enormous challenges ahead. We will face them decisively, both now and in the future. The following pages describe the CGIAR–GEF partnership in action, working to improve the productivity and sustainability of key components and challenges of agricultural development and environmental protection, biodiversity, water resources, forests, and land degradation. These projects, anchored in strong partnerships, are contributing different elements to the overall sustainable development agenda. Our common experience and successes offer hope that together we can make our world a better place, both for ourselves and for generations to come.

Ian Johnson
Chairman
Consultative Group on
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Mohamed T. El-Ashry
*Chief Executive Officer
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Global Environment Facility

Combating Desertification in Sub-Saharan Africa

Desertification affects more than 115 countries, adversely impacting the livelihoods and well-being of more than half a billion people living in the arid regions of Africa and Asia. The problem of desertification is most severe in Sub-Saharan Africa.

The desert margins of Africa are characterized by low rainfall and fragile soils, barely sufficient to support crops or natural vegetation. In the brief wet season, rains come hard, washing away precious topsoil and roads, cutting-off communities from markets, provisions, and communications. A rapidly growing population is placing ever-increasing demands on the land, clearing natural vegetation and tilling soil without fallow or nutrient replenishment. Such areas account for one-third of the world's dryland soil degradation, and are the epicenter of global desertification.

The GEF-supported, ICRISAT-led Desert Margins Program of the CGIAR is developing sustainable land management practices that are helping reverse the processes of desertification. Animals are the primary source of soil nutrients in the desert margins. By corralling livestock, farmers are able to concentrate manure on areas intended for crop production. Similarly, moderate applications of phosphorous are dramatically increasing vegetative cover in Nigerien research fields. Appropriate technologies like wedging pearl millet stalks into the soil, using stone barriers, and digging holes to trap soils, all help in minimizing soil loss during floods. Strategically-placed tree lines prevent wind erosion, provide year-long vegetative cover, provide income from diversified cash crops like date palms, and fix nitrogen in the soil. In Niger, improved varieties of pearl millet grown with moderate application of fertilizer yielded 1.5 tons per hectare with a single rainfall event, and 600 kilograms with no rain.

Combined with suitable policies that provide incentives to farmers and appropriate capacity among the national partners in the Desert Margins Program, these innovations strongly support the objectives of the United Nations Convention to Combat Desertification.

Conserving Agricultural Biodiversity in West Africa

The agricultural revolution which took place in the ancient Near East some 10,000 years ago made the Fertile Crescent the cradle of civilization. The region is at the center of the genetic origin of important crops like barley, chickpea, lentils, oats, rye and wheat. Over 38 percent of the world's population relies on these crops for food. In addition, almonds, apricots, cherries, figs, grapes, olives and plums remain important in the diets of West Asian populations. Many of the traditional varieties and wild relatives of these food crops and fruits continue to grow here, making the region a significant source of genetic diversity.

On-farm, *in situ* conservation of plant and animal genetic resources is an essential complement to the *ex situ* conservation of these resources in genebanks. It is a dynamic form of conservation and utilization that facilitates the development of crop varieties naturally adapted to local conditions and new farming practices that benefit from local knowledge accumulated over millennia.

Community driven *in situ* conservation is a guiding principle of ICARDA's GEF-funded project on the Conservation and Sustainable Use of Dryland Agrobiodiversity in Jordan, Lebanon, Syria and the West Bank and Gaza. The project is a model of two-way, participatory, applied research—providing local communities and national institutes with training and technical assistance on biodiversity conservation and management, while allowing researchers to benefit from traditional, inherited knowledge about crop and fruit production.

Looking at Changes in Land Use

Large areas of bush and grasslands in East Africa are steadily being converted to cropland, trends that are threatening biodiversity and posing significant risks of accelerating land degradation.

With GEF support, a new project—Land Use Change Analysis as an Approach for Investigating Biodiversity Loss and Land Degradation led by the

International Livestock Research Institute (ILRI)—is seeking to identify the social, economic, and environmental causes behind rapidly changing land use patterns in Kenya, Tanzania, and Uganda. Of special interest are the impacts of smallholder livestock production systems. By analyzing land use changes, scientists are gaining improved understanding of the multiple linkages between land use, land degradation, climate, and biodiversity loss. ILRI scientists are using biophysical data (gathered with the help of remote sensing, satellite imagery, and geographic information systems) and combining it with socioeconomic information (e.g. area livelihoods and population trends) to analyze and project the ramifications of changing patterns of land use—including agricultural intensification—for biodiversity and soil integrity. By gathering a wide variety of spatial and temporal information, ILRI scientists are developing a multidisciplinary research agenda that integrates land use change analysis, environmental impact assessments, animal epidemiology, and socioeconomic and market indicators. This research is benefiting from strong local partnerships including scientists and collaborators from the African Wildlife Foundation, University of Dar es Salaam, and Makerere University.

A sound understanding of the driving forces behind land use trends in East Africa is critical for developing land management practices that help conserve biodiversity and promote improved management of natural resources. ILRI's applied research, in partnership with others, is helping tackle problems of land degradation in some of the most fragile ecosystems of Africa.

Conserving Below-Ground Biodiversity

Soils play host to abundant and diverse populations of invertebrate communities of bacteria, fungi and other organisms. According to one estimate, a single gram of soil may contain 4,000 independent bacterial genomes or up to 40,000 different species. Unseen and largely uncharacterized, these below-ground communities of biodiversity fulfill vital services such as regulating soil structures, increasing moisture retention, and cycling nutrients. Agricultural practices and changes in land use on the surface can have profound impacts on below-ground biodiversity, ultimately impacting the well-being of poor farmers through reduced soil fertility, harvests, and incomes.

The GEF-supported Conservation and Sustainable Management of Below-Ground Biodiversity project is helping increase global knowledge for improving the management of soil biota. Six CGIAR Centers are working with the Tropical Soil Biology and Fertility Programme (TSBF) to develop methods for characterizing and evaluating below-ground biodiversity and promote improved practices for its management. These research efforts are addressing critical gaps in data and information concerning beneficial soil biological processes, the role of interactions among soil biota, and the multiple benefits that can be obtained by improving management of soil biota. Information gathered is helping identify the root causes of declining soil fertility associated with land conversion and agricultural intensification, as well as proximate causes such as household and community decisions about which crops are planted and their related crop-specific agricultural practices.

Recognizing the importance of interdisciplinary research and the need for a concerted approach to the challenges posed by declining soil fertility, CGIAR collaborators and facilitators to the TSBF-led project include the CGIAR Systemwide Program on Soil, Water and Nutrient Management convened by the Centro Internacional de Agricultura Tropical (CIAT), the Alternatives to Slash and Burn and African Highlands Ecoregional Programs convened by the World Agroforestry Centre, and the Soil Fertility Network for Maize-based Systems in Southern Africa organized by the International Maize and Wheat Improvement Center (known as CIMMYT, its acronym in Spanish), and others.

Participatory Management of Biodiversity in Agricultural Ecosystems

The GEF-funded People, Land Management and Environmental Change project responds to the Convention on Biological Diversity's call for action on the conservation and management of agricultural biodiversity. Its goal is to develop—in collaboration with farmers and local communities—sustainable approaches to biodiversity conservation within small farmers' production systems. The project also seeks to establish comparative baseline information on a variety of representative regions that can be

used to guide the formulation of strategies and policies to promote effective biodiversity management.

The active participation of farmers and local communities provides scientists with location-specific knowledge of production systems and farming practices and their interaction with surrounding environments. The diversity of cultures, conservation practices and genetic resources is called “agrodiversity,” a concept that captures the dynamic interplay between production systems, the resources provided by the natural environment, and environmental constraints. It also signals the importance of factors such as local communities’ values, norms, and attitudes in biodiversity conservation strategies. At project demonstration site villages, scientists work with farmers to gather data and identify affordable, socially sustainable, biodiversity-friendly technologies and other forms of natural resource management supporting the conservation of genetic diversity.

The project is co-organized by United Nations University and the United Nations Environment Programme and encompasses a network of more than 40 institutions and 200 professionals, including scientists from the International Plant Genetic Resources Institute (IPGRI) and other CGIAR scientists. The project facilitates collaborative research with participating farmers in locally-based research centers in Africa, East Asia, and Latin America.

Integrating Biodiversity Into Forestry Planning

The GEF-funded Biodiversity Planning Support Program was established to provide support and information to planners and policy makers in preparing and implementing the national biodiversity strategies and action plans that support the objectives of the Convention on Biological Diversity (CBD). Because forests harbor such rich biological diversity, forest diversity is one of five thematic programs of the CBD. Forest policy and planning is therefore an important component of national biodiversity strategies. The project supports the development of national capacities in forest planning and the design of public policies for conserving forest biodiversity.

Nine case studies conducted by the Center for International Forestry Research (CIFOR), in 2001 examined the extent to which biodiversity conservation issues were being integrated into national forest planning activities in Bolivia, Cameroon, Costa Rica, the Democratic Republic of Congo, Gabon, India, Indonesia, Mali, South Africa, and Zimbabwe. Subsequent research analyzed the reasons for the low levels of integration found in the case studies, and suggested strategies for improving priority setting, formulating policy, establishing suitable legal and regulatory frameworks, and planning. CIFOR's research is providing forest policy makers around the globe with vital information, and helping raise awareness of best practices in forestry management. More importantly, CIFOR's research is putting knowledge in the hands of those whose decisions will determine the future of forest biodiversity conservation efforts around the world.

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Selected sites for more information:

www.cgiar.org

www.gefweb.org

www.fao.org

www.ifad.org

www.unep.org

www.undp.org

www.worldbank.org

www.biodiv.org

<http://unfccc.int>

www.unccd.int

AGRICULTURE AND ENVIRONMENT: TWO SIDES OF THE SAME COIN

- Three of every four poor people in the developing world—900 million in all—live in rural areas and depend directly or indirectly on agriculture for their livelihoods
- Agriculture and the environment are closely linked and agricultural activities affect most of the world's natural resources such as land, fresh water, and biodiversity
- Agriculture is the bedrock of development and core of the export market; in developing countries accounting for one-fourth to one-half of gross domestic product (GDP)
- More than 800 million people, mostly women and children, go hungry every day—per capita food production has declined from 150 kg to 130 kg in the past 35 years
- Demand for food is set to double over the next 30-40 years with 80 percent of that increase occurring in developing countries
- Agricultural development, environmental protection, and human well-being all depend on healthy ecosystems—the world is losing natural capital at unprecedented rates, threatening long-term sustainability
- Biodiversity is being lost at alarming rates—25 locations around the world, occupying only 1.4 per cent of the world's earth, contain more than 60 per cent of the earth's plant and animal species
- Arable land per person is shrinking, from 0.38 hectares in 1970 to 0.23 in 2000, with a projected decline to 0.15 hectares per person by 2050
- Forty percent of the world's fish stocks have been fished to the limit
- With 40 million already infected, the HIV/AIDS pandemic is a major development challenge and rural areas are expected to be hit hardest, affecting agricultural productivity at the farm level, and leading to depletion of farm assets, skills, knowledge, social bonds, and economic opportunities
- Climate change projections indicate that the earth's average surface temperature could rise by 1.4 - 5.8 degrees Celsius (2.5 - 10.4 degrees Fahrenheit) over the next 100 years, adversely affecting agricultural productivity in tropical zones with Sub-Saharan Africa being the most vulnerable
- New knowledge must be mobilized for agricultural development and environmental protection but modern science is a capital-intensive endeavor: in 1998, 22 countries of the OECD spent more on research and development than the total economic output of the world's 61 poorest countries (the low-income countries, excluding China and India)

The Future Harvest Centers of the CGIAR

Centro Internacional de Agricultura Tropical (CIAT)

Cali, Colombia
www.ciat.cgiar.org

Center for International Forestry Research (CIFOR)

Bogor, Indonesia
www.cifor.cgiar.org

International Maize and Wheat Improvement Center (CIMMYT)

México City, México
www.cimmyt.org

Centro Internacional de la Papa (CIP)

Lima, Peru
www.cipotato.org

International Center for Agricultural Research in the Dry Areas (ICARDA)

Aleppo, Syrian Arab Republic
www.icarda.org

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Patancheru, Andhra Pradesh, India
www.icrisat.org

International Food Policy Research Institute (IFPRI)

Washington, D. C., USA
www.ifpri.org

International Institute of Tropical Agriculture (IITA)

Ibadan, Nigeria
www.iita.org

International Livestock Research Institute (ILRI)

Nairobi, Kenya
Addis Ababa, Ethiopia
www.cgiar.org/ilri

International Plant Genetic Resources Institute (IPGRI)

Maccarese, Rome, Italy
www.ipgri.org

International Rice Research Institute (IRRI)

Los Baños, Philippines
www.irri.org

International Service for National Agricultural Research (ISNAR)

The Hague, Netherlands
www.isnar.cgiar.org

International Water Management Institute (IWMI)

Battaramulla, Sri Lanka
www.cgiar.org/iwmi

West Africa Rice Development Association (WARDA)

Bouake, Côte d'Ivoire
www.warda.org

World Agroforestry Centre (ICRAF)

Nairobi, Kenya
www.worldagroforestrycentre.org

WorldFish Center

Penang, Malaysia
www.worldfishcenter.org

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