Two decades of experience:

Investing in Ecosystem Services and Adaptation for Food Security

gef GLOBAL ENVIRONMENT FACILIT
INVESTING IN OUR PLANET

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TWO DECADES OF EXPERIENCE IN THE GLOBAL ENVIRONMENT FACILITY (GEF)

Investing in Ecosystem Services and Adaptation for Food Security

January 2013

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ACRONYMS

ADB	Asian Development Bank
AFDB	African Development Bank
BD	Biodiversity
CBD	Convention on Biological Diversity
CC-A	Climate Change Adaptation
CC-M	Climate Change Mitigation
COP	Conference of the Parties
CSA	Climate-Smart Agriculture
ECA	Eastern and Central Asia
FA	Framework for Action
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GEF–1	Global Environment Facility First Replenishment
GEF–2	Global Environment Facility Second Replenishment
GEF–3	Global Environment Facility Third Replenishment
GEF–4	Global Environment Facility Fourth Replenishment
GEF–5	Global Environment Facility Fifth Replenishment
IEM	Integrated Ecosystem Management
IFAD	International Fund for Agricultural Development
IW	International Waters
IWRM	Integrated Water Resource Management
LAC	Latin America and the Caribbean
LD	Land Degradation
LDCF	Least Developed Countries Fund
MENA	Middle East and North Africa
MFA	Multi-Focal Area
MTF	Multi-Trust Fund
NAMA	Nationally Appropriate Mitigation Action
NAP	National Action Plan
NAPA	National Action Plan for Adaptation
NBSAP	National Biodiversity Action Plan
OPS	Overall Performance Studies
POPS	Persistent Organic Pollutants
RBM	Results-Based Management
REDD+	Reducing Emissions from Deforestation and Forest Degradation, plus the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
SCCF	Special Climate Change Fund
SFM	Sustainable Forest Management
SLM	Sustainable Land Management
SPA	Strategic Priority for Adaptation program
TF	Trust Fund
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

INVESTING IN ECOSYSTEM SERVICES AND RESILIENCY FOR FOOD SECURITY

With the world population projected to reach 9.5 billion by 2050, an estimated 70-to-100 percent increase in food supply will be required to meet basic demands. This is likely to become the most daunting challenge for society in the decades to come, as the pressure to expand cultivated areas for food, feed, and biofuel production increases. Much can be achieved by reworking global food systems, but this solution will be highly dependent on our capacity to safeguard the global commons that ultimately support agricultural productivity and sustainability. This is one example of how, in several key areas, environmental and economic pressures are pushing the earth beyond the boundaries of what it can sustain.

In the developing world, where 2.5 billion people depend on small-scale practices for their livelihoods and food security, efforts to increase crop and livestock production have largely focused on increasing access to inputs, such as fertilizers for higher productivity, and biotechnology for improved varieties. At the same time, the foundation of agriculture has been progressively undermined by widespread soil degradation. In a classic example of "the tragedy of the commons," long-term investments to combat land degradation and depletion of water resources in agro-ecosystems have been largely outweighed by investments directed toward chemical inputs and crop improvements geared toward short-term gain. Yet the sustainability and resilience of existing food production systems depend on safeguarding the natural capital (land, soil, water) and the services provided by nature. This is particularly vital for rural and poor communities.

We need to come to grips with the fact that just like freshwater, land and soil are finite resources whose depletion is rapidly becoming a significant global problem. Global aspirations for food security warrant major transformation in the economics of land and water management to accommodate the need for safeguarding ecosystem services globally. Tackling global environmental threats is essential for long-term sustainability of mainstream development investments in food security. This effort, which the Global Environment Facility strongly supports, involves helping countries handle biophysical threats to ecosystem services in agro-ecosystems, as well as providing the policy, socioeconomic, and institutional support needed to prevent unsustainable land use.

The GEF has been at the forefront of this battle for over two decades. We have long understood that through efforts in sustainable agriculture and enhancement of food security we can positively impact the global commons. In the context of fulfilling its mandate as the financial mechanism of the Rio Conventions, the GEF has been playing an invaluable role in supporting developing countries to pioneer practices that introduce sustainability and resilience features into agriculture and food security investments.

As the champion of the global commons, the GEF continues to be committed to promoting innovation and exploring practices that can ensure the long-term sustainability and resilience of agriculture. To illustrate the types of solutions and interventions the GEF has been championing, this publication offers a succinct overview of the investments already made in maintaining ecosystem service flows and securing the resiliency for food systems throughout the developing world.

While we are proud of this set of accomplishments, I am also cognizant that we are not doing enough to adequately face the emerging trends. With a new wave of the green revolution sweeping across the developing world, particularly in sub-Saharan Africa, the GEF must redouble its focus on the protection of vital agro-ecosystem components – water, healthy soils and biodiversity – at the same time that it strengthens its capacity to become an even more positive force and partner of choice to leading agriculture development institutions. This will be essential to ensuring that the planet's global environmental commons will continue to sustain agriculture potential worldwide.

As we prepare to enter a new cycle of investments by the GEF, it is my intention to sharpen the focus of our efforts to better address the quest for sustainable land management and food and water security. I truly believe that the GEF is very well positioned to stimulate the needed reform in environment and natural resources management practices that can secure the long-term sustainability of agro-ecosystems in developing countries. I am very hopeful that the experience illustrated in this publication will serve as the springboard to the next leap of the GEF in promoting transformative change in this vital dimension of sustainability for society.

Naoko Ishii,
CEO and Chairperson of the GEF

EXECUTIVE SUMMARY

BACKGROUND

Agriculture and livestock production preoccupy more than half of the world's population, including nearly 2.5 billion in the developing world that depend almost entirely on small-scale practices for their livelihood. Sustaining productivity of agricultural and grazing land is, therefore, essential for achieving global food security. *Sustainable intensification*, through fostering best practices for crops, livestock, forestry and aquaculture, has been considered a key and desirable way to increase the productivity of existing land and water resources in food production. The challenge, however, is ensuring that all such intensification efforts are focused on existing production systems, while minimizing risk of stressors in the natural environment.

> " THE **GEF IS THE WORLD'S LEADING PUBLIC FINANCIAL FUND** DEDICATED TO SMART, ENVIRONMENTALLY SOUND CHOICES THAT BOOST LOCAL ECONOMIES AND PROTECT THE PLANET. "

Investing in global environment and adaptation benefits through agriculture and food security initiatives can play an important role in addressing the potential effects of intensification on ecosystem services. This is a priority for the Global Environment Facility (GEF), created in 1992 with a mandate to serve as the financial mechanism of several major environmental Conventions – CBD, UNFCCC, UNCCD and the Minamata Mercury Convention. The GEF is the world's leading public financial fund dedicated to smart, environmentally sound choices that boost local economies and protect the planet. Because of the importance of agriculture and food security as a development priority in many of these countries, the GEF has been an important source of financing to address environment and natural resource management challenges. Yet there has been no systematic assessment of how GEF financing to generate global environment and adaptation benefits has supported the agriculture and food security sector.

Purpose of the Assessment

This assessment is an attempt to address this need by taking a close look at GEF financing in the context of agriculture and food security projects over the last two decades (1991–2011). The objective is threefold: a) to provide a synthesis of the GEF's experience in supporting the agriculture and food security agenda of eligible countries; b) demonstrate the GEF's value-added for investing in agriculture and food security projects to generate global environmental benefits; and c) establish a basis to strengthen the GEF's role as partner for addressing environmental sustainability in the agriculture and food security sector. The assessment was based on financing provided through the GEF Trust Fund for the Biodiversity, Land Degradation, International Waters and Climate Change Mitigation focal areas; and two other trust funds that specifically support climate change adaptation in eligible countries: the Least Developed Countries Fund and Special Climate Change Fund.

Analytical Approach

Three parallel assessments were done to ensure consistency with the approaches and priorities of GEF financing through the focal area and trust fund windows. Since financing for global environment benefits occurs through the GEF Trust Fund, two parallel assessment were conducted for a) projects financed under the BD, CC-M and LD focal areas focusing on agro-ecosystem; and b) projects financed under the IW focal area focusing on aquatic systems (freshwater and marine). The third assessment was based on projects financed through the LDCF and SCCF for climate change adaptation benefits across all production systems.

From a total of 308 discrete GEF Trust Fund projects and programs identified as appropriate for the period covered by the assessment, 93 were designed specifically to address ecosystem services in the context of agriculture and food security needs in agro-ecosystems. For the IW focal area assessment, 51 projects and four programs were determined to have direct links to food security through investments in freshwater systems, coastal marine ecosystems and long-term management of open ocean fisheries. A total of 78 projects related to agriculture and food security approved under the LDCF and SCCF were considered, of which

only 28 and 17 respectively were designed to include interventions supporting food security. Overall, 192 projects and programs were used for the assessment, comprising 158 stand-alone focal area projects and programs, 30 multi-focal area projects, three multi-focal programs and one multi-trust fund program. In addition to the 51 under IW, there were 39 BD, 25 LD, and one CC-M stand-alone projects.

All 192 projects were analyzed qualitatively for GEF amounts allocated to the relevant components and interventions. For GEF Trust Fund projects, the analysis was based on global environment benefits associated with focal area windows. The benefits are essentially ecosystem services in production landscapes generated through management of a) *land resources* (e.g. soil and water conservation, soil carbon sequestration, improvements in vegetative cover); b) *agricultural biodiversity* (e.g. preserving genetic diversity, on-farm diversification); and c) *aquatic ecosystems* (e.g. protection of species and habitats for fisheries, sustainable flow and improved quality of water for consumptive use). For LDCF and SCCF projects, investments are associated with *adaptation benefits* in the agriculture and food security sector – i.e. reducing vulnerability and increasing resilience to climate variability and projected effects of climate change. The focus on land, biodiversity, water, and adaptation was used to further assess GEF financing for specific project components supporting agriculture and food security.

Highlights of Findings

1 **Trends in Financing from the GEF Trust Funds and Focal Areas:** The 192 projects and programs together accounted for total GEF financing of US$1,086.8 million and an additional US$6,343.5 million in co-financing during the period covered by the assessment. The fourth GEF replenishment phase (2006–2010) accounted for 69 of the projects, with US$285.1 million (26.2 %) of total GEF funding and US$2,165.1 million (34.1%) of total co-financing. GEF financing under IW accounted for the largest single focal area funding, with US$289.09 million (27%) of total GEF grants. This was followed by financing for BD (US$143.9 million) and LD (US$104.7 million) stand-alone focal area projects. The CC-A financing overall amounted to US$257.4 million (24%), but in addition to LDCF and SCCF includes eight multi-focal area projects funded under the Special Program on Adaptation. Other multi-focal area projects accounted for US$288.5 million (26 %) of the total GEF grant, with contributions from the BD, LD, IW and CC-M focal areas.

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2 **Trends in Financing across Regions:** GEF financing in Africa accounted for US$277.1 million (25%) of the total grant, followed by Asia with US$195.9 million (18%), LAC with US$110.2 million (10%) and ECA US$92.5 million (9%) regions. These trends are consistent with global needs for addressing food insecurity since the world's largest population of hungry and malnourished people reside mainly in Africa and Asia. The LDCF investment in Africa is more than twice the amount for Asia region, but the two regions together account for more than 90% of the total LDCF and SCCF financing. A total of US$312.5 million (28.7%) was invested through 25 regional or multi-country projects targeting specific ecoregions, with 12 in Africa region, six in Asia, five in LAC and two in the ECA region.

3 **GEF Investments Supporting Agriculture and Food Security:** A detailed analysis of all 192 projects included in the assessment showed that GEF financing for specific

components supporting agriculture and food security amounted to an aggregate total of US$810.6 million (75%) of total GEF grants. Specific components across all projects supporting sustainable fisheries and water resources management used the largest amount: US$379.8 million (47%). This is followed by project components targeting sustainable land management interventions with US$179.3 million (22%); climate change adaptation actions with US$138.1 million (17%); and management of agricultural biodiversity with US$113.4 (14%).

A. *Sustainable management of fisheries* is crucial for poverty reduction in freshwater and coastal communities throughout the developing world, and GEF investments target interventions that help safeguard aquatic habitats and fish diversity for sustainability of the sector. At the same time, GEF investments support sustainable agricultural systems by targeting *efficient water management practices* that help to sustain flows (both surface and groundwater) and reduce downstream pollution. The level of GEF financing is consistent with the scale of interventions necessary to tackle these challenges, involving transboundary ecosystems and multiple countries.

B. GEF investments for *sustainable land management* mainly target on-farm productivity of crops and livestock through improved management of land, soil, water and vegetative cover. As a means to ensure long-term sustainability of outcomes, GEF financing also supports an enabling environment for SLM, such as improvements in policy options, marketing, extension and training programs. Because of the emphasis on integrated natural resource management, GEF financing for SLM often includes resources from the LD, BD, CC and IW focal areas through multi-focal area projects.

C. GEF financing for *climate change adaptation* in the agriculture and food sector is linked directly to country priorities identified in the National Action Plans for Adaptation (NAPAs), and other national plans and strategies. The funds specifically target adaptation benefits by support for best practices and integrated approaches for resilience in production systems; creation of options and alternatives for land users to cope with expected changes in the production landscapes; enabling environments for CC-A at all levels; financial schemes for climate-resilient practices and technologies; and knowledge management and dissemination platforms.

CONCLUSION

The assessment has demonstrated that GEF financing to generate multiple global environment and adaptation benefits plays a vital role in supporting the agriculture and food security sector globally. The approach to GEF financing emphasizes targeted investments in projects that address objectives of the focal areas, including support to countries for implementation of the Conventions for which the GEF serves as financial mechanism. The value-added of GEF financing is evident from the diversity of interventions in projects, and the potential for sustainability of outcomes for people and the global environment. By aligning focal area priorities with global aspirations for sustainable intensification of production systems, the GEF is well-placed to help feed the world while investing in our planet.

1

INTRODUCTION

With world population projected to reach 9.5 billion by 2050, it has been suggested that 70-100% more food will be needed in order to meet demands.[1] While much can be achieved by reworking global food systems, the pressure to expand cultivated areas for food and feed production will likely increase, with implications for the planet's land, freshwater, biodiversity and climate.[2]

Agriculture and livestock production preoccupy more than half of the world's population, including nearly 2.5 billion in the developing world that depend almost entirely on small-scale practices for their livelihood. Sustaining productivity of agricultural and grazing land is, therefore, essential for achieving global food security. It implies, however, that food production must be intensified to meet the demands of a growing world population. But agricultural intensification through increased irrigation and chemical fertilizers also tends to compromise the natural processes and services that underpin sustainability and resilience of production systems. This reinforces the need for innovations that increase agricultural productivity, while sustaining or improving environmental goods and services.

Sustainable intensification, through fostering best practices for crops, livestock, forestry and aquaculture, has been considered a key and desirable way to increase the productivity of existing land and water resources in food production.[3] It involves the prudent and efficient use of production farm inputs, improved varieties and breeds, more efficient use of labor and better farm management. The challenge, however, is ensuring that all such intensification efforts are focused on existing production lands, including those under pasture. When climate change is considered, practices may be shifted to lands more suited for livestock or crops, and through rehabilitation or conservation of existing production lands based on their likelihood of productivity in the short- and long-term.

The potential for generating global environment benefits through investments in agriculture and food security can be greatly enhanced by addressing the potential effects of intensification on ecosystem services. This is an important priority for the Global Environment Facility (GEF), created in 1992 to serve as financial mechanism of the Rio Conventions — the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD), and the Minamata Mercury Convention. The GEF is the world's leading public financial fund dedicated to smart, environmentally sound choices that boost local economies and protect the planet. In 21 years since its inception, the GEF has provided US$11.5 billion in grants, leveraging US$57 billion in cofinancing, and 3,215 projects in more than 165 developing countries and countries with economies in transition.

Because of the importance of agriculture and food security as a development priority in many of these countries, the GEF has been an important source of financing to address environment and natural resource management challenges. Yet there has been no systematic assessment of how GEF financing to generate global environment and adaptation benefits supports the agriculture and food security sector.

This assessment is an attempt to address this need by taking a close look at GEF investments in the context of agriculture and food security projects financed over the years, primarily through the funding windows linked to sustainable land and water resources management; biodiversity conservation; and climate change adaptation and mitigation as a basis for achieving sustainability and resilience in production systems. **The objective is threefold: a) provide a synthesis of the GEF's experience in supporting the agriculture and food security agenda of eligible countries; b) demonstrate the GEF's value-added for investing in agriculture and food security projects to generate global environment benefits; and c) establish a basis for strengthening GEF's role as a partner for addressing environmental sustainability in the agriculture and food security sector.** The assessment covered the entire GEF project portfolio from inception through the

[1] World Bank. 2008. World Development Report 2006: Agriculture for Development. World Bank, Washington, DC
[2] Godfray, H.C.J, et al. 2010. Food Security: The Challenge of Feeding 9 Billion People. *Science* 327:812-818
[3] Godfray, H.C.J, et al. 2010. Food Security: The Challenge of Feeding 9 Billion People. *Science* 327:812-81

start of the fifth replenishment phase (1991 – 2011). It used focal area investment in project components to determine how GEF resources help generate global environment and adaptation benefits.

The assessment was based on financing provided through the GEF Trust Fund and two other trust funds that specifically support climate change adaptation in eligible countries: the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). For the GEF Trust Fund, financing is through six focal area windows: Biodiversity (BD), Land Degradation (LD), International Waters (IW), Climate Change Mitigation (CC-M), Persistent Organic Pollutants (POPs) and Ozone. Assessment through the GEF Trust Fund window was limited, however, to projects funded under the BD, LD, IW and CC-M windows. While GEF financing under the POPs and Ozone focal areas includes a significant number of projects with links to agriculture (e.g. phase out of POP pesticides), the focal areas have no explicit focus on sustaining ecosystem services in production systems.

Financing through LDCF is driven largely by least developed countries' urgent and immediate adaptation needs, identified and prioritized in country-driven plans known as National Action Plans for Adaptation (NAPAs). The LDCF is primarily leveraged by eligible countries to finance the full cost of urgent and immediate adaptation actions that reduce vulnerability and increase adaptive capacity to the impacts of climate change.

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For most of the 49 least developed countries eligible under LDCF, the food security sector is a major priority given the projected vulnerability of poor farmers, herders and fishers that often make up a significant proportion of the population. The SCCF has adaptation as its top priority in all developing countries that are non-Annex I parties to the UNFCCC. Through its two active financing windows, the SCCF supports adaptation measures in various development sectors including food security and agriculture.

2

CONTEXT AND RATIONALE
for GEF Financing

According to the Food and Agriculture Organization (FAO), an estimated 4.9 billion hectares of the planet's land area is under cultivation, including 3.4 billion hectares of pasture land and 1.5 billion hectares of cropland (arable land and land under permanent crops). An estimated 5 to10 million hectares of these production areas are lost annually due largely to the impact of land degradation on productivity.

As a result, new land areas are continuously opened up for agriculture land use to sustain productivity; this, in turn, exacerbates the degradation and destruction of natural habitats and increases vulnerability of people and the environment to impacts of climate change. For example, it has been estimated that between 1985 and 2005, crop and pasture land expanded by 154 million hectares globally, with a 20% increase in crop yields.[4]

The FAO projects that an additional 120 million hectares will be needed by 2030 to support traditional growth in food production. This implies a net increase of 12.6% — from 956 million hectares in the base year to 1,076 hectares in 2030. Not surprisingly, the bulk of this projected expansion is expected to take place in sub-Saharan Africa (60 million hectares), Latin America (41 million hectares) and East Asia, excluding China (14 million hectares). Such an expansion will undoubtedly increase the risk of global environment threats from production systems — *biodiversity loss, land degradation, deforestation, desertification, and depletion of freshwater resources* — all of which are being exacerbated by climate change. And since the potential yield gains from expansion are not likely to be significant, sustainable intensification of land already under cultivation is important for meeting food security needs in a changing climate[5] (Box 1).

Ecosystem Services and Food Security

Ecosystem services — *provisioning, regulating, supporting and cultural* — are essential for sustaining productivity of agro-ecosystems (Table 1). The services depend on efficient functioning of ecosystems, including the natural cycles and flows that underpin life on the planet. From low-input and smallholder systems in most developing countries to the high-input and intensive systems of the developed world, ecosystem services play an important role in crop, livestock, fisheries and forest production. Harnessing these services in production systems requires a careful and deliberate management of ecosystem components (soil, water and biota) to ensure long-term sustainability and resilience. While knowledge of the economic value of ecosystem services has increased over the last decade,[6] investing in their maintenance remains a major challenge for many countries where a large proportion of the population depend on agriculture and fisheries for their livelihood.

Although there have been rapid improvements in agricultural productivity and economic growth over the second half of the 20th century, there are close to one billion food-insecure people in the world today. Land degradation, deforestation, desertification and depletion of freshwater resources are among the major threats in production landscapes that lead to declining agricultural

TABLE 1 Ecosystem services in production systems

[modified from Millennium Ecosystem Services (2005) and Global Environment Outlook (2007)]

PROVISIONING	REGULATING	SUPPORTING	CULTURAL
• Food and nutrients • Fuel • Animal feed • Genetic resources	• Erosion control • Climate regulation • Natural hazard regulation (droughts, floods, fire) • Water flows and quality • Pollination • Pest resistance	• Soil formation • Soil protection • Nutrient cycling • Water cycling • Habitat for biodiversity	• Traditional practices • Sacred groves as reservoirs

[4] Foley, J.A., et al. 2011. Solutions for a Cultivated Planet. *Nature, 478: 337–342*
[5] Tilman, D. et al. 2011. Global food demand and the sustainable intensification of agriculture. PNAS December 13; 108(50):20260–20264.
[6] TEEB 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature – A synthesis of the approach, conclusions and recommendations.

BOX 1

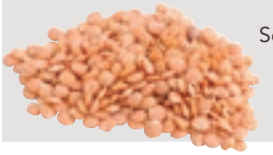
Food security in a changing climate

As defined by the FAO (2002), food security "*is a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.*" By this definition, an estimated 925 million people around the world were insecure in 2010, including at least 239 million in sub-Saharan Africa. Food security depends on three main factors: food *availability*, food access, and food *utilization*, all of which are influenced by climate change.

The *availability* factor encompasses issues of global and regional food supply. Climate change will have potentially large impacts on availability through agricultural yields and potential cropped areas, with global trade as a potential buffer when countries trade and when climate shocks are not uniform across countries/geographic regions. Developing countries with projected yield declines are likely to face increased food insecurity due to lack of alternatives and limited options for adaptation.

The *access* factor concerns the extent to which a given household is dependent on agriculture for its income, the nature of a household's exposure to food prices, the extent to which household incomes are spent on food and the extent to which local food markets are integrated with global markets. The greater a household's livelihood depends on agriculture the more the household is sensitive to the impacts of climate change. Similarly, if climate change induces changes in food supply which in turn affect prices, the net impact of these price changes on food access will depend on the net consumption in the household and how much of its income is spent on food.

The *utilization* factor relates to the nutritional and safety aspects of food consumption. Climate change could directly affect nutrient consumption in three main ways: by changing yields of important crop sources of micronutrients, by altering nutrient content of specific crops or by influencing decisions to grow crops of different nutritional value.



Sources: *Food and Agricultural Organization, 2002. The State of Food Insecurity in the World (2001). FAO, Rome; Worldwatch Institute, 2011. State of the World: Innovations that Nourish the Planet. Worldwatch Institute, Washington, DC*

productivity and food insecurity in the developing world. The progressive deterioration of ecosystem services caused by these threats is further exacerbated by climate change, especially in drylands where the challenge of poverty is also pervasive. Climate change is likely to further aggravate food insecurity by reducing agricultural productivity, production stability and incomes in developing countries and regions that already have high levels of food insecurity. After the global food price crisis of 2008, climate change emerged as a major factor for agriculture and food security in the 21st century, particularly in many of the poor,

agriculture-based economies with low capacity to cope effectively.[7,8]

Tackling global environmental threats is essential for leveraging mainstream development investments in agriculture and food security. This involves helping countries tackle biophysical threats to ecosystem services in agro-ecosystems, as well as providing the policy, socioeconomic and institutional support that would prevent poor land use. For example, extensive soil degradation due to erosion, salinization, compaction and nutrient depletion is one of the major drivers of declining crop and livestock productivity in agro-ecosystems. It reduces soil capacity to produce goods and services, such as sustaining biomass production and biodiversity, and regulating water and nutrient cycling.[9] Ultimately, severely degraded land becomes unable to sustain agriculture, which creates socio-economic problems in agro-ecosystems dominated by poor smallholder farmers and pastoralists.

The quality and quantity of ecosystem services such as flow of water resources, climate and natural hazard regulation, all of which underpin the productivity of agro-ecosystems, are also major factors influencing agriculture and food security. Overexploitation of water for irrigation is already a major threat to groundwater in many parts of the developing world.[10] Ecosystem services related to air and water quality, disease and pest control, and risk reduction from natural hazards are being severely compromised in most agro-ecosystems. Loss of native habitats affects agricultural production by degrading the services of pollinators (especially bees), while loss of vegetative cover has contributed significantly to increased greenhouse gas emissions from agriculture.[11] The consequences of land-based threats also extend into freshwater and coastal marine ecosystems where agricultural pollution undermines the quality and quantity of water and fisheries resources. These environmental challenges are a serious threat to food security, income and livelihoods of rural populations, especially in developing countries, and are being exacerbated by the effects of climate change.

The loss of goods and services derived from ecosystems is a significant barrier to achieving the Millennium Development Goals for reducing poverty, hunger and diseases. The Millennium Ecosystem Assessment noted that, if action is not taken, degradation of ecosystem services will threaten future improvements in human well-being and possibly reverse gains in some regions.[12] Overcoming these challenges requires integrated approaches that generate both environment and development benefits, and for which the GEF is well-placed to provide incremental financing to developing countries and countries with economies in transition. GEF financing enables eligible countries to implement innovative approaches that meet the demands for improving crop and livestock productivity without compromising the ecosystem services. This includes financing to improve land and soil health, enhance sustainability of surface and groundwater resources and increase resilience to effects of climate change.

[7] Shah et al., 2008. Food Security and Sustainable Agriculture. The Challenges of Climate Change in Sub-Saharan Africa. Laxenburg: International Institute for Applied Systems Analysis
[8] Nellemann et al., 2009. The environmental food crisis: the environment's role in averting future food crises. A UNEP Rapid Response Assessment. UNEP, GRID-Arendal
[9] Lal, R. 1997. Soil quality and sustainability. In: Lal, R., Blum, W.H., Valentin, C., and Stewart, B.A. (eds), Methods for Assessment of Soil Degradation, p 17-30. CRC Press, Boca Raton, Florida.
[10] Nellemann et al., 2009. The environmental food crisis: the environments role in averting future food crises. A UNEP Rapid Response Assessment. UNEP, GRID-Arendal
[11] IAASTD 2009. Synthesis Report. International Assessment of Agricultural Knowledge, Science and Technology. Island Press, Washington DC.
[12] Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being Scenarios; Findings of the Scenarios Working Group*, Millennium Ecosystem Assessment Series, Island Press, Washington, DC.

Financing Innovations for Increased Productivity and Resilience

Sustainable intensification of agricultural production, especially in developing countries, can improve food security through higher levels of production in agro-ecosystems. This requires innovations in land use and agricultural management that deliver improved crop and livestock productivity (see Box 2), while contributing to a) *biodiversity conservation* by reducing the conversion of natural ecosystems and safeguarding agro-biodiversity; b) *reduction of pollution risks and degradation of water resources* to ensure sustainable flow for consumptive uses; c) *climate change mitigation*

BOX 2

Examples of options and practices for enhancing environment benefits in production systems

Soil and nutrient management: Soil and nutrient management options under climate-smart agriculture include composting manure and crop residues; more precise matching of nutrients with plant needs; controlled release and deep placement technologies for fertilizer application or using legumes for natural nitrogen fixation; and methods and practices that increase organic nutrient inputs, retention and use.

Water harvesting and use: Improved water harvesting and retention (such as pools, dams, pits, retaining ridges, etc.) and water-use efficiency (irrigation systems) are fundamental for increasing production and addressing increasing irregularity of rainfall patterns.

Conservation Agriculture: Agricultural practices that encompass minimal mechanical soil disturbance (i.e. no tillage and direct seeding); maintenance of a mulch of carbon-rich organic matter covering and feeding the soil (e.g. straw and/or other crop residues, including cover crops); and rotations or sequences and associations of crops, including trees that are nitrogen-fixing legumes.

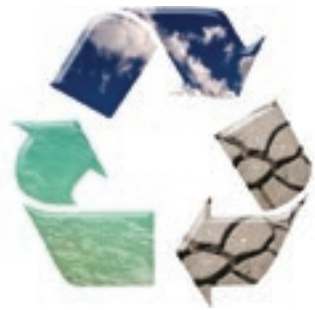
Agroforestry: The practice of integrating trees on farms and into production landscapes enables farmers to generate multiple environment benefits, such as sequestration of carbon, increasing vegetative cover and increasing the adaptability and resilience to climate change. Requires capacity building, extension and research programs to screen germplasm and match species with the right ecological zones and agricultural practices.

Agrobiodiversity: Preservation of genetic resources of crops and livestock breeds, and their wild relatives; generating varieties and breeds, which are tailored to ecosystems and the needs of farmers. Conservation and management of crop-associated diversity on-farm can contribute to yields (through optimal pollination and soil health) and reduce losses (through natural pest control).

Fisheries Management and aquaculture: Targeting fisheries reserve systems to safeguard breeding grounds and fragile ecologies such as coral reefs and coastal mangroves. Sustainable intensification through improved management approaches, selection of suitable stocks and integration of aquaculture with the farming landscapes.

by reducing deforestation and emission of greenhouse gases in production systems; and d) *climate change adaptation* by increasing sustainability and resilience of agro-ecosystem services. These multiple benefits from integrated management of production systems are at the heart of the GEF's mandate, and an opportunity to leverage investments in agriculture and food security in a changing climate.

GEF financing emphasizes the need for implementing innovative approaches to ecosystem management and land use that can sustain the flow of ecosystem services. In the context of mainstream agricultural, livestock and fisheries development programs, GEF financing can lead to more resilient, productive and sustainable systems that also contribute to reducing the emissions or increasing the sequestration of greenhouse gases. For example, with the livestock sector as the largest user of land resources through grazing lands and croplands used for feed production, expansion of agro-pastoral systems is a major cause of overgrazing, land degradation and deforestation in the developing world. Sustainable intensification in the livestock sector will include measures that focus on animal productivity, manure management and a range of grassland management practices to reduce emissions, overgrazing, land degradation and deforestation.



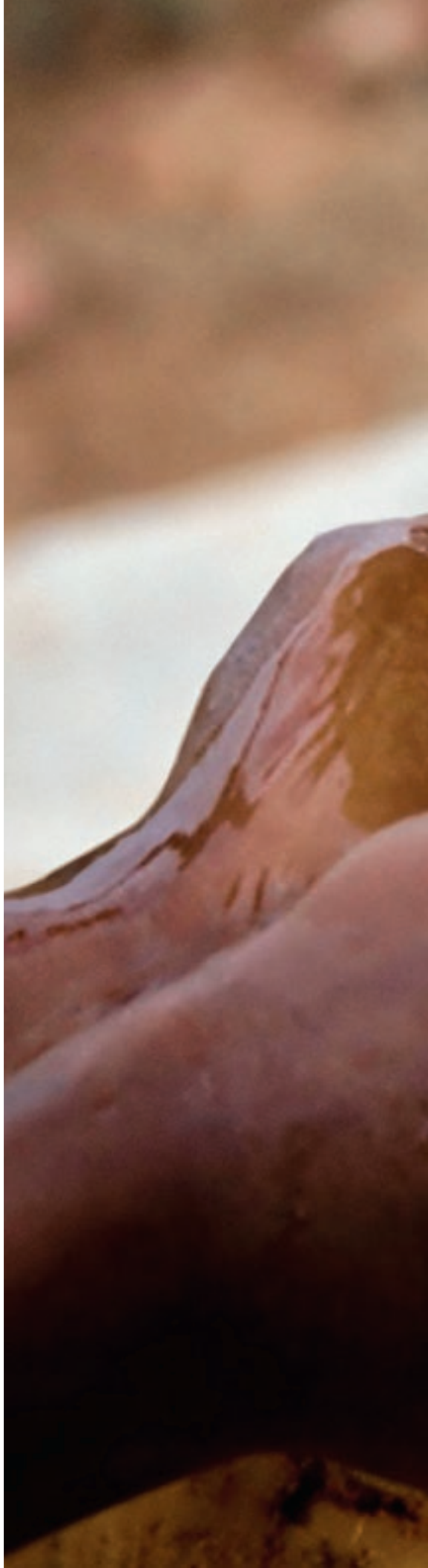
> " ...WITH THE **LIVESTOCK SECTOR** AS THE **LARGEST USER OF LAND RESOURCES** THROUGH GRAZING LANDS AND CROPLANDS USED FOR FEED PRODUCTION, EXPANSION OF AGRO-PASTORAL SYSTEMS IS A MAJOR CAUSE OF OVERGRAZING, LAND DEGRADATION AND DEFORESTATION IN THE DEVELOPING WORLD. "

Although GEF financing is primarily targeted toward rural landscapes where a great majority of poor land users are engaged in agriculture, opportunities abound for improving land and water management in urban areas. Cities are often unable to provide sufficient employment opportunities to their growing populations, which lead to a rapid increase in urban poverty rates and food insecurity. Urban and peri-urban agriculture is providing significant quantities of food (especially of perishable items) and improving food security of the urban poor in addition to other co-benefits like "greening" of cities, improving air quality and lowering temperatures. Emerging issues to foster urban agriculture include lack of access to water and other productive resources, competition for land and issues related to tenure rights, environmental impact of urban agriculture, the food safety concerns of using waste water and organic material and the risk of spreading disease and contaminating toxic pollutants.

3

ANALYTICAL APPROACH

to Assessment of GEF Financing



The underlying rationale for this portfolio assessment is that GEF financing for projects addressing agriculture and food security enables eligible countries to contribute global environment and adaptation benefits in production systems. The global environment benefits are based on priorities of the GEF focal areas — Land Degradation, Biodiversity, Climate Change and International Waters — through which financing is leveraged by the countries for investment in ecosystem services.

The adaptation benefits are based on priorities of the two separate funds managed by the GEF: the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). **Projects included in the assessment were identified on the basis of their linkage to agriculture and food security; this, in turn, was determined from actual investment of GEF resources in project components that explicitly target the maintenance or improvement of ecosystem services in production systems and in climate change resilience.** All selected projects were subsequently analyzed to determine the nature of GEF investments for generating global environmental and adaptation benefits.

> " **FINANCING FOR GLOBAL ENVIRONMENT BENEFITS** IS THROUGH THE GEF TRUST FUND, WHILE **FINANCING FOR ADAPTATION BENEFITS** IS THROUGH THE LDCF AND SCCF. "

Identification of Projects

To ensure a comprehensive analysis of GEF investments in the context of agriculture and food security, three parallel portfolio assessments were used to identify projects. These parallel assessments were necessary to ensure consistency with the approaches and priorities of GEF financing through the focal area and trust fund windows. Financing for global environment benefits is through the GEF Trust Fund, while financing for adaptation benefits is through the LDCF and SCCF. Although a great majority of GEF financing can be linked in some way to agricultural production, all three assessments considered only projects with explicit focus on addressing ecosystem services in agro-ecosystems (agricultural, silvopastoral and pastoral) as a means of enhancing sustainability and resilience.

The first assessment focused on projects financed under the GEF Trust Fund and allocated through the Biodiversity, Land Degradation and Climate Change focal areas. These are the three focal areas through which the GEF targets global environment benefits as a basis for financing projects to support implementation of the three Rio Conventions (CBD, UNFCCC and UNCCD). The GEF project database was initially screened using keywords that reflect direct links with priorities and activities in production systems, such as *agricultural production, food production, land use, agro-ecosystems, agrobiodiversity, crop production, genetic resources, livestock production, farm management, farmers, silvopastoral systems, agropastoral, integrated management and irrigation management.* A total of 308 discrete projects and programs[13] were identified as appropriate for the period covered by the assessment, of which only 92 were determined to be designed specifically in the context of addressing agriculture and food security needs. In addition, one multi-trust fund[14] program designed to include a focus on agriculture and food security was also identified.

The second assessment focused specifically on projects and programs financed through the International Waters focal area, which invests exclusively in management of water resources that are transboundary in nature and involve multiple countries. Under this focal area, projects with links to agriculture and food security are specifically designed to address these as the basis for transboundary management of water resources. For the period covered by this assessment, 51 projects and four programs financed with the focal area resources were determined to have direct links to food security.[15] The projects covered freshwater systems (integrated watershed resource management

[13] Programs are designed to include multiple projects as part of the GEF Programmatic Approach.
[14] Multi-Trust Fund implies the project or program combined resources from the GEF Trust Fund with the LDCF and/or SCCF.
[15] The cohort of projects was identified from a similar assessment for a recent GEF Publication entitled "*Contributing to Global Security: GEF Action on Water, Environment and Sustainable Livelihoods,*" published in March 2012.

in lake and river basins, water use for agriculture and irrigation, freshwater fisheries management); coastal marine ecosystems (protection of living resources, pollution control); and long-term management of open ocean fisheries that feed 85% of fishing countries, including developing and island nations.

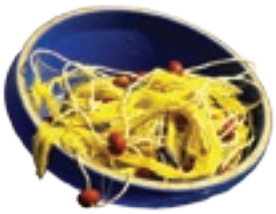
The third assessment focused exclusively on projects financed by the LDCF and SCCF, for which climate change adaptation benefit is the priority. LDCF and SCCF projects are designed to integrate climate change resilience through policy, projects and actions in vulnerable development sectors identified in NAPAs or other country plans. In the case of the LDCF, country profiles identified in the NAPAs drive financing; in the case of the SCCF, alignment of adaptation plans, policy, program and actions with national plans and agenda drive financing. Projects supporting agriculture and food security were based on a previous assessment of the full list of approved projects under both funds,[16] which included 78 projects approved during the period covered by the assessment (49 under the LDCF and 29 under the SCCF). Based on the assessment, 28 LDCF and 17 SCCF projects were determined to include interventions supporting food security. The projects primarily address climate change adaptation in the agriculture sector, focusing on systems and capacities, best practices for both crop and livestock production and approaches to increase resilience of production systems.

Analysis of Trends in GEF Financing

The overall portfolio assessment resulted in 192 projects and programs with GEF investments supporting agriculture and food security. The portfolio includes 157 stand-alone focal area or trust fund projects, 30 multi-focal area (MFA) projects, three MFA programs, one multi-trust fund (MTF) program and one stand-alone IW program. The stand-alone projects include 51 under IW focal area, 39 under BD focal area, 25 under LD focal area and only one under CC-M. Eight of the 30 MFAs were designed as part of the Strategic Priority for Adaptation (SPA) program, which was established to finance pilot and demonstration measures that generate climate change adaptation benefits in projects supported through other GEF focal areas.[17]

Trends in GEF financing were analyzed by replenishment phase, trust fund, focal area and regions. The full amount of GEF resources and co-financing invested in all 192 projects and programs was used to analyze trends. Financing by the GEF Trust Fund replenishment was considered from Pilot phase (1991-1992) through first full year of the Fifth phase (2010-2011). Financing under the LDCF and SCCF is on a rolling basis and therefore not presented by replenishment phase. Trends by focal areas was based on GEF financing through BD, LD, CC-M, CC-A, and IW. Regional trends were based on the four GEF regions: Africa (including North African countries), Europe and Central Asia (ECA), Asia, and Latin America and Caribbean. Regional trends also included regional projects targeting specific geographies and global projects covering multiple countries.

[16] The assessment was conducted by the Climate Change Adaptation team, which also identified the specific intervention areas financed by the two funds.
[17] The SPA portfolio included 26 projects. The portfolio was recently evaluated by the GEF Evaluation Office, which noted an emphasis on global environment benefits under the BD and LD focal areas (Evaluation Report is available from http://www.thegef.org/gef/SPA%20Evaluation)



Assessment of GEF Investments in Project Components

A detailed assessment was conducted to determine GEF financing for specific components and interventions supporting agriculture and food security within the projects and programs identified from the portfolio analysis. All 192 projects were analyzed qualitatively for GEF amounts allocated to the relevant components and interventions.

For GEF Trust Fund projects, investments were based on global environment benefits associated with focal area windows from which resources are allocated. The global environmental benefits are essentially ecosystem services in production landscapes generated through management of a) *land resources* (e.g. soil and water conservation, soil carbon sequestration, improvements in vegetative cover); b) *agricultural biodiversity* (e.g. preserving genetic diversity, on-farm diversification); and c) *aquatic ecosystems* (e.g. protection of species and habitats for fisheries, sustainable flow and improved quality of water for consumptive use). For LDCF and SCCF projects, investments are associated with *adaptation benefits* in the agriculture and food security sector i.e. reducing vulnerability and increasing resilience to climate variability and projected effects of climate change.

The focus on land, biodiversity, water and adaptation was used to further assess GEF financing as follows:

A. Sustainable land management — *financing to enhance capacities, policies, practices and incentives to improve crop and livestock production; promote innovations to improve land and soil quality, water availability and vegetative cover in production landscapes; and foster improvements in management of rangelands, pasture, and pastoral systems.*

B. Management of agricultural biodiversity (or agrobiodiversity) — *financing to promote conservation and sustainable use of crop and livestock genetic resources; in-situ maintenance of genetic diversity; improve soil or below-ground biodiversity; preserve and enhance pollination and pest control services; and safeguard indigenous knowledge and practices that maintain diversity in production landscapes.*

C. Sustainable fisheries and water resources management — *financing to improve policies and practices for governance of shared water resources; promote efficient water management practices in production systems; improve fisheries production; and reduce agricultural pollution in watersheds and coastal ecosystems.*

D. Climate change adaptation for food security — *financing to mainstream adaptation and investment planning; policy improvements; early warning systems; capacity development; knowledge management; and implement best practices and coping strategies against climate change risks at multiple scales.*

For the first three categories, GEF financing is through the Biodiversity, Land Degradation, Climate Change Mitigation and International Waters focal areas. It focused on addressing global environment benefits in the context of crop and livestock production, as well as management of freshwater and fisheries. The fourth category of climate change adaptation includes GEF financing only through the LDCF and SCCF. This typology therefore reflects consistency with priorities of the different but complementary funding windows in the GEF.

Following the approach used to identify and select projects, analysis of GEF financing for project components linked to agriculture and food security was done separately for the GEF Trust Fund and the LDCF/SCCF. For projects under the GEF Trust Fund, grant amounts were derived from the Results-based Management (RBM) framework. The RBM framework of GEF projects includes specific components for which GEF resources are leveraged to generate global environment benefits. Because each component includes specific intervention areas with targeted outcomes and outputs, it is possible to determine grant amounts supporting agriculture and food security irrespective of the GEF focal area. For this reason, the analysis did not distinguish between stand-alone and multi-focal area projects. For the IW stand-alone projects, however, the analysis was based on cross-cutting themes and ecosystems targeted for GEF financing under the focal area. Similarly for LDCF and SCCF projects, the analysis was based on types of adaptation investment as reflected in the project RBM framework.

Project components in the RBM framework were considered relevant if the target outcomes and outputs focused directly on safeguarding ecosystem services (provision, regulating, supporting and cultural) and enhancing resilience of production systems. The full amount of GEF grant allocated to the component was counted toward GEF investments supporting agriculture and food security. For most projects included in the assessment, the components were designed to accommodate a diversity of interventions in an integrated and cross-cutting manner at appropriate scales. Therefore, the breakdown of GEF grants allocated for specific components was aggregated across all projects irrespective of focal area, and whether the project is designed as stand-alone or multi-focal area.

4

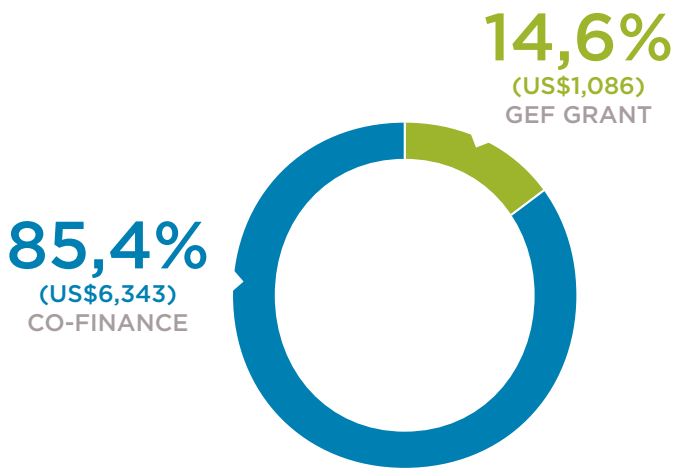
TRENDS IN GEF FINANCING

for Projects

Together, the 192 projects and programs accounted for GEF financing of US$1,086.8 million and an additional US$6,343.5 million in co-financing (Fig. 1) during the period covered by the assessment.

FIGURE 1 Total GEF Grant and Co-finance (USD millions) for all projects and programs with links to Agriculture and Food Security

(Note: Total GEF amount includes grants from the LDCF and SCCF)



Trends by GEF Replenishment Phase and Trust Fund

Financing trends over the years since the GEF's inception showed a steady increase during the first three replenishment phases, but a significant jump during the fourth phase (Table 2). The fourth GEF replenishment phase (GEF–4) accounted for 69 projects, with US$285.1 million (26.2 %) of the total GEF funding, and US$2,165.1 million (34.1%) of total co-financing.

The significant jump in investment between GEF–3 and GEF–4 coincides with the start of the first full replenishment phase during which GEF resources were allocated to a dedicated Land Degradation (LD) focal area. The focal area specifically targets maintenance of ecosystem

TABLE 2 Breakdown of GEF financing and Co-finance by Replenishment Phase and Trust Fund

(Note: LDCF and SCCF funding only started during the GEF–3, and GEF–5 amount includes only projects and programs approved during the first full year of the Replenishment Phase)

REPLENISHMENT PHASE / TRUST FUND	NUMBER OF PROJECTS	GEF AMOUNT (US$)	CO-FINANCE (US$)
Pilot	4	15,056,300	10,230,000
GEF-1	5	28,592,764	105,305,500
GEF-2	25	124,704,706	346,177,783
GEF-3	36	208,186,812	980,919,418
GEF-4	69	285,166,757	2,165,149,224
GEF-5	8	217,831,857	1,905,366,429
LDCF	28	126,062,669	310,069,981
SCCF	17	81,241,762	520,284,507
TOTAL	**192**	**1,086,843,627**	**6,343,502,842**

services in production landscapes through sustainable land management. While only 19 of the stand-alone BD and LD focal area projects were financed during GEF–3, the number increased to 30 during GEF–4. At the same time, the number of MFAs jumped from six during GEF–3 to 15 in GEF–4. The proportionally high amount for GEF–5 is due mainly to three programmatic approaches, which will eventually be delivered through separate subprojects. These observations are further supported by the focal area trends in GEF financing as shown in the following section.

Trends by GEF Focal Area

GEF financing under the International Waters (IW) accounted for the largest single focal area funding, with US$289.09 million (Table 3) representing about 27% of total GEF grants (Figure 2). Since inception of the GEF, the IW focal area has been the primary entry point for GEF investments in freshwater and coastal marine ecosystems; these focus mainly on mobilizing intergovernmental or regional agreements on policies and actions for sustainable management of shared aquatic systems. Hence the focal area plays a major role in management of fisheries and in safeguarding transboundary water resources that underpin production systems in developing country regions.

Financing for stand-alone projects under the BD focal area accounted for US$143.9 million (13%) of the total grant. The BD focal area has been a signficant entry point for projects addressing agricultural biodiversity (or agrobiodiversity); this was a GEF operational program established during GEF–1 in response to CBD

FIGURE 2 Proportional breakdown of GEF Financing by Focal Area

(See Note in Table 3)

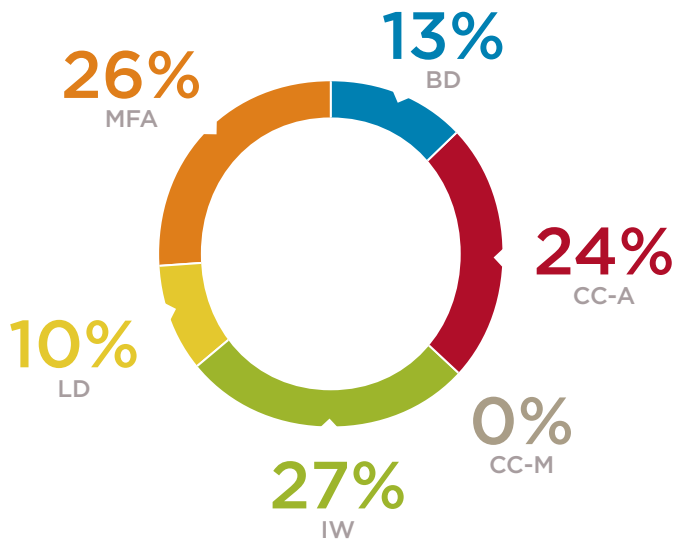


TABLE 3 Breakdown of GEF financing and Co-finance by Focal Area

(Note: CC-A includes all financing under the LDCF and SCCF, as well as SPA; MFAs include financing from multiple focal areas)

FOCAL AREA	GEF AMOUNT (US$)	CO-FINANCE (US$)
BD	143,995,206	511,423,621
CC-A	257,423,796	1,156,253,044
CC-M	3,000,000	3,000,000
IW	289,090,195	1,841,733,563
LD	104,784,799	648,915,678
MFA	288,549,631	2,182,176,936
TOTAL	**1,086,843,627**	**6,343,502,842**

COP guidance on "Conservation and Sustainable Use of Biological Diversity Important to Agriculture." GEF investments under the program specifically targeted needs and priorities for protection of genetic resources (crops and livestock breeds), management of below-ground biodiversity and harnessing pest control and pollination services in production systems. Hence, some components of agrobiodiversity projects related to soil health also have direct relevance for the LD focal area.

Climate Change Adaptation (CC-A) financing overall (including for SPA projects) amounted to US$257.4 million (24%) of the total GEF grant. As noted previously, CC-A focal area investments are directed towards building climate resilience in the agriculture and food security sector. CC-A projects address both the vulnerability of production systems and the practices associated with those systems. The Climate Change Mitigation (CC-M) focal area accounted for only US$3 million of the total GEF grant. This was through a single stand-alone project on *"Alternatives to Slash-and-Burn"*, which examined alternative land use practices such as agroforestry that generate carbon benefits while increasing on-farm productivity in the tropical forest margins.

Stand-alone projects under the LD focal area accounted for US$104.7 million (10%) of total GEF financing, even though the focal

BOX 3

Senegal: Improving soil quality for crop production in the Groundnut Basin

Senegal's Groundnut Basin covers nearly 46,367 square kilometers, with a largely rural population of about 4 million. Since the Quaternary era, salt water has intruded into the basin and recurrent droughts have decreased ground water. Areas affected (*or Tanns*) became gradually bare and uncultivated, leading to impoverishment, food insecurity and the subsequent migration of land users. In response, the UNDP/GEF *Groundnut Basin Soil Management and Regeneration Project (PROGERT)*, was launched in 2006 by the Government of Senegal to develop and implement agronomical and silvopastoral methods of restoration. Two particular innovations promoted by the project involved the use of peanut shell (which is rich in calcium ions and enhances infiltration capacity) to improve soil health and the integration of adaptive species into salt-affected areas. Through a participatory process, the project tested peanut shells with two staple food crops — millet and maize production — and showed significantly high yields.

Meanwhile, the introduction of salt-tolerant tree species (*Acacia Senegal, Eucalyptus camaldulensis, Tamarix aphylla and Melaleuca*) has greatly improved vegetative cover in the area. Recent evaluation suggests that recovered land is more profitable than producing salt. As a result, the project is scaling-up its approach beyond the initial 500 ha. In addition to significantly raising local incomes and producing more food, the practice is safeguarding productive lands and increasing their resilience in the face of climate change. The Senegal Soil Management and Regeneration Project is one of 37 financed by the GEF through the "*Strategic Investment Program for Sustainable Land Management in sub-Saharan Africa*" under the TerrAfrica partnership, and whose activities are integrated into the action program of the New Partnership for Africa's Development (NEPAD). At least 25 countries are involved in the program overall, with projects covering a wide range of ecologies and agro-ecosystems across sub-Saharan Africa.

BOX 4

Regional (West Africa): Implementing a vision for climate-resilient development in the Sahel

In 2011, the GEF and World Bank joined forces with 12 countries in the West Africa region (Benin, Burkina Faso, Chad, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan and Togo) to tackle desertification and climate vulnerability areas in the Sahelian region. The *Sahel and West Africa Program in Support of the Great Green Wall Initiative* will support the implementation of a country-driven vision for integrated natural resource management to enhance sustainable and climate-resilient development in the Sahel and broader West Africa region. The investments cover agriculture, biodiversity conservation, climate change mitigation, adaptation to climate change, sustainable forest management, food security enhancement, disaster risk management, rural development, erosion control and/or watershed management.

The program uses US$80.4 million from the GEF Trust Fund, US$14.81 million from the LDCF and US$4.6 million from the SCCF. It will build on a series of planned baseline investments of up to US$1.8 billion in co-financing, with projects in each of the 12 countries. GEF financing will contribute to increasing the land area with sustainable land and water management practices on up to 2 million ha. It will also promote large-scale watershed planning or smaller-scale community land use planning, improve vegetation cover, promote renewable energy alternatives and increase the adaptive capacity to reduce risks and response to climate variability. The whole approach will help communities adapt production systems to climate variability and change and generate income and livelihoods. An improved information base will also enhance climate and water monitoring networks to fuel further policy development.

area only became fully operational during GEF–3. The focal area targets investments in combating land degradation (specifically desertification and deforestation) to arrest or reverse the progressive deterioration of ecosystem services in production systems (agriculture, rangelands, forest landscapes). The projects are designed to ensure a direct focus on sustainable land management interventions that generate global environment benefits while supporting livelihood needs of poor land users (e.g. Box 3). As a result, components in some of the projects also contribute to Biodiversity focal area objectives through conservation of agrobiodiversity.

In addition to the stand-alone focal area investments, 30 multi-focal area (MFA) projects, three MFA programs, and one multi-trust fund program were designed to leverage GEF resources from multiple GEF windows based on their objectives. These projects account for US$288.5 million (26 %) of the total GEF grant, with contributions from the BD, LD, IW, and CC-M focal areas. In principle, MFA and MTF project frameworks reflect priorities of the different focal areas from which GEF resources were used. However, most multi-focal area projects are often designed with integrated approaches that lead to multiple environment benefits. This helps to streamline investments for maximizing synergies during project implementation and fostering innovations in management of natural resources (land, water and biodiversity) to maintain ecosystem service flows in production systems. An important example is the MTF *Sahel and West Africa Program in Support of the Great Green Wall Initiative*, which combines resources from the GEF Trust Fund, LDCF and SCCF (Box 4).

GEF grants used by projects related to agriculture and food security under the different trust funds and focal areas account for a significant proportion of overall GEF financing during the period covered by the assessment (Table 4). Ratio of the focal area amounts invested to the total financing is highest for the CC-A (57%) and lowest for BD stand-alone projects (5%). The LD and IW focal areas showed similar ratios even though financing for LD represents about one-third of the IW total. The ratios further suggest that while BD focal area investments were significantly higher than for LD, the latter directed proportionally larger amounts toward projects related to agriculture and food security. Considering that both LD and CC-A financing only started in earnest during GEF-3, these two GEF windows are clearly the most important for leveraging food security investments in developing countries.

Trends by Regions

The breakdown of GEF financing by region shows countries in Africa using US$277.1 million (25%) of the total grant, followed by those in Asia with US$195.9 million (18%), LAC with US$110.2 million (10%) and ECA US$92.5 million (9%) (Fig. 3). These trends are consistent with global needs for addressing food insecurity since the world's largest population of hungry and malnourished people reside mainly in Africa and Asia. The majority of countries in these two regions are well placed to leverage GEF resources for investment in the agriculture and food security sector.

The overall trend in financing by replenishment phase and trust fund also shows consistency between the different regions (Fig 4). GEF Trust Fund grant amounts increased gradually between GEF–2 and GEF–4 for the Africa and Asia regions, while

FIGURE 3 Proportional Distribution of GEF Financing by Regions

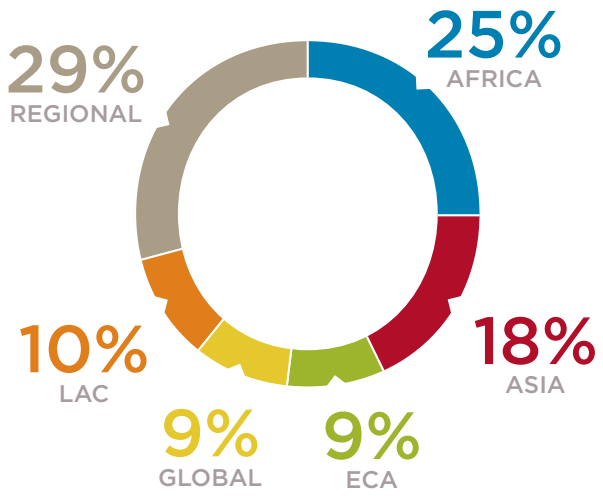


TABLE 4 Ratio of Grants to Total GEF Financing[18] by Focal Area

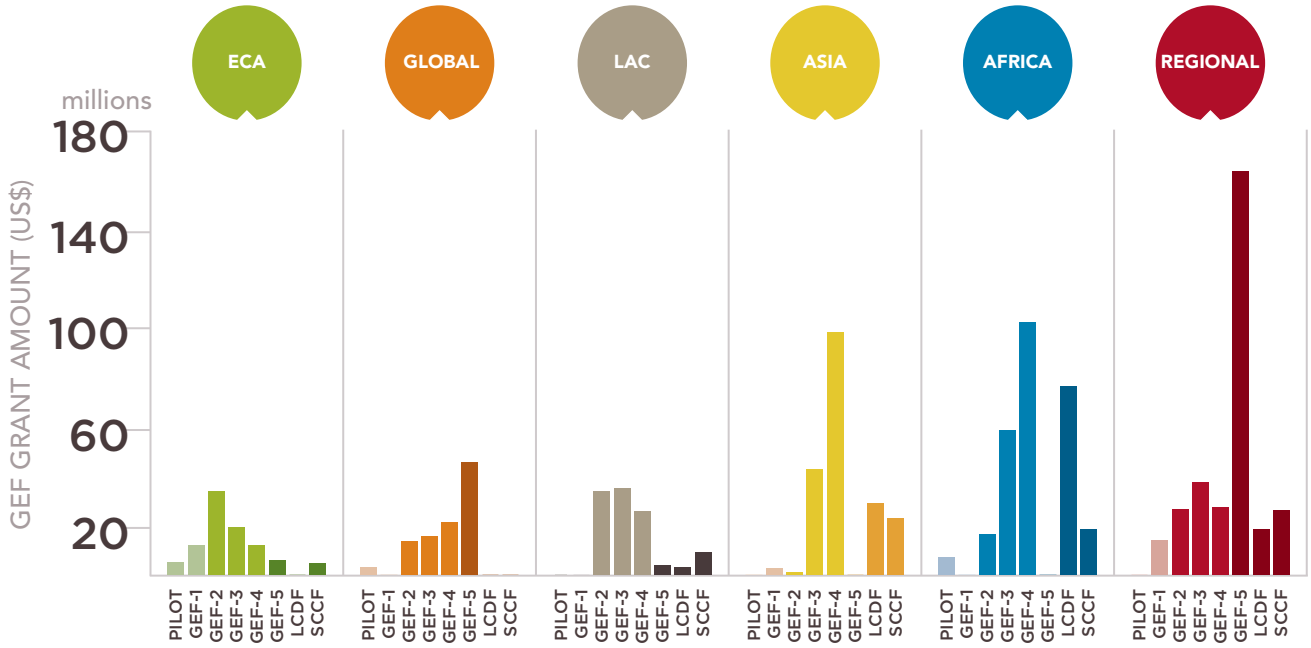
(Note: Total GEF financing covers 1991–2011; CC-A includes only grants from the LDCF and SCCF)

FOCAL AREA	TOTAL GRANTS	TOTAL GEF FINANCING	RATIO
BD	143,995,206	3,100,000,000	0.05
CC-A	171,679,431	300,000,000	0.57
IW	289,090,195	1,200,000,000	0.24
LD	104,784,799	438,000,000	0.24

[18] Source: "Behind the Numbers: A Closer Look at GEF Achievements" (Version 2010). Global Environment Facility

FIGURE 4 Trends in GEF Financing by Replenishment Phase, Trust Fund and Regions

(LDCF and SCCF only started during GEF–3 and are not subject to GEF Replenishment Phases; Data for GEF–5 includes only projects approved during the first full year of the Replenishment Phase)



	ECA	GLOBAL	LAC	ASIA	AFRICA	REGIONAL
PILOT	5,100,000	3,000,000	0	0	6,956,300	0
GEF-1	12,000,000	0	0	2,700,000	0	13,892,800
GEF-2	33,600,000	13,479,800	33,657,800	904,000	16,549,000	26,514,100
GEF-3	19,196,800	15,406,100	34,957,200	42,796,200	58,280,700	37,549,800
GEF-4	12,049,400	21,221,400	25,755,000	97,924,500	101,804,000	27,133,000
GEF-5	5,750,000	45,372,800	3,720,000	0	0	162,989,000
LCDF	0	0	2,999,700	28,730,300	75,999,300	18,333,300
SCCF	4,807,000	0	9,185,080	22,866,800	18,243,500	26,139,400

those for the ECA region decreased. GEF amounts in the LAC region held steady between GEF–2 and GEF–3 and then decreased during GEF–4. The LDCF investment in Africa is more than twice the amount for Asia region, but the two regions together account for more than 90% of the total LDCF and SCCF financing. This further reaffirms the potential for developing countries to use GEF resources in the context of agriculture and food security investments.

GEF financing for regional and global projects supporting agriculture and food security was relatively low from the pilot phase through GEF–4. However, early trends in GEF–5 show a considerable increase in regional and global level investments.

BOX 5

Transboundary (Lake Victoria): Supporting community-based co-management of fisheries

Fish from Lake Victoria make a significant contribution to regional food security, feeding 22 million people. They also provide critical support for livelihoods through an export fishery worth at least $400 million each year. As well as fostering collaboration at a regional and national level, the GEF has provided direct support for local communities around Lake Victoria to play an active role in securing their fish stocks, which is the main source of protein for the region. The establishment of over 1,000 Beach Management Units (BMUs) has played a critical role in this process. BMUs are community-based organizations that bring together everyone involved in fisheries at a beach level — including boat owners, boat crew, traders, processors, boat builders and repairers, net repairers and others. Together, they plan and manage fishing in their local area and work with government and other stakeholders in managing fisheries resources to improve the livelihoods of community members.

This co-management approach has accrued a number of benefits for food security. The BMUs monitor fish stocks, protect breeding grounds, combat illegal fishing gears that catch juvenile fish, improve beach hygiene and ensure fish are of sufficient quality for the important export market. BMUs are a great example of the catalytic impact of the GEF's involvement and support. Because they have been effective at delivering community-based, collaborative fisheries management in Lake Victoria, BMUs were given legal status in all the partner states of the East African Community and mainstreamed by ministers into national fishery policies.

This trend is due mainly to use of programmatic approaches, which allows the GEF to invest significant amounts of resources for tackling environment and development challenges on a regional scale.[19] Three such programs focusing on the West Africa and the Sahel region (World Bank/GEF), East Asia Large Marine Ecosystem (World Bank/GEF) and the Lake Chad Basin (AfDB/GEF) account for nearly US$170 million of GEF–5 financing to-date.

There were 25 regional projects overall, with 12 focused on the Africa region, six in Asia, five in LAC and two in the ECA region. The total grant of US$312.5 million (28.7%) invested through regional projects mainly targeted specific ecoregions or multiple countries within the four geographical regions. The financing is also leveraged for thematic and cross-cutting initiatives that contributed knowledge for planning and decision-support. For example, several major regional projects were designed to strengthen knowledge management for agrobiodiversity (genetic resources) in Africa, the Middle East and North Africa, Central Asia and the Andes Region. With further advances in programmatic approaches, GEF financing is also helping countries to tackle regional-level challenges related to land degradation and climate change (see Box 4 on the Sahel).

The emphasis on ecoregional or multi-country projects is a primary feature of IW focal area financing, which enables governments to

[19] GEF policies and procedures for programmatic approaches are based on approved Council documents GEF/C.33/6 (April 2008) and GEF/C.38/5/Rev.1 (2010). The latter introduced the single-Agency modality for GEF–5, which presents new opportunities for multilateral development banks to design robust investments.

cooperatively address systemic threats to water and fisheries resources that extend beyond national boundaries. IW projects benefited all four geographical regions, including coverage of major lake and river basins. IW financing has contributed to coastal fisheries management in large marine ecosystems off the coasts of Western, Eastern and Southern sub-regions, and to management of water and fisheries resources in lake and river basins in these sub-regions (e.g. Box 5).

Global projects, which accounted for only US$98.4 million (9%) of the total GEF grant, mainly addressed thematic issues that generate knowledge resources to support country-level efforts. There were 13 such projects, of which six were under the IW focal area and covering issues related to management of fisheries and nutrient pollution. An important global flagship in the marine realm is the FAO/GEF multi-focal area program on "*Sustainable Fisheries Management and Biodiversity Conservation in the Areas Beyond National Jurisdiction*" (Box 6). In the terrestrial realm, global projects also targeted knowledge needs for managing pollinators and below-ground biodiversity in production landscapes.

Trends within Regions

Within the Africa region, GEF financing was mainly focused on projects in the drylands where countries such as Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Malawi, Niger, Senegal and Tanzania face major challenges with land degradation and effects of drought. Some of these countries have over the years designed multiple projects to leverage GEF resources in the agriculture and food security sector. Malawi, for example, has four GEF projects focused on production systems, of which three are specifically designed to address agriculture and food security priorities, including the need for adaptation and resiliency (Box 7).

BOX 6

Global: Securing fisheries in Areas Beyond National Jurisdiction (ABNJ)

A major initiative to promote efficient and sustainable management of fisheries resources and biodiversity conservation in *Areas Beyond National Jurisdiction* (ABNJ) was launched by the GEF, in partnership with more than a dozen public and private organizations. The GEF grant of US$50 million will leverage more than US$269.7 million in co-financing from the partners, with FAO, World Bank and UNEP as lead GEF Agencies to design four separate projects under the program. Two of the four projects will specifically address the need for improved and sustainable fisheries practices in the ABNJ.

The project on *Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the ABNJ* will pilot Rights-Based Management systems and other sustainable fishing practices; reduce illegal, unreported and unregulated fishing; and reduce by-catch and other adverse ecosystem impacts on biodiversity. A separate project will focus on *Sustainable Fisheries Management and Biodiversity Conservation of Deep-Sea Ecosystems in the ABNJ*. This project will use an ecosystem approach to improve sustainable management practices for deep-sea fisheries and area-based planning for deep-sea ecosystems.

BOX 7

MALAWI: Achieving global environment and climate adaptation benefits through multi-scale investments in agricultural development

Malawi is a landlocked country, with an estimated 75% of its 12 million people engaged in agriculture as their main source of livelihood and income. The agriculture sector is therefore considered as the potential main driver of poverty-reducing growth. Smallholders account for about 75% of agricultural production, and are mostly engaged in rain-fed maize production. Nearly 60% of the smallholders in Malawi cultivate less than 1 ha. On average, farm households cultivate about 1.2 ha of land and the distribution of land holdings ranges from 0.2 – 2 ha. Sustainable intensification therefore represents the best option for increasing agricultural production, especially in the southern region where there is extreme pressure on arable land.

Over the years, the Government of Malawi has embarked on a series of efforts to improve access to sustainable land management practices that protect against soil and land degradation, strengthen access to financial services and markets and provide opportunities for diversification of agricultural practices. The GEF has been a strategic partner in this effort through a number of projects in the agriculture sector. Four such projects amounting to US$17.1 million in GEF financing, along with an additional US$122 million in co-financing (see table below), are briefly described in this text box. Although not sequential or strategically aligned, these projects reflect a comprehensive and multi-scale approach that demonstrates the GEF's catalytic role for such an important sector. The approach represents a model for other countries that are keen to harness the GEF as a strategic partner for leveraging global environmental benefits in the context of addressing sustainable development priorities at multiple scales, from local to national.

PROJECT TITLE	GEF AGENCY	GEF GRANT	CO-FINANCING
Climate Adaptation for Rural Livelihoods and Agriculture (CARLA)	AfDB	3,000,000	24,505,000
Agriculture Sector Development Program – Support to SLM (ADP-SLM)	IBRD	5,600,000	36,400,000
Private Public Sector Partnership on Capacity Building for SLM in the Shire River Basin	UNDP	2,072,940	4,700,000
Shire Natural Ecosystems Management Project	IBRD	6,578,000	68,314,000

The World Bank/GEF *Agriculture Sector Development Program Support Project (2008 – 2013)* is designed to improve the effectiveness of investments aimed at food security and sustainable agricultural growth; this, in turn, will strengthen the natural resource base by doubling the area under sustainable land management and securing ecosystem services that underpin production practices. The project will (i) strengthen institutional capabilities necessary to improve the design of, and to implement, the Agricultural Development Program; (ii) increase the land, water and nutrient-use efficiency of smallholder maize-based farming systems; and (iii) increase the resilience of the maize supply system to cope with climate risks and shocks. GEF incremental support will contribute to increasing farmers' uptake of conservation farming technologies that can build up the natural soil capital for long-term productivity, with potential for up-scaling nationally. As a result, the project will reduce soil erosion and soil nutrient mining;

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increase soil fertility and maintenance of ecological flows and services (hydrological flows, biodiversity, buffers to extreme events); and reduce threats from siltation, nutrient and pollutant contamination to important regional and national water-bodies such as Lake Malawi, rivers and reservoirs.

The AfDB/GEF *Climate Adaptation for Rural Livelihoods and Agriculture* project (2010 – 2015) is based on the Malawi National Adaptation Programs of Action (NAPA), and represents a direct response to urgent and immediate adaptation needs identified as top priorities. They include a) improving community resilience to climate change through the development of sustainable rural livelihoods, and b) improving agricultural production under erratic rains and changing climatic conditions. The project will directly address these priorities through: 1) improving practical, community-level irrigation efficiency and promoting water recycling and harvesting in vulnerable districts; and 2) strengthening the capacity of National/District agencies to support community-based climate change adaptation actions. The project, which is funded entirely from the LDCF, will take an integrated approach to community-based climate change adaptation. As such, it will develop and pilot new and innovative approaches and practices in the Malawian context.

The UNDP/GEF *Private Public Sector Partnership on Capacity Building for Sustainable Land Management in the Shire River Basin* project (2010 – 2014) seeks to reduce land degradation through improved institutional, policy and payments for ecosystem services (PES) arrangements. The project is focusing on the middle and lower Shire river basin, with potential for up-scaling to the entire basin through the River Shire Development Authority that will be established during implementation. GEF financing will facilitate policy and institutional arrangements for basin-wide SLM; promote public-private partnerships to create financial incentives for SLM (e.g. through green water credits and sustainable charcoal) and increase knowledge and skills at all levels to support SLM. Emphasis will be placed on SLM practices such as conservation agriculture, water harvesting, application of compost manure, mulching with crop residues to reduce the effect of erosive raindrop splash and the use of Vetiver grass along the contour bands to control soil run off.

The World Bank/GEF *Shire Natural Ecosystems Management* project (2012 – 2017) targets the entire river basin to maximize the potential for sustainability and resilience of the ecosystems. The project combines resources from land degradation and biodiversity focal areas as well as the SFM/REDD initiative with an LDCF grant. It will a) strengthen the institutional capacities and mechanisms for Shire Basin monitoring, planning, management and decision-support systems; b) invest in water-related infrastructure that sustainably improves water resources management and development; c) reduce erosion in priority catchments and sedimentation and flooding downstream, while enhancing agricultural productivity and improving livelihoods; and d) reduce flood risks in the Lower Shire through improved management of critical wetlands and provide community-level adaptation and mitigation support. At the basin level, the project would identify areas of natural habitats scattered within broader productive landscapes where smallholder agriculture predominates. These remnant areas still deliver "free" environmental services for local communities, including watershed protection, provision of forest products and clean water. They are also a key source of biomass energy for local populations — over 90% of household energy comes from biomass fuels. GEF financing will foster an integrated landscapes management approach to ensure conservation of globally important biodiversity and protection of forests and wetlands essential for livelihoods, climate resilience and economic development.

BOX 8

China: Mainstreaming adaptation to climate change into water resources management and rural development

The Huang–Huai–Hai (3H) basin is home to more than 400 million people and is China's prime agricultural area. Water demand in the basin is already expected to rise due to increasing industrial and domestic demand. However, increasing temperatures and decreasing summer precipitation caused by climate change is expected to affect the water supply and may cause a serious water deficit in the 3H region. Diminishing water supply has substantial repercussions on agricultural production and lives of farmers in the area. The World Bank/GEF financed *Irrigated Agriculture Intensification Loan III Project (IAIL3)* is supporting comprehensive agricultural development initiated by the central government of China. The project aims to support agricultural and ecological development, strengthen agricultural infrastructure, ensure national food security, advance agro-processing production and increase the income of farmers in the five provinces of the 3H Plain.

In 2006, in response to changes in the climate observed by farmers in the project area, the project accessed a GEF grant through the SCCF to mainstream climate change adaptation into the IAIL3 project. Plans for the remaining IAIL3 funding were reexamined and project activities were adjusted to improve and enhance existing adaptation measures and add measures not included in the original design. Drought and pest-resilient wheat variety was introduced in Jiangsu province. Initially farmers were reluctant to use the new seeds, but increased production in pilot areas has helped convince them; adoption of this resilient wheat variety is growing among farmers. In the project provinces, water-retention walls have been built to maintain the water table; new sluices have also been constructed to increase irrigation water storage capacity. In Xinyi municipality alone, 17 new sluices have been increasing irrigation water storage by 850,000 m^3 each year. The project also assisted the locals in establishing water users associations, offered training to raise awareness about climate change and helped women in the project sites master some technical skills of water-saving irrigation.

Through the implementation of adaptation activities and the large-scale training programs at various levels of government, project management officials and the leaders in the State Office for Comprehensive Agricultural Development have genuinely realized these measures are imperative, as well as taken into account the needs of farmers in adapting to climate change.

For the Asia region, China, India, Lao PDR, Vietnam and Jordan are among the countries with multiple projects focusing on the agriculture and food security sector. China has five such projects included in this assessment, covering agricultural biodiversity, integrated water resource management, fisheries and climate change adaptation. One of these is focused on the Hunag-Huai-Hai Basin where climate change is exacerbating threats to agriculture (Box 8). The other mainland Asia countries have focused mainly on management of agricultural biodiversity and climate resilience in the agriculture sector. Iran and Jordan in the Middle East

have also targeted the agriculture and livestock sector with multiple projects, mainly addressing land and water management, and taking into account the need for adaptation and resiliency.

Argentina, Bolivia, Brazil and Colombia are among countries in the LAC region with multiple projects targeting the agriculture and livestock sector. The projects in Bolivia were focused mainly on management of agricultural biodiversity, including in the Andean region where the food security needs of indigenous communities is supported by the rich genetic resources heritage. Larger countries such as Brazil and Mexico also invested GEF resources for water resource management in river basins, while Small Island Development States (SIDS) in the Caribbean mainly benefited from regional projects (e.g. Box 9).

BOX 9

Jamaica: Farming the Drivers River watershed

The Drivers River demonstration project recognized the highly integrated and closely interlinked nature of watersheds and coastal areas in small islands. It aims to develop a management approach, both at the national and regional level. Small grants helped with the cultivation of cash crops, raising of broiler chicks, organic farming, planting of timber and ornamental seedlings. They also supported some cottage industries, using products of sustainable agriculture (honey and jam) and recycled paper products. One of the major challenges faced by the Drivers River watershed is that the area is steep and soils are easily eroded. To combat this, a demonstration project under the GEF/UNEP *Integrated Watershed and Coastal Area Management (IWCAM) in Small Island Developing States of the Caribbean* project, engaged an Agriculture Society Farmers Group in Jamaica to provide training to farmers in the Drivers River watershed. Training focused on the stabilization of soils using vegetation barriers with pineapple and vetiver species.

In one pilot, approximately 250 pineapple sets and approximately two lengths of vetiver grass were planted in a 1 ha microcatchment. To ensure maximum understanding, each farmer was then given the chance to repeat the process, corrected and commended by other participants as the training continued. Although the demonstration project has ended, community members are still monitoring the water quality and quantity using bioindicator species of plants and animals. Based on the success of the Drivers River project, the model is now being implemented in other watersheds across islands in the Caribbean.

In the ECA region, countries have generally focused on projects addressing agricultural pollution problems through integrated water resource management. Romania, Croatia, Moldova and Turkey are among the countries that leveraged IW financing as part of regional-level collaboration. Several major lake and river basins have been targeted for GEF investments, including the Danube River and Black Sea (Box 10). GEF financing through the IW focal area has contributed significantly to management of water resources for both agriculture and fisheries management in Eastern European countries.

BOX 10

Turkey: Watershed rehabilitation in Black Sea catchments

Centuries of agricultural practices had degraded upland catchments in many of the watersheds surrounding the Black Sea. To continue maximizing yield, farmers were adding excessive amounts of fertilizer and other agricultural pollutants to their lands. One demonstration project under the GEF/World Bank *Danube River and Black Sea Investment* targeted 28 microcatchments in Anatolia and Turkey's Black Sea Region. The demonstration project's overall objective was to support sustainable natural resource management and new farming practices. In this way, it would raise incomes of communities affected by resource degradation and reduce the discharge of nutrients and other agricultural pollutants into surface and ground water draining into the Black Sea. The project organized training for 38 farmers and 32 provincial staff from the four project provinces to promote organic fruit production. An accredited control and certification services company had been contracted to help in initial organizing of the organic fruit growing in the project area and later in certification.

Three organic walnut fields were established in three different microcatchments. In one specific microcatchment, 40 ha of walnut farms belonging to 77 farmers were converted into organic farming. Interest in organic farming and related requests has now spread from the pilot sites to neighboring provinces not originally participating in the project. Ultimately, the organic farming methods will help reduce nutrient discharge from agricultural sources into the Black Sea. Other project benefits included sustainable increases in crop yields; higher fodder production on rangelands and improved livestock yields; higher and more stable household incomes leading to reduced poverty; improved water quality; and safer food products that meet national environmental regulations with regard to good agricultural practices for access to EU markets.


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GEF FINANCING

for Project Components and Interventions

The analysis of all 192 projects included in the assessment showed that GEF financing for specific components supporting agriculture and food security amounted to an aggregate total of US$810.6 million, about 75 % of the total GEF grant used (Table 5).

Sustainable fisheries and water resource management used the largest amount of GEF Trust Fund resources: US$379.8 million, or 47% of the total GEF grant.[20] This is followed by sustainable land management (22% of the total grant supporting agriculture and food security), climate change adaptation (17%) and management of agricultural biodiversity (14%).

Sustainable Land Management

GEF investments for sustainable land management offer direct opportunity to generate multiple environmental benefits in the context of agriculture and food security. The investments mainly target on-farm productivity of crops and livestock through improved management of land, soil, water and vegetative cover. As a means to ensure long-term sustainability of outcomes, GEF financing also supports an enabling environment for SLM, such as improvements in policy options, marketing, extension and training programs. Because of the emphasis on integrated natural resource management, GEF financing for SLM often includes resources from the LD, BD CC and IW focal areas through multi-focal area projects.

The projects using GEF resources for SLM covered a range of interventions, from soil and water conservation to incentives and policies for improving on-farm productivity (Table 6). Investments in soil and water conservation accounted for US$51.7 million (29%) of the GEF resources, which enables farmers and land users to apply field-tested technologies for improved soil quality on farmlands. This includes efficient irrigation and water-saving techniques that are specifically invaluable to dryland farmers, as well as SLM interventions to reduce erosion and increase soil fertility in sub-humid and humid regions.

GEF investment of US$41.2 million was used for community-based land management, which helps farmers to collectively implement SLM at landscape scale. This is particularly useful in contexts where such collective action is necessary to target drivers and effects of land degradation that extend beyond individual farms or farm households. This approach was also evident in projects concerned with overgrazing in rangelands, for which an aggregate amount of US$5.3 million was used directly. Collective action in rangeland management helps to address potential conflicts between herders, as well as conflicts at the livestock-wildlife interface (Box 11).

Investment in incentives and policies (US$39.3 million), institutional capacity development (US$26.9 million) and development of the knowledge base (US$13.9 million) supports creation of enabling environments or removal of barriers for land users to implement SLM. These investments also facilitate

TABLE 5 GEF Financing Components supporting Agriculture and Food Security

(Note: Figures in parentheses are percentages of the total)

TYPE OF INVESTMENTS	GEF FUNDING ('000 $)
Sustainable Land Management	179,317.9 *(22)*
Management of Agricultural biodiversity	113,432.8 *(14)*
Sustainable Fisheries and Water Resource Management	379,819.2 *(47)*
Climate Change Adaptation for Food Security	138,119.4 *(17)*
Total Investments	**810,688.9 *(100)***

[20] This amount is higher than the IW focal area total in Table 3 because it includes the focal area resources invested in stand-alone, as well as regional, multi-focal area projects.

BOX 11

Regional (Africa): Enhancing sustainability at livestock–wildlife Interface

The co-existence of livestock and wildlife in the savanna landscape is threatened by over-exploitation of natural resources due to increasing human populations and weakening of traditional institutions that control and regulate access to grazing resources and protection of wildlife. The UNEP/GEF *Dryland Livestock Wildlife Environment Interface* (DLWEIP) project was designed to address the complex problem of sustaining mixed production systems in sub-Saharan savanna agro-ecosystems that are undergoing rapid changes due to modernization of agriculture, and other emerging land use practices. The project mobilized key stakeholders in Kenya and Burkina Faso to implement new approaches to natural resources conservation and management. The stakeholders involved included communities, NGOs, private sector players and the various government departments/institutions.

GEF financing helped promote community conservation and land rehabilitation initiatives, community capacity building, income-generating activities (alternative livelihoods), and some aspects of community conflict management and resolution initiatives. The project also contributed to improving lives of sedentary pastoralists in targeted conservancy areas in Kenya by investing in SLM as an income-generating activity. Furthermore, definition of resource tenure under group ranch bylaws ensures that household investors enjoy sustained benefit. Through exchange visits and workshops, land users were offered an effective strategy for sharing and disseminating good practices at community/local, national and international levels.

access to methods for improved productivity, marketing services, extension, training and policy analysis for the agriculture sector. Lack of access to methods for soil fertility improvement and prevention of land degradation is among the major constraints to improving productivity of agricultural lands, especially for smallholder farmers. GEF support makes it flexible for countries to strengthen or create systems that help address this problem as part of agriculture and food security investments.

TABLE 6 Financing Sustainable Land Management Interventions

(Note: Figures in parentheses are percentages of total)

PROJECT COMPONENTS	GEF FUNDING ('000 US$)
Soil and water conservation	51,734.2 *(29)*
Institutional capacity development for SLM	26,962.6 *(15)*
Incentives and policies for improved farm productivity	39,308.1 (22)
Development of knowledge base on SLM best practices	13,959.4 *(8)*
Community-based land management	41,989.3 *(23)*
Ecosystem and pasture management	5,363.8 *(3)*
Total GEF Investment	**179,317.4 *(100)***

Management of Agricultural Biodiversity

Agrobiodiversity is a key attribute of production systems, and includes soil fauna (below-ground biodiversity) that keep the soil healthy; genetic resources of crop and livestock used by farmers and herders; and the indigenous knowledge and traditional practices that help maintain ecosystem services. Although most GEF financing for agrobiodiversity is through the BD focal area, investment in soil health also used LD resources through multi-focal area projects. The interventions were focused on three main aspects: knowledge management for conservation of germplasm and genetic diversity; best practices and technologies for optimal use of agrobiodiversity; and policy and institutional development for agrobiodiversity.

The largest GEF investment of US$45 million (40%) was directed toward best practices and technologies (Table 7). The investments contribute toward *in-situ* conservation of genetic resources and soil fauna, reduction of pest and disease incidence through biological control (e.g. application-integrated pest management), harnessing pollination services (see Box 12) and development of markets as incentives for maintaining crop diversity on farms.

TABLE 7 Financing Agricultural Biodiversity Interventions

(Note: Figures in parentheses are percentages of total)

PROJECT COMPONENTS	GEF FUNDING ('000 US$)
Knowledge management for conservation of germplasm and genetic diversity	33,077.5 *(29)*
Practices and technologies for conservation of agrobiodiversity	45,079.2 *(40)*
Policies and institutional development for agrobiodiversity	35,276.1 *(31)*
Total GEF Investment	**113,432.8 *(100)***

An aggregate GEF amount of US$33 million was invested in knowledge management, which targeted data collection on crop biodiversity and indigenous varieties, conservation of germplasm and awareness-raising on the importance of agrobiodiversity. This investment is particularly invaluable for countries to establish frameworks for long-term management of crop and livestock genetic resources, including engagement of farmers whose invaluable knowledge of the resources is often at risk of being lost (e.g. Box 13).

BOX 12 Global: Safeguarding pollinators in sustainable agriculture

Two-thirds of all food crops depend on insect pollinators, especially bees, for maximum production. With bee populations rapidly declining and more crops being grown under intensive systems, multiple agro-ecosystems and ecologies need to adopt practices to prevent the loss of pollination services. Unfortunately, the level of capacity to manage these services, and public awareness of their importance, is very low, both in traditional and modern societies. Several highly localized crop pollination failures, however, have brought the issues to the forefront of global debate on ecosystem services and agricultural land use and conservation.

The GEF/UNEP/FAO *Conservation and Management of Pollinators for Sustainable Agriculture through an Ecosystem Approach* project engaged with partners in seven countries to develop best practices for management of pollination services for the benefit of human livelihoods and sustainable agriculture. In Ghana, for example, partners found that spraying insecticides decreases populations of midges by one-third to one-half: without these pollinators, yields of cocoa – a key cash crop in Ghana - may drop by 90%. In farms that grow bananas or plantains near cocoa trees, however, leaf litter from the trees provides a microhabitat for midges, enabling populations to recover faster. The project works with farmers to establish best management practices to conserve pollinators over the long term, enabling farmers, extension agents, land managers, policymakers and the general public to support pollinator conservation efforts worldwide.

BOX 13

Regional (Asia): Safeguarding local fruit-tree diversity in home gardens for nutritional security

India, Indonesia, Malaysia and Thailand are home to four genera of tropical fruit trees: *Citrus* (citrus), *Mangifera* (mango), *Nephelium* (rambutan) and *Garcinia* (mangosteen). These tropical fruits, valued for their wide range of nutritional, health and other benefits, are an important part of Asian culture. The fruit trees are at risk, however, due to an alarming loss of biodiversity caused by three factors: lack of systematic assessment and documentation of local and traditional knowledge; inadequate use of unique and high-value trait differentiation of existing diversity; and the lack of capacity of farmers, user groups and rural institutions to implement good practices and link to value-chain actors to provide incentives for custodians.

The countries are working together through a UNEP/GEF project, *Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihood, Food Security and Ecosystem Services*, to strengthen the capacity of farmers and institutions to implement community-based management of local fruit-tree diversity in home gardens, as well as to enhance the *in-situ* conservation of their wild relatives in forests. This is helping document available diversity and related knowledge; identify and promote good practices; enhance the livelihoods of farmers who conserve genetic resources of tropical fruit trees; and build local, national and regional capacity for monitoring and policy support. To date, all countries have identified a set of unique and high-value genotypes from farmers' gardens that provide benefits to the custodian farmers. In addition, the project identified 23 good practices from 36 communities to sustain conservation of target biodiversity, and trained 150 participants to strengthen capacity of national frontline staff to implement good practices that promote conservation and enhance livelihood.

GEF financing also included US$35.2 million for institutional strengthening to support management of genetic resources, and for development of national- and regional-level policies to promote agrobiodiversity. Investment in institutional development, policies and regulatory frameworks helps protect indigenous varieties and knowledge for sustainable use of agrobiodiversity. At the same time, it also ensures that smallholder farmers can maintain land use practices that preserve and promote agrobiodiversity, which also contributes to SLM.

Sustainable Fisheries and Water Resources Management

Fisheries management is crucial for poverty reduction in freshwater and coastal communities throughout the developing world, and GEF financing helps safeguard the aquatic habitats and fish diversity for sustainability of the sector. At the same time, sustainable agricultural systems and efficient water management practices help sustain irrigation needs and reduce pollution from agricultural areas. The level of financing is consistent with the scale of interventions necessary to tackle these challenges, which involve transboundary ecosystems and multiple countries.

> " **FISHERIES MANAGEMENT IS CRUCIAL FOR POVERTY REDUCTION IN FRESHWATER AND COASTAL COMMUNITIES** THROUGHOUT THE DEVELOPING WORLD, AND GEF FINANCING HELPS SAFEGUARD THE AQUATIC HABITATS AND FISH DIVERSITY FOR SUSTAINABILITY OF THE SECTOR. "

GEF investments in sustainable fisheries and water resources management for food security are a major contribution of the IW focal area. A key feature of the investment is promoting multi-country or regional cooperation in management of shared water resources. By working at the transboundary scale, regional knowledge-sharing and cooperative frameworks can better prepare neighboring countries in the event of crisis, such as floods and droughts. It can also allow neighboring countries to better manage migratory fish populations as climate change makes their distribution less predictable. The typology of interventions ranges from targeted systems to cross-cutting priorities as described next:

- **FISHERIES MANAGEMENT**
  Managing commercial fish stocks through ecosystem-based sustainable approaches, including conservation of habitats at various life stages of targeted species, working with national governments and transboundary committees and establishing restricted harvesting and no-take zones.

- **INTEGRATED COASTAL AND MARINE ECOSYSTEM MANAGEMENT**
  Investing in integrated ecosystem management of coastal and marine environments with legal agreements for pollution control, sustainable coastal development zones and establishment of protected areas for ecosystems inhabited by commercially important fin and shellfish such as coral and oyster reefs, seagrass meadows, salt marshes and mangrove forests.

- **LAKE BASIN MANAGEMENT**
  Improving governance and cooperation of transboundary freshwater lake basins to reduce pollution, unsustainable withdrawals and other conflicts in order to provide sustainable sources of clean water for agriculture, freshwater fisheries and other ecosystem services.

- **RIVER BASIN MANAGEMENT**
  Improving governance and cooperation of transboundary river basins to reduce pollution, unsustainable withdrawals and other conflicts in order to provide sustainable sources of clean water for agriculture, freshwater fisheries and other ecosystem services.
- **MANAGEMENT OF AQUIFERS**
  Improving governance and cooperation of transboundary aquifers to reduce pollution, unsustainable withdrawals and other conflicts in order to provide sustainable sources of clean water for drinking and agriculture.
- **POLLUTION/ NUTRIENT REDUCTION**
  Managing municipal and agricultural practices and governance to reduce chemical toxins and nutrient pollution from fertilizers that result in the poor water quality and eutrophication of lakes, rivers, coasts and marine environments, depleting oxygen for commercially important fin and shellfish.
- **IRRIGATION MANAGEMENT**
  Managing irrigation systems to provide sustainable water withdrawals from transboundary freshwater lakes, rivers and aquifers to ensure long-term and sustainable agricultural yields.

The breakdown of GEF investments showed an aggregate total of US$179.4 million for targeted systems (lakes, river basins, aquifers and coastal marine) and US$200.3 million for the cross-cutting (fisheries, pollution/nutrient reduction, irrigation) priorities (Table 8). GEF financing for lakes, river basins, aquifers and coastal marine systems helps countries manage these resources across boundaries collectively and collaboratively. The investment targets specific geographies for which countries are prepared to engage in transboundary diagnostic assessments that lead to development of strategic action plans for long-term management of ecosystem and water resources.

The significant proportion of GEF resources directed toward cross-cutting issues further highlights the importance of cooperation across boundaries in addressing systemic threats to freshwater (surface and groundwater) and coastal marine ecosystems. GEF financing helps countries jointly identify and commit to solutions, including policy options, targeted investments and institutional frameworks for long-term monitoring of the threats. Fisheries management accounted for US$119.4 million, representing more than one-third (31.4 %) of the total GEF investment. These investments play an important role in addressing risks

TABLE 8 Financing Sustainable Fisheries and Water Resources Management

(Note: Figures in parentheses are percentages to total)

AREAS OF INVESTMENTS	GEF FUNDING ('000 US$)
Fisheries management	119,414.4 *(31.4)*
Integrated coastal and marine ecosystem management	72,538.4 *(19.1)*
Lake basin management	29,788.4 *(7.8)*
River basin management	63,703.4 *(16.7)*
Management of aquifers	13,400.0 *(3.5)*
Pollution/nutrient reduction	69,799.8 *(18.4)*
Irrigation management	11,175.0 *(2.9)*
Total GEF Investments	***379,819.5 (100)***

BOX 14

Egypt: Improving livelihoods through nutrient reduction

Lake Manzala in Egypt is a long, shallow lake on the northeastern edge of the Nile delta between the two port cities of Dormietta and Port Said. Much of the heavily polluted drain water crossing the delta enters large coastal lakes, such as Lake Manzala, before flowing into the Mediterranean Sea. Contaminated water and tainted fish stocks in the lake represent huge risks for the region's food security. Through the UNDP/GEF *Lake Manzala Engineered Wetlands* project, 24 ha of constructed wetlands were used to imitate the role of natural wetlands as "biofilter" to remove nutrients, heavy metals and toxins from wastewater. As a result, up to 50,000 m^3 of water is treated per day, removing 90% of traditional pollutants and 75% of toxins. The cleaned water is then used for a number of agriculture activities, including by crop irrigation by local farmers. Local fishermen collect the clean water in ponds to farm fish that are fit for human consumption and that can also be used to restock the lake.

The benefits are summed up by Project Director Dr. Diaa el-Quosy, "This technology costs only 10% of other technologies, it is environmentally friendly as no chemicals are used and maintenance is very simple. The community knows about this new technology. By breeding fish we are creating a stock that can be used to produce more fish," he says. Lake Manzala is also an internationally registered Important Bird Area and pollution threatens not just regional food security, but the lake's entire ecosystem. In the past 70 years, the area of natural wetlands has shrunk from 280,000 to 80,000 ha. The demonstration at Lake Manzala has created international visibility for constructed wetlands and now provides Egypt with the opportunity to become a recognized leader in the development of this innovative technology.

of overexploiting fish stocks in both freshwater and marine ecosystems, particularly threats that undermine food security, such as from live fish food trade and fishing of pelagic species like tuna.

GEF investments in pollution/nutrient management (US$69.7 million) and irrigation (US$11.1 million) are linked more directly to management of agricultural systems that depend on freshwater resources. The financing supports interventions to tackle nutrient pollution, such as promotion of low-cost water treatment options, constructing manure management facilities and protecting wetlands that serve as important nutrient filters (Box 14). In parts of the developing world where irrigated agriculture faces major threats from loss of water supply due to overexploitation and poor management of flows, GEF financing helps develop options for improving conservation and sustainable use of freshwater (surface and groundwater) for irrigation (e.g. Box 15)

Integrated coastal and marine ecosystem management used US$72.5 million of the IW resources. Investments were targeted mainly for interventions to protect coastal zone and marine biodiversity, including legal frameworks and regulations for pollution control, sustainable development of the coastal zones and designation of protected areas for coral reefs and other unique habitats. GEF financing for lakes (US$29.7 million), river basins (US$ 63.7 million) and aquifers (US$13.4 million) supports interventions on governance mechanisms to reduce risks of conflicts; promote cooperation in management and use of the shared freshwater resources; and increase resilience of the systems.

BOX 15

China: New irrigation technology in the Hai River basin strengthens food security

The Hai River basin is home to 134 million people, with agriculture as a major economic activity. Wasteful irrigation in the basin had resulted in serious environmental degradation, putting the region's food security at risk. The groundwater extraction rate far exceeded rechargeable quantities, with water tables falling by three meters every year. Rapid industrial growth had also created a serious pollution problem with contaminated water flowing from the Hai River to the Bohai and Yellow Seas. To address this concern, the Government of China developed the *Hai River Basin Integrated Water Resource Management* project, with World Bank/GEF support. The project brought together the Ministry of Water Resources and Ministry of Environment Protection to work on integrated water management at the local level for the very first time. The project was the first large-scale initiative in the world to combine remote sensing satellite technology and a new water allocation system with economic incentives together with the involvement of hundreds of local farmer-led associations to ensure participation and compliance. The method, known as ET (evapotranspiration) Management, produced real water savings without crop loss and generated substantial gains in farm income. New criteria for water allocation were developed, including the amount of water consumed and the amount to be returned to the local water system (with the water quality stipulated).

The changes supported by the GEF project led to 40% reductions in water use, up to five-fold increases in farm incomes and, most importantly, a significant contribution to food security and farmers' livelihoods. The 16 pilot counties have saved over 266 million m^3 of water. Pollution loading into the Bohai Sea has also been reduced by 38,615 tons/year for Chemical Oxygen Demand and 4,665 tons/year for ammonia-nitrogen. These GEF-supported measures and technologies can be applied around the globe to produce real water savings and ensure a reliable source of food for future generations to come.

Climate Change Adaptation for Agriculture and Food Security

As pointed out in the previous section, all of the GEF financing in this category is through the LDCF and SCCF. This financing is linked directly to country priorities identified in the NAPAs and other national plans and strategies. The projects in this category are targeted to generate adaptation benefits in the food and agriculture sector. To that end, they ensure that production systems are resilient to climate risks by creating options and alternatives for land users to cope with expected changes in production landscapes; developing effective warning systems; and by providing decision-support mechanisms at local and national levels.

The total US$138.12 million of LDCF and SCCF funds directed towards food security and agriculture was directed to investments in six main categories of interventions described below:

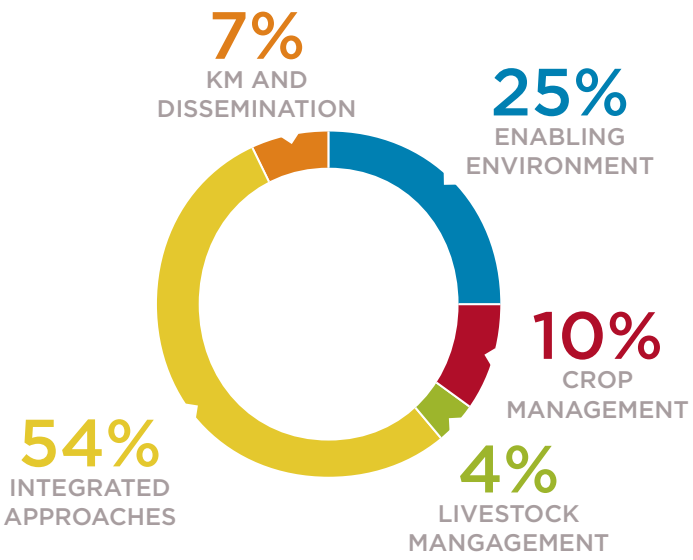
- **ENABLING ENVIRONMENT FOR CC-A AT ALL LEVELS,** including development of policies and regulatory frameworks based on sound climate risk information,

ensuring budget allocations in appropriate sectors to support adaptation measures and training and capacity building along with provision of extension services to implement concrete adaptation activities.

- **BEST PRACTICES FOR RESILIENCE IN CROP PRODUCTION SYSTEMS**, including demonstration and diffusion of resilient crop varieties, improvement in land and water management and improvements in post-harvest processes as a response to specific climate change vulnerabilities.
- **BEST PRACTICES FOR RESILIENCE IN LIVESTOCK PRODUCTION SYSTEMS,** including demonstration and diffusion of feed and forage management, as well as grazing improvement in response to specific vulnerabilities to climate change.
- **INTEGRATED APPROACHES FOR RESILIENCE OF AGRO-ECOSYSTEMS AND LIVELIHOODS,** including management of natural ecosystems and agro-ecosystems for generation of adaptation benefits, as well as livelihood diversification to enhance climate change resilience.
- **FINANCIAL SCHEMES TO SUPPORT RESILIENT AGRICULTURAL PRACTICES,**[21] including financial services for transferring risks and scaling-up proven, climate-resilient practices and technologies; weather-index based insurance; and micro-finance services to support implementation of new climate-resilient practices.
- **KNOWLEDGE MANAGEMENT AND DISSEMINATION,** including synthesis of lessons learned through direct investments to build climate-change resilience in the agriculture sector and establishment of platforms for dissemination of such information.

The breakdown of LDCF and SCCF funding for these intervention areas across all projects is presented in Table 9, with proportions shown in Figure 5. It shows highest investments through both the funds toward integrated approaches followed by an enabling environment to support food security and resilience in agriculture sector. LDCF provides significantly higher investments targeted solely at crop management than the SCCF. This highlights the urgent and immediate priorities of the LDCs to manage their production landscape

FIGURE 5 Proportional Use of Climate Change Adaptation Financing in Interventions to Support Food Security



[21] This intervention area was not a major target for investment before Dec. 2011, and therefore not included in the assessment. It is, however, included in the typology because of growing evidence in recent projects.

and associated water resources to ensure food production; most populations in these countries rely directly on subsistence agriculture. Developing countries lack capacity at institutional, policy and technical levels to appreciate the climate risks and suitable mechanisms to integrate them into planning and operations at national and local levels. Significant funding through LDCF and SCCF is targeted towards creating an enabling environment to build and maintain such capacity.

Agricultural production depends on the health of surrounding natural ecosystems, while climate resilience of smallholder and subsistence farmers is closely tied to their ability to diversify livelihoods beyond farm or forest production. Hence, the highest proportion of LDCF and SCCF investment has been directed toward integrated approaches for resilience of agro-ecosystems and livelihoods. This approach enables the promotion of production landscapes management conducive to the health of the entire ecosystem. It also includes establishment of on- and off-farm activities that generate income beyond the main household agricultural activities at risk due to climate change. It is therefore not surprising that more than half (54%) of total LDCF- and SCCF-financing in agriculture and food security (US$75.2 million) is invested in integrated approaches. The interventions specifically target community-driven initiatives to enhance livelihood and coping strategies, development/piloting of resilient adaptation systems and natural resources management.

Interventions to create enabling environments for adaptation accounted for US$34.3 million. The investments cover developing institutional capacity building to recognize the risks posed by climate change in agriculture-related sectors and to identify policy, strategy and investment solutions to reduce such risks. Such capacity building ensures that necessary budgetary allocations are made at national and sub-national levels to recognize and address climate risks in production landscapes. The investments in this category also cover development of early warning systems and hydro-meteorological databases to inform communities of the risks and influence their behavior (e.g. Box 16). These enabling activities are essential for mainstreaming climate risks and relevant adaptation measures in national, local and regional processes to maximize benefits for adaptation related to food security in both the short- and long-term.

Implementation of adaptation measures in developing countries is a fairly new initiative. Lessons learned from LDCF and SCCF investments in the agriculture and food security sector will be of great value in replicating adaptation measures in different regions of the same country and in other countries facing similar challenges.

TABLE 9 LDCF and SCCF Financing (in US$) by Type of Project Interventions

(Note: LDCF = 28 Projects; SCCF = 17 Projects)

	ENABLING ENVIRONMENT	CROP MANAGEMENT	LIVESTOCK MANAGEMENT	INTEGRATED APPROACHES	KM AND DISSEMINATION	TOTAL
LDCF	20,512,824	12,728,463	3,731,600	43,592,621	6,934,206	**87,499,714**
SCCF	13,808,244	1,684,700	*1,180,000*	*31,676,765*	*2,270,000*	**50,619,709**
TOTAL	**34,321,068**	**14,413,163**	**4,911,600**	**75,269,386**	**9,204,206**	**138,119,423**

BOX 16

Regional (Andes): Piloting climate change adaptation measures in the Andean region

Millions of people throughout the Andes region depend on the glacial runoff for their daily fresh water needs. Andean glaciers are already receding rapidly and projections show this will continue. This disruption in the hydrological cycle is bound to strain access to fresh water in the region, threatening agriculture, hydropower generation and public health. The GEF has financed, through the Special Climate Change Fund, a project that will meet the anticipated consequences of the catastrophic glacier retreat induced by climate change.

The project's activities include the updating of local and national water management policies; plans to address the long-term impacts of climate change and receding glaciers on water availability; and concrete adaptation pilots to demonstrate how climate change impacts can be integrated into practical development activities across the Andes. The project will fund installation of eight monitoring stations at the glacier basins of Peru, Ecuador and Bolivia to monitor the state of glaciers and their impacts on the hydrological cycle in the region.

The meteorological and hydrological information generated will be used to plan and design adaptation measures, especially with respect to the use and management of water resources. Pilot adaptation measures for this sub-basin include soil restoration in the Andean highlands, climate-resilient irrigation techniques, alternative crops and best practices in agriculture, improved water-use efficiency in urban areas and the prevention of landslides and flash floods due to accelerated glacier melting induced by climate change. A pilot in Peru specifically targets agricultural production planning. It includes measures such as testing and promoting crops that are less water-demanding; demonstrating more water-efficient land and water management practices; and promoting export of new and more drought-resistant crops.

An amount of US$9.2 million was invested in providing technical guidance on understanding climate risks and possible adaptation measures in agriculture, documenting effective policy lessons and on-ground investments and dissemination of such best practices for further replication and scaling up.

In summary, this section has elucidated the important role of GEF financing in agriculture and food security projects for generating multiple global environment and adaptation benefits. The approach to GEF financing emphasizes targeted investments in projects that address objectives of the GEF focal areas, including support to countries for implementation of the Conventions. The value-added of GEF financing is evident from the diversity of interventions in projects, and the potential for sustainability of outcomes for people and the global environment.

6.

GLOBAL ENVIRONMENT and Adaptation BENEFITS

In the context of fulfilling its mandate as financial mechanism of the Rio Conventions, the GEF is playing an invaluable role in supporting eligible countries to build sustainability and resilience into agriculture and food security investments. A major result from this assessment is that GEF financing reflects consistency between priorities of the different funding windows and the global aspirations for environmental sustainability and resilience in production systems.

> " SAFEGUARDING ECOSYSTEM SERVICES AND BUILDING RESILIENCE IN PRODUCTION SYSTEMS IS THEREFORE A PRIORITY FOR DEVELOPING COUNTRIES..."

Managing land, water and biodiversity in an integrated manner is key to ensuring sustainable flow of ecosystem services that underpin agriculture and food security needs in a changing climate. This section highlights the multiple benefits that can be derived from the GEF approach to financing global environmental and adaptation benefits, and the need to further enhance the GEF's role in promoting sustainability and resilience in the sectors.

Global Environment Benefits

The agriculture, livestock and fisheries sectors are major sources of anthropogenic stressors on the natural environment. The progressive deterioration of existing crop and rangelands, and of freshwater and marine systems, undermines food security for millions of poor people around the world. Safeguarding ecosystem services and building resilience in production systems is therefore a priority for developing countries where a significant proportion of the population depends on agricultural, livestock and fisheries management. GEF investments under the different focal areas create opportunities for developing countries to leverage global environment benefits in the context of agriculture and food security investments. A wide range of global environment benefits is possible based on the nature of GEF investment, with links to priorities of focal areas through which the financing is allocated (see Table 10).

Sustaining Ecosystem Services Flows in Production Landscapes

The GEF plays an important role in sustaining flows of ecosystem services that underpin productivity of agricultural and rangeland systems. As shown in this assessment, GEF support toward production systems is largely through sustainable land management (SLM) investments that seek to combat **land degradation**. Through the end of GEF–4, it is estimated that GEF financing has contributed to promoting SLM practice in at least 20 million hectares of production landscapes.[22] An even greater coverage has been achieved through integrated ecosystem management, which facilitates SLM across wider landscapes for biodiversity conservation and climate change mitigation.

GEF investment in SLM fosters a diversified portfolio of interventions from farm-level to wider landscapes, with a focus on maintaining or improving the productivity

[22] Estimate is based on LD portfolio synthesis in the 2010 GEF Annual Monitoring Report available at http://www.thegef.org/gef/sites/thegef.org/files/documents/C.40.04-AMR2010_updatedAug11.pdf.

BOX 17

Eritrea: Boosting agricultural production through integrated approaches in the Central Highland Zone

Natural resources are central to the livelihoods of the Eritrean population in general and critical in the Central Highland Ecological Zone, where 65% of the total population lives. The main causes of land degradation in the Central Highland Zone (CHZ) of Eritrea are inappropriate agricultural practices, unsustainable use of woodlots and natural forests, inherently poorly developed soils, insecure land-tenure systems that discourage investment in sustainable practices, poorly coordinated land use planning and limited application of knowledge and technologies by farmers to enhance productivity. To tackle these challenges, the UNDP/GEF *Pilot Sustainable Land Management (SLM)* project is creating an SLM enabling environment, hinging its strategies both at upstream (policy) and at community levels. In line with the 1994 Land Proclamation, barely put into practice, the project is testing implementation of the decrees on the shift from the seven-year rotational temporary land-ownership system to a usufruct-based system with permanent possession by farmers. This new scheme of land ownership incentivizes farmers to make long-term investment on agricultural and individual forest plots to combat land degradation.

In refurbishing the unsustainable agricultural practices, the project launched the concept of a village-based land use system to ensure land is used for its best economic and ecosystem services. Over the hilly and complex landscape of the CHZ, the project is promoting the principles of conservation agriculture, whereby intensive soil and water conservation and re/afforestation programs minimize land degradation and soil erosion. In sequel, through active community participation, 470 km of hill side and 300 m^3 of check dam have been constructed; aided by machinery works, 22.5 ha of land have been leveled for irrigation. In addition, 255,938 indigenous trees have been planted. The mosaic of different but integrated interventions is expected to boost agricultural production, strengthening communities and livelihoods.

The Eritrea Pilot SLM project is one of 37 financed by the GEF through the "*Strategic Investment Program for Sustainable Land Management in sub-Saharan Africa*" under the TerrAfrica partnership, and whose activities are integrated into the action program of the New Partnership for Africa's Development (NEPAD). At least 25 countries are involved in the program overall, with projects covering a wide range of ecologies and agro-ecosystems across sub-Saharan Africa.

of drylands, rain-fed and irrigated systems. Interventions such as crop diversification, crop rotation, conservation agriculture, agroforestry and small-scale irrigation schemes, as well as water harvesting and water-saving techniques, are helping farmers in many developing countries to secure fragile production lands from further deterioration (e.g. Box 17). As a result, potential gains in soil health and quality will enable sustained productivity of farm lands, while maximizing ecosystem service flows. Furthermore, arresting soil erosion and siltation in the production landscapes will also reduce the risk of sedimentation in aquatic systems.

TABLE 10 Potential Global Environmental and Adaptation Benefits from Leveraging Investments in Agriculture and Food Security

INVESTMENT CATEGORY	TYPOLOGY OF INTERVENTIONS FOR PROJECT SUPPORT	EXAMPLES OF GEBS / ADAPTATION BENEFITS	GEF FOCAL AREA(S)
Management of Agricultural Biodiversity	• Collection and conservation of germplasm, knowledge management and awareness-raising • Practices and technologies for optimal use of crop genetic diversity • Development of policies at national and regional levels • Institutional development at national, regional levels and community levels • Methods to improve productivity • Improve agricultural marketing services as incentives for conservation • Extension, demonstration and training activities for scaling-up	• Conservation of indigenous and adaptive crop genetic resources • Maintenance of pollinators and "biocontrol" species on farms • Preservation of indigenous knowledge, practices and production systems • Diversification of crops on farms and in existing production systems • Maintenance and improvement of soil health and quality (i.e. below-ground biodiversity) • Increased vegetative cover and soil carbon in production landscapes • Reduced demand for clearance of natural habitats (deforestation)	BD LD CC-A
Sustainable Land Management in Crop and Rangelands	• Knowledge base on SLM best practices in agricultural lands • Micro-irrigation, and soil and water conservation • Institutional capacity development for sustainable land management • Innovations to reverse land degradation and restore degraded lands • Institutional finance for land management • Community-based land management • Ecosystem and pasture management	• Diversification of farms and existing production systems • Maintenance and improvement of soil health • Sustained flow of water resources for irrigation • Increased tree and vegetative cover in crop lands • Increased soil carbon sequestration • Reduced erosion and siltation risks in water bodies • Preservation of indigenous knowledge and practices • Sustainability of grazing lands and pasture systems	LD IW CCA CC-M
Sustainable Fisheries and Water Resources Management	• Fisheries management • Integrated water resource management in lake basins • Integrated coastal management • Large marine ecosystem • Persistent toxic substances • Integrated water resource management in river basins • Integrated water resource management in aquifers • Learning and capacity building	• Conservation and maintenance of fish diversity • Sustainability of fish stocks and reduced risk of depletion • Improved quality and flow of freshwater • Reduced risk of siltation and pollution in freshwater bodies and coastal marine areas • Increased protection of aquifers and wetlands	IW BD CC-A

>

< CONT'D

TABLE 10 Potential Global Environmental and Adaptation Benefits from Leveraging Investments in Agriculture and Food Security

INVESTMENT CATEGORY	TYPOLOGY OF INTERVENTIONS FOR PROJECT SUPPORT	EXAMPLES OF GEBS / ADAPTATION BENEFITS	GEF FOCAL AREA(S)
Climate Change Adaptation for Food Security	• Institutional capacity development at national, local and district level for planning and management of climate change adaptation • Mainstreaming climate change adaptation in the agricultural sector • Knowledge management, codification of best practices for adaptation to climate change • Development of early warning systems, hydro-meteorological databases • Research development/piloting of resilient adaptation systems • Water resources management in agricultural sector • Community-driven initiatives to enhance livelihood and coping strategies • Demonstration and technical guidance, dissemination of knowledge on adaptation and food security	• Reduced vulnerability of crop and livestock production practices • Increased resilience of crop and livestock production systems and agro-ecologies • Maintenance of adaptive crop and livestock resources	CC-A

In most developing countries, SLM represents a major opportunity for *sustainable intensification* of existing farmlands through efficient management of nutrients (combining organic and inorganic sources of fertilizers), integrated management of land and water resources ("blue water" and "green water"[23]) and diversification of farming systems (combining crops, trees and livestock). This approach ensures improved management of agro-ecosystem services across production systems and reduces pressure on natural areas, especially those under threat from agricultural expansion. At the same time, it reduces the various externalities that arise from conventional approaches to intensifying production, such as the overuse of inorganic fertilizers and pesticides that lead to eutrophication and sedimentation of surface water bodies. This particular benefit of SLM is also relevant to the IW focal area, especially in geographies where the affected water bodies are transboundary in nature, and for which collaborative engagement by countries involved is crucial (e.g. Box 18).

[23] *Green water* and *blue water* are used to describe water use in non-irrigated (rain-fed) and irrigated agriculture, respectively.

BOX 18

Transboundary (Kagera River basin): Integrated management for food security and ecosystem services

The Kagera River basin is located in Eastern Africa and is shared by four countries: Burundi, Rwanda, United Republic of Tanzania and Uganda. The basin covers a surface area of 59,700 km^2 and occupies a strategic position, contributing to almost a fourth of the inflow into Lake Victoria. The tributaries of the Kagera River in Rwanda and Burundi are fed by the remotest upstream sources of the River Nile: maintenance of the Kagera flow regime is vital for water levels in Lake Victoria and outflow to the Nile. More than 16.5 million people live in the Kagera basin, the majority rural, depending directly on farming, herding and fishing activities. Land use includes a range of diverse production systems: extensive and intensive livestock systems; cropping systems — cereals associated with legumes and tubers; and mixed farming systems (agroforestry, crop-livestock, crop-fish and systems dominated by perennial crops — bananas, coffee and tea).

The FAO/GEF "*Transboundary Agro-ecosystem Management Project for the Kagera River Basin,*" approved by the GEF in June 2009, is a strategic response by the four countries to collaboratively tackle large-scale degradation of ecosystem services and associated effects on food security and livelihoods in fragile watersheds of the basin. Frequent and uncontrolled burning of vegetation on rangelands and cultivated land, and cultivation on marginal areas (steep slopes, fragile soils) contribute to the loss of protective vegetation cover and biodiversity. These processes lead to substantial runoff, which causes accelerated soil erosion and downstream sedimentation of water courses and lakes. The impacts of these processes include a loss of productive land and a significant reduction in productivity, as well as negative effects on the quality of water, the hydrological regime and recharge of the water table and, hence, on the amount of available water. As a result, food insecurity increases, as well as vulnerability to periods of drought and floods — aspects that are already heightened by climate change.

With a GEF grant of US$6.36 million and co-financing of more than US$21 million contributed by governments of all four countries, partner organizations in the basin and by FAO, the project will promote an integrated ecosystems approach for management of land resources in the Kagera basin that will generate local, national and global benefits. The project approach will facilitate planning and policy processes at basin level, while promoting adoption of improved land use systems and management practices that generate improved livelihoods and ecosystem services. Sustainable management of shared land and ecosystems of the Kagera basin and revitalized farm-livelihood systems will generate significant environmental benefits through restoration of well-functioning ecosystems and maintenance of their goods and services. In the context of addressing increased food security and improved rural livelihoods, the project will deliver important environmental benefits such as carbon sequestration, protection of international waters, agrobiodiversity conservation and sustainable use.

The Kagera Basin project is one of 37 financed by the GEF through the "*Strategic Investment Program for Sustainable Land Management in sub-Saharan Africa*" under the TerrAfrica partnership, and whose activities are integrated into the action program of the New Partnership for Africa's Development (NEPAD). At least 25 countries are involved in the program overall, with projects covering a wide range of ecologies and agro-ecosystems across sub-Saharan Africa.

> " **SLM INTERVENTIONS** THAT IMPROVE SOIL AND LAND QUALITY ALSO **CONTRIBUTE TO INCREASING SOIL ORGANIC CARBON**, AS WELL AS ABOVE-GROUND BIOMASS ACCUMULATION. "

GEF financing also helps to improve and sustain the economic productivity, as well as environmental sustainability, of rangeland and agro-pastoral systems. Specifically, GEF financing targets SLM priorities such as improved grazing management and livestock fodder alternatives, as part of investments to enable livestock producers to maintain sustainable livelihoods through effective planning; animal selection, nutrition and reproduction; and herd health. The GEF also supports interventions that safeguard rangelands from risk of degradation, through actions such as reducing water and wind erosion, resolving wildlife–livestock–crop conflicts and creating fodder-banks. While the types of interventions are influenced by the context, the ecosystem service benefits are consistent with respect to keeping the rangelands productive and healthy.

A major global environment benefit of SLM is the potential for reducing greenhouse gas (GHG) emissions and increasing carbon sequestration in agricultural and rangeland systems, as a contribution to climate change mitigation. SLM interventions that improve soil and land quality also contribute to increasing soil organic carbon, as well as above-ground biomass accumulation. For most developing countries, the synergy between climate change mitigation and food security is best manifested in projects that demonstrate these multiple environmental benefits. However, while increase in soil carbon is a useful indicator of SLM achievements, the value-added for climate change mitigation is likely to vary considerably depending on type of agro-ecosystem and production practices. Therefore, climate change mitigation through SLM will likely impose trade-offs for food security and livelihoods. This implies that emphasis on GHG emissions and carbon sequestration as global environment benefit from SLM may not always be appropriate for projects targeting food security.

Agrobiodiversity — Preserving the Global Heritage

The assessment has shown that GEF financing plays an important role in safeguarding the genetic diversity of major food crops around the world, including fruits and vegetables that are important sources of nutrition in developing countries. This is achieved through projects that foster *in-situ* conservation of important crop genetic resources, livestock breeds, landraces and crop wild relatives; and through conservation and management of globally important agricultural heritage systems (e.g. Box 19). GEF investment in these projects ensures that the genetic resources and associated management practices are sustained for posterity, while future options for agriculture and food security are maintained.

Important food crops benefiting from GEF financing include rice in Asia (China, Philippines and Vietnam), date palms in the Maghreb, coffee in Ethiopia, and potatoes in the Andes region.

Agrobiodiversity also embodies the range of supporting functions associated with management of pests, diseases, and pollination in production systems. GEF financing helps in development of "diversity rich" solutions to manage pest and disease pressures for small and marginal farmers around the world.

Maintaining local crop genetic diversity on-farm not only contributes to sustainable production and farmers' livelihoods, but also reduces the uses of pesticides. The use of genetic diversity can also be applied as part of Integrated Pest Management (IPM) — an ecosystem-based approach to preventing and controlling pest damage that combines techniques such as biological control and habitat manipulation. GEF financing has also helped to value pollination as an important service in agro-ecosystems, thereby contributing to the conservation and sustainable use of pollinators globally.

A third aspect of agrobiodiversity is the important attribute of soils in production landscapes, where the living components (e.g. microbes, mycorrhizal fungi, earthworms) play important supporting functions, such as decomposition of organic matter, nutrient cycling and disease control. By investing in knowledge and tools for conservation and management of below-ground biodiversity, the GEF is helping improve and maintain healthy soils for crop and livestock

BOX 19

Regional (Maghreb): Conservation and adaptive management of agricultural heritage systems

The oases of the Maghreb region are green islands flourishing in a constraining and harsh environment. They are home to a diversified and highly intensive and productive oases system, which has been developed over millennia. Old but sophisticated irrigation architectures, supported through customary local resource-management institutions, ensure a fair water distribution and constitute a crucial element of the oases systems. Agricultural products from the oases systems provide an important source of nutrition and income for its inhabitants; they are the primary or secondary source of livelihood for many. However, oases systems are threatened by the depletion of aquifers through modern irrigation structures, the disruption of customary institutions for managing water systems and associated ruptures in transfer of specialized traditional knowledge.

Through the FAO/GEF project on *Conservation and Adaptive Management of Globally Important Agricultural Heritage Systems (GIAHS),* a multi-stakeholder participatory process was used to identify and assess needs, aspirations and priorities of the oases communities in Algeria and Tunisia. The project also helped the oases communities to identify, safeguard and add economic value to the oases' agricultural biodiversity. Training of farmers, youth and women from Gafsa (Tunisia) and El Oued (Algeria) is being conducted regularly. At the same time, local actors (farmers, women, civil societies, youth) are more engaged in agricultural activities. Various media are increasing awareness of the importance of agricultural patrimony. The project has helped local communities identify and adopt policies and strategies to safeguard the cultural patrimony of oases in Gafsa and El Oued. Agricultural practices and local institutions that maintain diversity in the oases are also revitalized.

BOX 20

Senegal: Community-driven fisheries conservation

The coastline of Senegal is home to some of the richest fishing grounds in the world. Fishing and associated activities such as processing, marketing, services and other part-time activities together are estimated to provide more than 600,000 jobs in Senegal, which equals approximately 17% of the labor force and 10% of the total rural population. In addition to livelihoods, the fisheries in Senegal make an extremely significant contribution to food security, constituting some 70% of animal protein consumption in the country: estimated annual per capita fish consumption is 26 kg (well above the world average of 16 kg). The World Bank/GEF *Sustainable Management of Fish Resources* project empowered communities to reduce fishing pressure on the fish stocks supporting the central coastal fisheries of Senegal, from the Cap Vert Peninsula south to the Saloum River Delta.

With GEF financing, a sustainable supply of fish in Senegal's waters was achieved through a number of measures implemented by well-organized community fishing groups. The project helped the communities establish no-fishing zones, erect artificial reefs and support monitoring with boats and equipment. As a result, fish catches are now more sustainable. The community of Ngaparou, which lies just south of Dakar (Senegal's capital), is now so well organized that it exports part of its catch to markets in Europe. Not only has the project been successful at increasing the availability of fish to feed Senegal's population, it has also been an economic boon to many coastal fishing communities.

productivity. This enables land users to harness the services provided by the soil organisms as natural assets, while contributing to their preservation.

Safeguarding the Aquatic Commons

Sustaining hydrological services is a growing challenge in the agriculture and food security sector, and for which GEF financing has been leveraged to target specific agro-ecosystems around the world. To date, 22 transboundary river basins, eight lake basins, five groundwater systems and 16 large marine ecosystems, have benefited from GEF financing; this has led to development of regional treaties, protocols and agreements for sustainable management of the resources.[24] Strategic action plans emerging from intergovernmental cooperation include targeted interventions to ensure long-term availability and flow of freshwater, and fisheries resources for consumptive use by the countries. GEF financing is contributing to implementation of action plans for major lake and river basins such as Lake Victoria, which is a lifeline for over 30 million people.

The agriculture and food security linkages of integrated water resources management are mainly demonstrated through projects focusing on fisheries management, irrigation flow and control of nutrient pollution. GEF financing for collaborative fisheries management by governments helps improve the health of fish stocks, protect breeding zones for fish species and support development of policies and institutional frameworks to tackle the economic drivers of overfishing (e.g. Box 20). In coastal areas, the GEF targets projects that advance ecosystem-based approaches to balance the demand for fish resources with the need for species and habitat conservation.

[24] Source: From Ridge to Reef: Water, Environment, and Community Security. GEF Action on Transboundary Water Resources. Global Environment Facility, Washington, DC.

Safeguarding water in irrigated systems is key to ensuring long-term sustainability of food production. GEF financing specifically advances Integrated Water Resource Management (IWRM), which combines innovative technologies for irrigation with options and incentives to reduce demand for water in agricultural systems. This approach ensures the needs of farmers are met, while reducing waste of scarce water resources. GEF financing for IWRM also plays a major role in tackling nutrient pollution from excessive use of chemical fertilizers in irrigated systems. Nitrogen pollution is an emerging global problem because of its link to coastal "dead zones" resulting from poor management of irrigated lands and floodplains. GEF investment in the Danube River basin is a model of regional cooperation for water quality improvement based on achievements in controlling nutrient pollution through IWRM.

Adaptation and Resilience Benefits

Guided by the UNFCCC mandate and aligned with country priorities, LDCF and SCCF financing targets climate change effects that threaten livelihoods and development in developing countries. As demonstrated by a number of studies, as well as priorities stated in the National Adaptation Plans of Action (NAPA), risks to food security is one of the most urgent climate change effects. Climate vulnerabilities related to food security will also influence national economies and the stability of critical agro-ecosystems. GEF investments in adaptation help developing countries deal with a myriad of challenges related to climate change and variability. The emphasis is on increasing adaptive capacity of farmers and enhancing resilience of production systems.

The first step towards making agriculture and food production resilient to climate change is creation of awareness among farmers and policymakers of climate variability and projected changes. The second step is to understand the inadequacy of business-as-usual agriculture practices and policies in maintaining food security. Third is to use the available climate information to design agricultural systems that are resilient to climate variability and change. In almost all projects, LDCF financing supports integration of assessed climate risks into agriculture-related policies at all levels and practices. This helps improve the existing decision-making schemes at national to local levels, and to alter farm and crop management according to the expected changes.

Projects have introduced use of drought-resilient crop varieties and supported farmers with appropriate extension services that provide help with the new techniques. In water-scarce areas, climate change adaptation funds have provided infrastructure and training for infield rainwater harvesting; medium-range

BOX 21

Niger: Building resilience and adaptive capacity in the agriculture sector

In Niger, population is heavily dependent on rain-fed agriculture and pastoralism for survival. The projected increase in temperature and decrease in rainfall will add strain on the communities whose livelihoods are so closely tied to climatic factors. The UNDP/GEF project on *Implementing NAPA Priority Interventions to Build Resilience and Adaptive Capacity of the Agriculture Sector to Climate Change* used LDFC resources to address this challenge. The project adheres to NAPA priorities of Niger, focusing specifically on building climate-change resilience in the agricultural sector of the country.

Prior to the project, farmers in target areas had limited knowledge of climate change. They did not have access to information that could help them make appropriate decisions to reduce their losses due to climate change. The project supports training to fill this capacity gap. It also provides extension services for distribution of seasonal weather forecasts and local advice on the design of water and crop management strategies. In addition, the project supports the incorporation of adaptation to climate change issues into provincial and local development and risk management plans.

In a drought-prone country like Niger, soil–water retention is of great importance for agricultural productivity. With the project's financial and technical support, farmers are practicing improved soil management methods such as construction of *zaï* pits. *Zaï* pits, which are essentially holes of approximately 0.5 m filled with manure and topsoil, provide greater water retention capacity and also have higher soil nutrient content. The farmers participating in the project planted millet, sorghum and maize in the *zaï* holes; they observed increased productivity relative to plants sown outside of the *zaïs*.

weather forecast systems have been developed to deal with uncertain rainfall. In Sudan, through the LDCF grant, wells were dug to sustainably provide groundwater for irrigation and household activities.

Safeguarding soil quality is key to maintaining agricultural productivity; a number of projects employ soil management practices known to limit additional risks that climate change may pose. Certain practices have been known to maintain soil quality. These include planting seedlings to prevent further erosion in Sudan and promoting indigenous micro-catchment techniques like *zaï* pits and semi-circular bunds to retain soil moisture in Burkina Faso and Niger (Box 21).

LDCF employs an integrated approach to natural resource management in addressing food security risks posed by climate change. In Bangladesh, for example, LDCF financing is helping diversify livelihoods and create project ownership by promoting small-scale aquaculture and fruit farms among the mangroves protected and rehabilitated for storm protection (Box 22). Beyond the smallholder farmers, sustainable management of natural resources could create new sources of employment and stable incomes for local communities. In the long term, such an investment in highly vulnerable regions like the Sahel will help reduce the risk of environmental conflict and contribute to improving overall security.

BOX 22

Bangladesh: Community-based adaptation to climate change through coastal afforestation

Bangladesh is one of the countries most vulnerable to the impacts of climate change. The country NAPA, and numerous other scientific-based assessments, clearly state sea-level rise and extreme events to be the most urgent threat due to climate change. Through the UNDP/GEF project on *Integrating Community-based Adaptation into Afforestation and Reforestation Programs in Bangladesh*, LDCF resources are helping the country tackle this challenging problem through improved management of natural resources.

The project will implement effective community-based adaptation measures in 19 coastal districts. Communities will be involved in planting a more genetically diverse mix of mangrove species that has higher regenerating abilities. To gain local support and ensure sustainability for the ongoing afforestation practices in the region, the communities have been involved in nursery management, as well as in planting seedlings. In addition, the LDCF project will train the communities in sustainable use of mangroves and integrate livelihood diversification methods such as fisheries, fruit farming and livestock rearing into the afforested areas. This will include a mound–ditch–type plantation of mangrove and palm species (serving predominantly protective functions) with interspersed fruit trees (Bau Kul, Apple and Guava) and aquaculture. The top surface of the mounds will provide an opportunity to grow vegetables and gourds, whereas aquaculture in the ditch will sustain fish production for local communities.

The integrated approach will ensure the coastal greenbelts, which protect the livelihood assets of communities, will be valued, maintained and managed in a participatory manner. By facilitating community ownership and by providing economic incentives for communities to nurture, protect and conserve newly planted greenbelt structures, the LDCF project is contributing towards sustainability of these natural buffers.

Climate change adaptation projects are engaging local communities in on-the-ground activities. In addition to creating project ownership, they are demonstrating that climate-informed management of natural resources represents a long-term strategy for safeguarding and improving livelihood options. Other development opportunities, such as community-based ecotourism, alternative livelihood options, expansion of suitable insurance schemes for the agriculture sector and payment for ecosystem services, can protect investments in uncertain climate conditions. In some regions, they also offer new and sustainable sources of income for local communities.

The success of these opportunities depends on the design of incentive mechanisms that facilitate implementation of integrated land, water and forest management practices with full understanding of ecosystem flows and food production. Harnessing these options will also require certain conditions to ensure empowerment, equity (including gender) and rights of the communities. For this to be achieved, the programs will consider tools and mechanisms to empower communities hobbled by high illiteracy rates (which are often higher for women). The projects funded through LDCF and SCCF pay special attention to gender; progress is tracked through gender-disaggregated indicators.

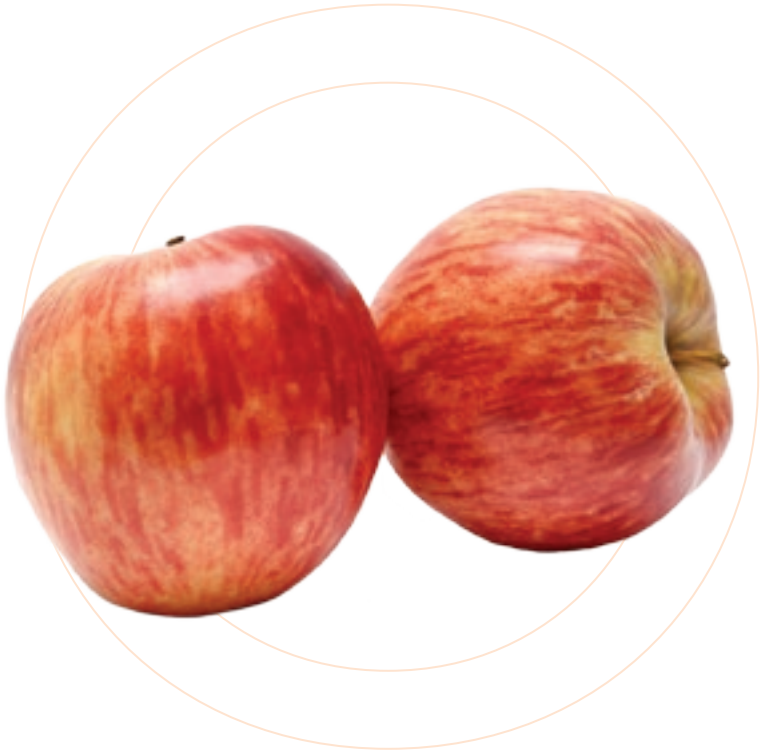
The different needs, responsibilities and interests of women and men should continue to be considered in efforts of building climate resilience in production landscapes.

> " ...CLIMATE-INFORMED **MANAGEMENT OF NATURAL RESOURCES REPRESENTS A LONG-TERM STRATEGY** FOR SAFEGUARDING AND IMPROVING LIVELIHOOD OPTIONS. "

The Challenge of Managing Trade-offs and Synergies

This assessment demonstrates a strong link between the GEF mandate for investing in global environment benefits and global aspirations for achieving agricultural sustainability and food security. It shows the GEF is directing significant amounts of resources to this development priority through its focal areas, addressing the potential for harnessing and sustaining ecosystem services in production systems. But the diversity of approaches inherent in GEF projects do sometimes present challenges for sustainability of the ecosystem services due to trade-offs. The GEF therefore seeks to maximize synergies in its projects, while emphasizing the need to manage trade-offs between environment and development goals.

For projects in the terrestrial realm, a major challenge lies with integration of land use practices to enhance sustainable flow of ecosystem services. Integrated approaches must create opportunities to improve crop and livestock productivity for food security and livelihoods of the target beneficiaries. Synergies are possible where the proposed interventions are appropriate and adequate to meet the needs of land users.[25] For example, the use of tree-based practices such as agroforestry for improving soil fertility can lead to higher crop yields, while contributing to carbon sequestration and increasing resilience in the production system. But synergy can only be achieved if the practice is appropriately targeted and, at the same time, embraced by land users.



Trade-offs are sometimes inevitable when sustainable land management (SLM) practices are implemented to generate ecosystem service benefits at scale. Because of the diversity of practices available to land users and the dynamic nature of production landscapes, informed choices must be made on options that will minimize trade-offs in land, water and biomass production. In some cases, SLM outcomes that generate ecosystem service benefits can also create new stressors in the production systems (Table 11).

[25] See: Palm, C.A. et al. (2010). Identifying potential synergies and trade-offs for meeting food security and climate change objectives in sub-Saharan Africa. *Proceedings of the National Academy of Sciences,107(46):19661-19666*

TABLE 11 Examples of Potential Trade-offs from Implementation of SLM in Production Systems

PRODUCTION SYSTEM	SLM OUTCOME	POTENTIAL TRADE-OFF	IMPLICATION FOR PROJECT APPROACH
Rangelands	Increased vegetative cover and biodiversity in pastures and grazing areas	Increased livestock population creates new pressures on natural habitats	Establish livestock thresholds and carrying capacity or create fodder alternatives
Agriculture	Improved small-scale irrigation for crop production	Expansion of crop production increases risk of water resources depletion	Integrate management options for improving hydrological flows in the landscape
Forest Landscapes	Increased tree and forest cover	Shifting of crop production creates new pressures on natural habitats	Enhance shift toward high- value tree crops in the production landscape

GEF financing ensures that projects are designed to accommodate these challenges, including the application of decision-support tools that balance the interests of multiple stakeholders. The UNEP/GEF global project on *Alternatives to Slash-and-Burn* (ASB) developed such a tool to help address greenhouse gas emissions due to deforestation in the tropical forest margins.[26] The *ASB Matrix*, which was developed from project activities, has now emerged as an important flagship tool for trade-off analysis in SLM at the agriculture–forestry interface.[27]

Synergies and trade-offs are also typical of GEF projects in aquatic systems, especially in relation to irrigation and fisheries management. Fortunately, the IW approach emphasizes the integrated management of water resources, including policy and institutional frameworks to facilitate effective governance at scale. This approach ensures that informed choices are made to enhance sustainability of the ecosystem services and simultaneously reduce the stressors. Groundwater depletion through excessive withdrawal for agriculture increasingly demands specific focus for integrated management. The focal area also invests in a "learning platform" to facilitate knowledge sharing and exchange among stakeholders.[28]

An important approach to managing trade-offs in GEF projects is the use of financial and incentive mechanisms for land users. A common example linked to agriculture and food security projects is payments for ecosystem services (PES), a mechanism that "compensates land users for off-site ecological benefits associated with biodiversity conservation land-use practices."[29] The World Bank/GEF multi-focal *Integrated Silvopastoral Approaches to Ecosystem Management* regional project implemented in Colombia, Costa Rica and Nicaragua, used the PES approach to demonstrate potential for achieving sustainability and productivity of cattle ranching by smallholder farmers. Though implemented on a modest scale, the project resulted in some 12,000 hectares with improved biodiversity and carbon sequestration, with measurable impacts on livelihood of farmers. This has led to the design of additional projects for strengthening sustainable ranching in the region.

[26] See: Palm, C.A. et al. (eds.) 2005. *Slash-and-Burn Agriculture: The Search for Alternatives.* Columbia University Press, New York.
[27] See: World Bank, 2006. *Sustainable Land Management: Challenges, Opportunities and Trade-offs.* The International Bank for Reconstruction and Development/ The World Bank, Washington, DC.
[28] See www.iwlearn.net
[29] GEF 2010. Payments for Ecosystem Services. Global Environment Facility, Washington, DC. See also: Wunder, S. et al. 2010. Payments for Environmental Services and the Global Environment Facility: A STAP Advisory Document.

7

Strengthening the GEF's Role in

SUSTAINABLE AGRICULTURE and FOOD SECURITY

The GEF role as financial mechanism of the Conventions will continue to gain importance as all developing countries seek to address environment and development goals in an integrated manner. Consequently, potential increases in development financing for agriculture and food security will create new opportunities for the GEF to target global environment and adaptation benefits in production systems.

This assessment has shed some light on how the GEF mandate directly supports global aspirations for environmental sustainability and resilience in the agriculture and food security sectors. This section provides additional justification for GEF positioning, including findings from Overall Performance Studies (OPS), current priorities of the Conventions and emerging opportunities in the environment–development nexus.

Learning from the GEF Overall Performance Studies

Most of the lessons and experiences with regard to GEF financing in production systems have also been consistently highlighted in the Overall Performance Studies (OPS) of the GEF. These are independently conducted, state-of-the-art and authoritative reviews of the GEF Replenishment Phases. Four OPS reviews have been conducted to date, providing very insightful knowledge on GEF operations, including lessons from focal area activities. The Pilot Phase (1991–1994), which was conducted as an independent evaluation, highlighted some early achievements of projects related to agriculture and food security.

Two projects, the World Bank/GEF project on *In-Situ Conservation of Genetic Biodiversity* in Turkey and the UNDP/GEF Project on *A Dynamic Farmer-based Approach to the*

> " ...THE GEF ALSO TAKES NOTE OF **EMERGING DEVELOPMENT PRIORITIES AS DRIVEN BY DEMANDS OF THE CHANGING GLOBAL ENVIRONMENT**, INCLUDING THE CHALLENGE OF FEEDING AN EVER-GROWING POPULATION. "

Conservation of African Plant Resources in Ethiopia were cited as good examples of projects with global benefits.[30]

The Second OPS (OPS2) provided many more examples of projects that were important entry points for GEF support to the agriculture and food security sector. These included highlights of relevant focal area achievements based on the GEF Operational Programs.[31] The Operational Program on *Integrated Ecosystem Management (OP12)* and *on Conservation and Sustainable Use of Biological Diversity Important to Agriculture (OP13)* paved the way for countries to design innovative projects for safeguarding ecosystem services in production systems. OP12 was the GEF window for SLM projects prior to designation of the dedicated Land Degradation focal area, while OP13 enabled GEF financing for crop and livestock genetic resources. OPS2 noted that GEF projects contributed to prevention and reduction of land degradation by arresting the loss of woody vegetation, deforestation and unsustainable fuel wood use; managing overharvesting of flora and fauna; and reversing habitat conversion from cropping and pasture expansion and urban development.

The Third OPS (OPS3) highlighted achievements with agrobiodiversity through projects specifically designed to support the conservation and sustainable use of biodiversity important to agriculture (OP13).[32] It was reported that 13% of assessed projects directly addressed issues related to agrobiodiversity, and involved agricultural landscapes, farmers and traditional agricultural practices. The UNEP/GEF regional project on *Community-Based Management of On-Farm Plant Genetic Resources in Arid and Semi-Arid Areas of Sub-Saharan Africa* was cited as having achieved innovative results in indigenous crop conservation by increasing knowledge and understanding of the value of indigenous crops among farmers, identifying the types of policies required at all levels for conservation and establishing the basis for replication beyond the scope of the project.

Although the Fourth OPS (OPS4) did not offer detailed highlights of specific project achievements, agriculture and food security were considered as important aspects of the global context for GEF investments under the different focal area mandates and strategies.[33] In particular, OPS4 noted the critical role of the IW focal area in addressing cross-border challenges, such as land-based sources of water pollution, loss of critical habitats and biodiversity, overuse and conflicting uses of surface and groundwater, integrated water resource management, overharvesting of fisheries and adaptation to climatic fluctuations. In addition to their cross-cutting nature and overlap with other focal areas, these challenges are at the heart of the GEF's role in tackling food insecurity.

Alignment with Convention Strategies

As financial mechanism of major environmental Conventions, the GEF develops its focal area strategies largely in response to guidance from the relevant Conference of the Parties (COP). In addition, the GEF also takes note of emerging development priorities as driven by demands of the changing global environment, including the challenge of feeding an ever-growing population.

[30] World Bank 1994. Global Environment Facility: Independent Evaluation of the Pilot Phase. UNDP, UNEP, World Bank.
[31] GEF 2002. The First Decade of the GEF: Second Overall Performance Study (OPS2). Global Environment Facility, Washington DC.
[32] GEF 2005. Progressing Toward Environmental Results: Third Overall Performance Study (OPS3) of the Global Environment Facility. Office of Monitoring and Evaluation of the GEF, Washington DC
[33] GEF EO 2010. Fourth Overall Performance Study of the GEF (OPS4): Progress Toward Impact. GEF Evaluation Office Document No. 54, Washington, DC.

UN Convention on Combating Desertification (UNCCD)

The UNCCD text includes an explicit mention of links between desertification, drought and lack of food security as they relate to affected countries and regions. The Convention focuses primarily on the drylands, but its focus on combating land degradation through sustainable land management practices makes it relevant for all countries. During the Eight Conference of the Parties (COP8) in Madrid, Spain, the Parties adopted the "Strategy"— a strategic plan and framework of action for implementing the Convention between 2008 and 2018.[34] The Strategy aims to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in order to help reduce poverty and support environmental sustainability. Four strategic objectives with their own long-term impacts guide the actions of all UNCCD stakeholders and partners in seeking to achieve the global vision. Three of the strategic objectives have expected impacts that can be directly supported through GEF financing for projects in the agriculture and food security sector (Box 23).

Convention on Biological Diversity

The CBD also recognizes the critical importance of conservation and sustainable use of biological diversity for meeting the food, health and other needs of the growing world population. At its first meeting in 1994, the CBD COP decided to consider conservation and sustainable use of agricultural biodiversity, and

BOX 23

The UNCCD 10-Year Strategic Objectives (SOs) and Expected Impacts (EIs) with direct links to agriculture and food security

SO1 - To improve the living conditions of affected communities

- EI 1.1 People living in areas affected by desertification/land degradation and drought to have an improved and more diversified livelihood base and to benefit from income generated from sustainable land management
- EI 1.2 Affected populations' socioeconomic and environmental vulnerability to climate change, climate variability and drought is reduced

SO2 - To improve the conditions of affected ecosystems

- EI 2.1 Land productivity and other ecosystem goods and services in affected areas enhanced in a sustainable manner contributing to improved livelihoods
- EI 2.2 The vulnerability of affected ecosystems to climate change, climate variability and drought is reduced

SO3 - To generate global benefits through effective implementation of the UNCCD

- EI 3.1 Sustainable land management and combating desertification/land degradation contribute to conservation and sustainable use of biodiversity and mitigation of climate change

[34] http://www.unccd.int/Lists/OfficialDocuments/cop8/16add1eng.pdf

BOX 24

Aichi Biodiversity Targets with direct links to agriculture and food security

Target 6 - By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Target 7 - By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Target 8 - By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

Target 13 - By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socioeconomically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Target 18 - By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

subsequently established a multi-year program of work on agricultural biodiversity.[35] The program of work includes a focus on four cross-cutting initiatives that are important for food security: *pollinators; soil biodiversity; biodiversity for food and nutrition; and genetic use restriction technologies*. At COP10 in Nagoya, the Parties adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the period 2011–2020.[36] The Aichi Targets include several that are of direct relevance to agriculture and food security (Box 24), with potential for harnessing GEF financing to address them.

[35] http://www.cbd.int/agro/pow.shtml
[36] http://www.cbd.int/sp/targets/

The Sustainable Development Agenda: Rio+20 and Beyond

The outcomes of the recent United Nations Conference on Sustainable Development (Rio+20) include a focus on sustainable agriculture and food security as one of the thematic areas for action and follow-up.[37] The world leaders specifically reaffirmed the need "*to promote, enhance and support more sustainable agriculture, including crops, livestock, forestry, fisheries and aquaculture, that improves food security, eradicates hunger and is economically viable, while conserving land, water, plant and animal genetic resources, biodiversity and ecosystems and enhancing resilience to climate change and natural disasters.*" The potential for significant investment in the relevant sectors therefore remains strong, with a likely focus on a new Green Revolution agenda similar to that of the 1960s, which transformed Asian agriculture.

A focus on agricultural growth and food security has implications for management and sustainability of ecosystem services in production systems, including in the face of global climate change. In particular, the environmental costs of the Asian Green Revolution on ecosystem services such as depletion of groundwater for irrigation are likely to be repeated elsewhere unless prudent efforts are made to develop a holistic approach that harnesses and safeguards nature's assets. World leaders at Rio+20 also recognized "*the need to maintain natural ecological processes that support food production systems,*" and stressed "*the crucial role of healthy marine ecosystems, sustainable fisheries and sustainable aquaculture for food security and nutrition and in providing for the livelihoods of millions of people.*"

The GEF mandate as financial mechanism for global environment and adaptation benefits offers a unique opportunity to implement holistic approaches toward achieving sustainability and resilience in production systems. This is particularly critical for the natural resource focal areas — Land Degradation, Biodiversity and International Waters — but also for climate change mitigation and adaptation. The GEF has two decades of experience responding to a diversity of country demands on global environmental benefits in production systems. GEF partnership with many countries is already quite advanced in this regard, and offers strategic entry points for transformational impact in the agriculture and food security sector. However, much more remains to be done elsewhere across the developing world, especially in sub-Saharan Africa where the task remains daunting.

Although global commitments to agricultural development have potential to vastly improve land area under production through sustainable intensification, the risk of deforestation and habitat loss in fragile ecosystems is likely to increase in parts of the developing world. For example, the Savanna zone in Africa was described in a recent FAO/World Bank publication as the "sleeping giant" for commercial agriculture, with potential to transform the economy of many countries.[38] Yet, in addition to its spectacular ecology and rich biodiversity, the Savanna zone contains some of the world's largest stocks of below-ground carbon, estimated at over 200 gigatons. The global community cannot afford to predispose such a major source of potential carbon emissions to poor land use and natural resource management. In this context, the GEF mandate presents an opportunity for countries to pursue land uses that will deliver transformational impact at scale without degrading the multiple ecosystem services of such a globally valuable asset.

[37] http://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf
[38] FAO and World Bank 2009. *Awakening Africa's Sleeping Giant: Prospects for Commercial Agriculture in the Guinea Savannah Zone and Beyond.* Directions in Development – Agriculture and Rural Development. The World Bank, Washington, DC

Agriculture and Food Security in the Green Economy

For much of the developing world where rural poverty is pervasive, promoting a *Green Economy* in the agriculture sector means increasing farming yields and sustaining harvests without degrading the ecosystem services that underpin the production systems and practices. By investing in global environmental and adaptation benefits in production systems, the GEF is well placed as strategic partner to help advance the *Green Economy* agenda for agriculture and food security in developing countries. However, there is need for greater coherence, coordination and integration between agricultural development, food security and climate change policy processes at the national level.

While plans for agricultural development and food security are expressed in national development strategies and poverty reduction strategy papers (PRSPs), priorities of the Conventions are limited to national action plans: National Action Plans (NAPs) for Combating Desertification, National Biodiversity Action Plans (NBSAPs), National Action Plans for Adaptation (NAPAs), and the Nationally Appropriate Mitigation Actions (NAMAs). Creation of mechanisms that foster cross-sector dialogues between relevant agencies and institutions involved in these planning processes is fundamental for advancing the *Green Economy*. This will ensure a stronger alignment of development investments with environmental sustainability and climate change adaptation needs.

At the international level, better integration of financing for food security, agricultural development and climate change actions are needed. Sustainable transformation of the agriculture sector, necessitating combined action on food security, development and climate change will require large-scale investments to meet the projected costs. The extent to which agriculture could attract climate finance in future will depend on better recognition of its significant mitigation potential, its role as a driver of deforestation, the importance of its adaptation to climate change for food security and development and the feasibility and costs of implementing action and measuring results. This effort can be further enhanced by a robust replenishment of the GEF Trust Fund for financing global environment benefits, and the two adaptation funds (LDCF and SCCF) for investment in climate-resilient actions.

An emerging opportunity for integrating global environment and adaptation financing is through Climate-Smart Agriculture (CSA), defined as "*….agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals.*"[39] This assessment has demonstrated the potential for delivering the triple bottom-line of CSA in production landscapes — increased productivity, enhanced climate resilience and greenhouse mitigation. All that is required are country-driven policies that recognize the need for streamlining multiple environmental priorities at scale for long-term sustainability and resilience. In the drylands for example, water-efficient approaches and productive safety nets must be implemented alongside concrete actions that diversify income and improve livelihoods of farmers and pastoralists.

For communities dependent on fisheries for food security, the need to balance current demands with future needs is key to helping them benefit from a Green Economy in the sector. Securing healthy fish stocks through improved policies and practices will remain a global priority, for which the GEF is a strategic partner by providing financing under the International Waters focal area. In addition, GEF financing under the Biodiversity focal area can also support improved and effective management of marine protected areas (MPAs) in threatened ecosystems, such as coral reefs. In coastal areas, GEF support through the LDCF and SCCF also helps advance ecosystem-based approaches for adaptation, including options to diversify livelihoods of fisher communities.

[39] http://www.fao.org/climatechange/climatesmart/en/

CONCLUSION

The assessment has demonstrated that GEF financing to generate multiple global environment and adaptation benefits plays a vital role in supporting the agriculture and food security sector. The approach to GEF financing emphasizes targeted investments in projects that address objectives of the focal areas, including support to countries for implementation of the Conventions for which the GEF serves as financial mechanism. The value-added of GEF financing is evident from the diversity of interventions in projects, and the potential for sustainability of outcomes for people and the global environment. By aligning focal area priorities with global aspirations for sustainable intensification of production systems, the GEF is well-placed to help feed the world while investing in our planet.

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