

AgroEcosystem Action



Advancing landscape approaches to improve food security and rural livelihoods

Ecosystem services are the multiple benefits that all people receive from landscapes – ranging from nutritious food and clean water to climate regulation and outdoor recreation.

The United Nations first put ecosystem services at the center of debate about environmental policy in its Millennium Ecosystem Assessment, published in 2005. Since then, various global efforts, such as The Economics of Ecosystems and Biodiversity Initiative, have highlighted the enormous value of these services in an effort to strengthen the case for halting their deterioration.

The challenge now is to advance from debate and big numbers to action on the ground. This is partly a matter of assessing more fully the economic and social value of ecosystem services

in relation to national priorities. After all, labeling something as a “service” tends to understate its real worth. We must then deliver convincing evidence that these services can be effectively preserved and enhanced through approaches that integrate technological, institutional, and policy innovations.

Agriculture is especially reliant on ecosystem services – including plant genetic resources, soil fertility, and fresh water – but it also delivers key services (like food production), while at the same time exerting greater negative impacts on them (providing a “disservice”) than any other land use, especially in the tropics. For these reasons, there is an urgent need and also tremendous scope in tropical agriculture to improve the management of ecosystem services and generate larger benefits from them for human well-being.

In response, the International Center for Tropical Agriculture (CIAT) has embarked on a new strategic initiative called AgroEcosystem Action, which mobilizes research in support of a wide range of landscape approaches.




Ecosystem facts

Land degradation and the resulting costs worldwide have reached unacceptable levels. The only affordable course of action now is to invest in land restoration, thus creating benefits for millions of rural households in developing countries and for the rest of us who rely on the ecosystem services that farm families help maintain.

Consider these big facts:


In recent decades, landscape **degradation** has accelerated to a rampant pace that is **36** times historical rates.



A bar chart with a vertical axis labeled '2000' and '2010'. A red bar for 2010 is significantly higher than the bar for 2000, illustrating the acceleration of landscape degradation.

The **cost of global land degradation** has reached **US\$490 billion** per year, far higher than the cost of action to reverse it.

In 2013, governments, businesses, and others invested nearly **US\$6 billion** in programs designed to compensate about **7 million** rural households for managing the land more sustainably.



An illustration of a simple, single-story house with a red roof and a white door. Two people, a man and a woman, are standing in front of the house on a small patch of green grass.

By 2030, if current trends persist:

- **10–15 million poor rural households** could benefit from markets for biodiversity conservation,
- **25–50 million from** carbon markets,
- **80–100 million** from watershed protection,
- **and 5–8 million from** restoration of scenic landscapes.

Impacts in the making: Cases to watch

The credibility of CIAT's AgroEcosystem Action initiative rests on a solid record of achievement, made possible through collaboration with diverse partners in research for development. During recent years, scientists have demonstrated that ecological perspectives can be put to work effectively in agriculture, generating significant benefits for people and the environment. Described briefly below are some instructive cases.

Helping nature along: A clampdown on invasive pests in Asia

Entomologists were among the earliest system thinkers in modern agricultural research, demonstrating the enormous impact that an ecological approach can have in research on staple crops. One especially noteworthy achievement involves biological control of the cassava mealybug, an insect pest that in recent decades has traveled to Africa from its area of origin in South America and has lately shown up in Southeast Asia as well, with devastating consequences. The spread of cassava mealybug forms part of a growing worldwide threat posed by invasive species to economies and ecosystems.

Research at the International Institute of Tropical Agriculture (IITA) and CIAT has shown that the safest and surest way to clamp down on this pest is through

the release of a parasitic wasp, which co-evolved with the mealybug in South America and naturally keeps the pest in check. This strategy has worked well in Africa, saving billions of US dollars in food supplies, and was applied a few years ago in Thailand.

In response to the mealybug's recent appearance in Indonesia, scientists from Bogor Agricultural University released about 3,000 wasps during September 2014, with support from CIAT and the Food and Agriculture Organization of the United Nations (FAO). This is the first phase of an effort to subdue a major threat to the country's second most important staple after rice.

The work on cassava mealybug falls within a wider biological control initiative in the region that includes simple modifications in cropping systems aimed at making the natural enemies of pests more abundant and effective.



An ecosystem anchor for hillside farming in Central America

Some agro-ecosystem approaches result from the fusion of traditional knowledge with new insights from science. Such is the case with Quesungual, an agroforestry system originally developed in the early 1990s by FAO with farmers and community-based organizations in Lempira Department of Honduras.

Quesungual includes different kinds of trees scattered across cropland at a density of up to 1,000 per hectare. The roots act as anchors, stabilizing hillsides, minimizing soil erosion, and improving nutrient uptake from deeper soil layers. Most of the trees are pruned at regular intervals and the green cuttings used as mulch to provide nutrients and retain moisture – giving crops some protection against failed rains. This also helps increase soil organic matter, which encourages biological activity and nutrient cycling while improving soil structure.

Some of the trees are kept so small that it's hard to spot them in the surrounding maize or sorghum crops. Others are left to grow big enough to provide timber and fruits. In addition to capturing carbon dioxide, many of the trees in the system fix nitrogen, thus improving soil fertility. The overall result is a more reliable and productive system – come rain or shine.

Already widely practiced in Lempira, Quesungual has spread and undergone further development in El Salvador and Nicaragua as a result of CIAT-coordinated efforts. Preliminary studies suggest that the system could work in other areas of the subhumid tropics as well.

Ecosystem health has its rewards in the Andes

One of the main reasons for slow uptake of ecological approaches to land management is that their immediate economic benefits often do not provide strong enough incentives for rural people to alter traditional practices. Such is the case with conservation agriculture in the highlands around Lake Fúquene in central Colombia; while offering clear benefits over traditional crop-livestock production in terms of water quality, the approach delivers only modest productivity gains. In response, a revolving fund was created to provide credit for farmers willing to give conservation agriculture a try.

In a novel effort to open such pathways in Peru, the Ministry of the Environment (MINAM) and various partners are promoting mechanisms for equitable distribution of economic benefits from vital services provided by the country's diverse ecosystems. The scheme is based on a new law approved by the Peruvian Congress and Executive Branch in June 2014, which is now being put into effect.

MINAM's work on the novel reward scheme resulted from a pilot project carried out in the Cañete River Basin, with support from the CGIAR Research Program on Water, Landscapes and Ecosystems (WLE) through CIAT. A key contribution from research was to determine the value of ecosystem services, especially water, for a variety of sectors, including agriculture. The good news is that users of this resource clearly recognize its value and are willing to contribute financially to its preservation.

In search of ways to implement the reward scheme, MINAM and CIAT found a viable option with help from the International Fund for Agricultural Development (IFAD). IFAD has agreed to contribute start-up capital for the creation of a trust fund and also to cover operational expenses. Water users in the lower basin now have a way to make voluntary contributions. Communities in the upper watershed are already applying to the fund for project support centering on conservation of rural landscapes and restoration of degraded lands.

Preserving Kenya's lifeblood

By building on the model that has taken shape in Peru and other Latin American countries, Kenya will soon get a taste of the mutual benefits that result when societies share responsibility for improving ecosystem services. The means by which Kenyan society will achieve this end is the Nairobi Water Fund, the first of its kind in Africa, to be launched in 2015. It was developed by The Nature Conservancy through a collaborative effort with public and private sector partners, including CIAT, in the upper Tana River Basin.

This area is a major water catchment for Kenya's capital city and provides hydropower for much of the country. Over the last 3 decades, it has undergone rapid changes, as a consequence of increasing population density and entrenched poverty. Unsustainable use of agricultural land, stone quarrying near river courses, and other activities have given rise to high levels of water runoff and soil erosion, incurring high costs for downstream users of water supplies.

Through well-targeted development of sustainable land management practices, the Water Fund will work to reduce erosion and sedimentation in the basin's predominantly rural upstream watersheds, thus ensuring that downstream urban residents have good quality drinking water as well as adequate water supplies for hydropower generation. CIAT's role in this effort is to determine what benefits can be expected from land management solutions and how these benefits can be distributed equitably.

A five-point action agenda for research

Drawing on much past experience, CIAT is undertaking new projects that constitute the building blocks of the AgroEcosystem Action initiative. Some of these bring an ecosystem perspective to work on specific agricultural technologies – for example, the introduction of tropical forages into diverse cropping systems – with the aim of delivering productivity increases as well as environmental benefits. Other projects address ecosystem issues more directly and comprehensively but with particular emphasis on services (like pollination, nutrient cycling, and water retention) that are critical for strengthening food and nutritional security, while lowering the environmental impacts of agricultural intensification.

With support from the German government, for example, CIAT and ten partner organizations have embarked on a major effort in the Colombian and Peruvian Amazon, through which rural communities will develop and pilot sustainable land-use practices that improve their livelihoods, enhance ecosystem services, and strengthen local capacity to cope with climate change. Another German-supported project in Malawi and Tanzania is helping restore degraded land while creating new income opportunities for women based on ecosystem services. An important contribution of research is to build the case for investment by identifying and quantifying key services.

All CIAT projects pertaining to ecosystem services contribute importantly to the global CGIAR Research Programs. These contributions result from our collaborative efforts with more than 70 partner organizations to perform the five tasks described below through an integrated approach that works across scientific disciplines.

1. Demonstrate delivery

Securing the commitment of rural people and society as a whole to enhance ecosystem services requires that we show how rural landscapes deliver these services. Under a UK-supported project, for example, CIAT scientists are using a combination of quantitative and participatory methods in collaboration with European universities and partners in Colombia, Malawi, and Peru to document the important role of ecosystem services in strengthening the food and nutrition security of rural communities.



2. Put it on the map

Being able to visualize ecosystem services is essential for managing them better. To this end, CIAT and its partners are devising more efficient tools and methods to quantify and map ecosystem services in rural landscapes. In a new CGIAR/WLE initiative involving Kenya, Peru, and Tanzania, for example, we're developing novel tools that, in a first for research, integrate the modeling of crops with that of ecosystem services. When used in participatory planning with smallholder farmers and others, these tools will contribute to better investment decisions, resulting in productivity gains, improved ecosystem services, and greater benefits, especially for women and marginalized groups.



3. Value the benefits, measure the threats

To help translate environmental commitment into collective action, scientists must bring to the negotiating table solid quantitative information about the socio-economic value of ecosystem services and about agriculture's impacts on them. A key contribution of research in Peru's Cañete watershed (see page 4) was to deliver such information, which provides a basis for determining what incentives are needed to protect ecosystem services in agricultural landscapes. Our research will also address the impacts of climate change on these services.

NAME	DATE	TIME	LOCATION	VALUE
HERNANDEZ ENRIQUE Y ESPOSA	24 JUL	05:04 PM	Amorosa	1.00
MESA JORGE MARINO	24 JUL	06:48 AM	Amorosa	1.00
MULLEN HERACLIO	25 JUL	02:48 AM	Amorosa	1.00
TALLA LUIS	25 JUL	02:22 AM	Amorosa	1.00
CHIRINO ANATOLIA	25 JUL	01:45 PM	HABO	1.00
DE MACHA FAUSTA	25 JUL	09:35 PM	Amorosa	1.00
LOPEZ PAJARO	25 JUL	01:48 PM	HABO	1.00
LOPEZ FLORENTINO Y	26 JUL	09:32 AM	Amorosa	2.00
VOLE DE FERNANDEZ JERUSA	26 JUL	08:44 PM	HABO	2.00
OLUTO DANAB	27 JUL	06:48 AM	Amorosa	0.54
DE MENDOZA RUPINA	27 JUL	06:41 AM	Amorosa	7.67
YARON JUAN Y ESPOSA	27 JUL	06:17 PM	Amorosa	9.15
	27 JUL	06:34 AM	HABO	4.70

4. Assess alternative land-use practices

Whether investments in ecosystem services actually deliver the expected payoffs depends on the effectiveness of the different land-use practices that rural people adopt. CIAT has developed a wide range of sustainable solutions through decades of research on crop, soil, and land management across the tropics. Now, Center scientists are taking the work a step further by assessing the wide range of benefits that result from sustainable practices to better inform and target investments in ecosystem services. In Africa, this work presents the special challenge of finding stronger incentives for the rural poor to adopt sustainable land-use practices.



5. Support innovative financial mechanisms

Developing novel financial mechanisms to achieve more equitable sharing of the costs and benefits of improved ecosystem services is a critical early step to enhance their preservation and management. For researchers and their development partners, however, this is just the beginning of a process aimed at ensuring effective implementation of these mechanisms. CIAT already provides such support through research with Peru's Ministry of Environment and has undertaken this type of work in other countries (Kenya, for example) where new financial mechanisms are being established.



Acting in tandem

CIAT's AgroEcosystem Action initiative is a central component of the Center's new strategy for building an eco-efficient future in tropical agriculture. Our aim is to help intensify food production sustainably and improve rural livelihoods, while reducing agriculture's environmental footprint through economically and ecologically prudent resource use.

Improved production technologies are necessary but not sufficient for achieving this end. They must form part of an integrated approach that also delivers the institutional and policy innovations needed to establish sustainable production systems. This is the approach CIAT is pursuing through the AgroEcosystem Action initiative. It envisions a new role for farmers and other rural people as stewards and suppliers of vital ecosystem services in exchange for fair compensation from the sectors of society that benefit.

While working through collaborative projects in selected countries, AgroEcosystem Action will participate in several global initiatives that have emerged recently. One is the Intergovernmental

Platform on Biodiversity and Ecosystem Services (IPBES), which was established in recognition of the dire consequences of ecosystem degradation and biodiversity loss. This new body has the potential to bring major scientific and policy attention to ecosystem degradation, just as the Intergovernmental Panel on Climate Change (IPCC) did for another emerging threat to human livelihoods.

To this end, IPBES will gather scientific evidence in support of policy decisions on ecosystem management and restoration – a task to which CIAT scientists are well prepared to contribute. The Center will also seek a role in a new study on agriculture and food undertaken by The Economics of Ecosystems and Biodiversity Initiative, which will elucidate the intricate links between agriculture, especially smallholder production, and ecosystem services.

Through these efforts, CIAT scientists and their partners will gain a thorough grasp of the state of the art on ecosystem service provision – knowledge they can then apply to major initiatives for restoring degraded land to productivity and halting the decline of ecosystem services at the national and global levels.



About CIAT

The International Center for Tropical Agriculture (CIAT) – a member of the CGIAR Consortium – develops technologies, tools, and new knowledge that better enable farmers, especially smallholders, to make agriculture eco-efficient – that is, competitive and profitable as well as sustainable and resilient. With headquarters near Cali, Colombia, CIAT conducts research for development in tropical regions of Latin America, Africa, and Asia.

www.ciat.cgiar.org

CGIAR is a global research partnership for a food-secure future. Its science is carried out by the 15 research centers who are members of the CGIAR Consortium in collaboration with hundreds of partner organizations.

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CIAT Strategic Initiatives

AgroEcosystem Action is one of four strategic initiatives created under CIAT's new strategy for the period 2014–2020. The aim of these forward-looking, collaborative endeavors is to open new avenues for enhancing the development impact of CGIAR research.

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