Global survey of agricultural mitigation projects

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MITIGATION OF CLIMATE CHANGE IN AGRICULTURE SERIES

MICCA

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Global survey of agricultural mitigation projects

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Mitigation of Climate Change in Agriculture (MICCA) Project

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Acknowledgements

We are grateful to the many people who have contributed directly or indirectly to the preparation of this report. We would especially like to thank everyone who has contributed to the survey and hope that the information provided in this report may support efforts to make a meaningful contribution to combat climate change through smallholder agricultural mitigation projects. This initiative can be seen as a first step and has motivated us to work on an interactive database on agricultural mitigation projects to be made available on the internet. We would welcome any feedback or input to this. In addition we would like to thank the Government of Finland for the funding provided for this publication.

1. Introduction

Agriculture is a fundamental human activity, providing human societies with food, clothing, medicine and other useful products as well as a number of vital ecosystem services including biodiversity, soil formation, water regulation, carbon sequestration and more. Since our world population is expected to reach 9.1 billion people by 2050, agricultural production needs to grow accordingly to meet this growing demand; climate change presents a challenge to this, since it has and will continue to seriously affect agriculture. The International Food Policy Research Institute (IFPRI) estimates that climate change could reduce irrigated wheat and rice yields by 30 and 15 percent, respectively (Nelson *et al.*, 2009). The agriculture, forestry and the fisheries sectors are essential to the livelihoods of around 75 percent of the people living in rural areas. Thus, the threat presented by climate change is very significant for the livelihoods of a large share of the worlds' population.

Agriculture and the other land-based sectors are not only impacted by climate change, but are themselves major emitters of greenhouse gases (GHG). About one third of the global emissions can be attributed to the agriculture, forestry and other land use (AFOLU) sectors. Agriculture accounts for 13.5 percent and land use change and forestry represent 17.4 percent of all GHG emissions (IPCC, 2007). However, the land-based sectors are also part of the solution for climate change, because they have a high potential for reducing emissions and enhancing carbon sinks. This potential provided through the AFOLU sectors can make an important contribution to reach the necessary targets for reducing the threat of climate change.

At the beginning of 2010, a new project, Mitigation of Climate Change in Agriculture (MICCA) was established at the Food and Agriculture Organization of the United Nations (FAO) to support efforts to mitigate climate change through agriculture in developing countries and to move towards carbon friendly agricultural practices. As one of the first activities under this project, the participation of smallholders in activities to mitigate GHGs in agriculture will be supported. This involves the development of three to five pilot projects to test on the field the engagement of smallholder farmers in climate change mitigation. It is based on the premise that if changes are implemented in production systems, emissions can be reduced and sinks created in biomass and soils while resilience and productivity of the agricultural systems are increased.

As part of this project activity, a review was made of current agricultural mitigation projects. A survey was sent out in April 2010 for project developers to register agricultural projects that have a mitigation component in an online database. The resulting inventory of agricultural mitigation projects was compiled in order to provide an overview of the state-of-the-art with respect to the types of agricultural projects currently developed, their focus, objectives and activities as well as the entry points for their establishment. The inventory aims to explore and shed light on the agricultural sector's interest and involvement in the carbon markets.

During the preparation of the survey launch, several other ongoing initiatives by different institutions have been acknowledged, with whom information has been exchanged. Their data have not been included in this publication. However, possibilities are being investigated to establish a necessary, interactive database on the Internet to be fed with brief summaries of relevant projects.

Additionally, several project developers pointed out that many agricultural projects or even rural development projects are currently developed that do not have agricultural mitigation as their main goal; however, their activities indirectly also provide climate change mitigation benefits through the implemented agricultural activities. Thus, the main database provides information on a wide variety of agricultural projects with differing mitigation objectives.

Finally, this inventory is by no means meant to provide a complete picture of all agricultural mitigation projects currently carried out all over the world; it is meant to provide an overview of the current status within this field. It is structured as follows: Chapter 2 provides an overview of the importance of mitigation and puts it into the context of agricultural climate projects; Chapter 3 focuses on the results of the survey; Chapter 4 presents 22 case studies on agricultural mitigation projects; and finally, Chapter 5 provides a summary and an outlook.

2. Agricultural climate projects – putting mitigation into context

For many farmers in rural settings, the main aim of agriculture is to secure their livelihoods and to produce products that can be used directly or sold in the market. Mitigation is not the first activity consciously undertaken, but can be integrated into the current practices if it makes economic sense. Thus, mitigation must be seen in the context of farmers' decision making. For most farmers, it will be a co-benefit whilst increasing agricultural productivity in a climate-smart manner. Adaptation to climate change is an inevitability for all agricultural producers; any choice of technology has to be appropriate for the local circumstances and climate-proofed for adaptation.

Mitigation of GHG emissions in agriculture has several approaches: (i) emissions can be reduced; (ii) emissions can be avoided or displaced; or (iii) sinks can be created to remove emissions.

To reduce emissions from farming systems, several means are available. For example, in the livestock sector, emissions can be regulated to some extent by increasing the productivity per animal unit or through the choice of production practices and a more efficient use of feeds. In crop and feed production, the use of inorganic fertilizer can be optimized, or in some cases, replaced by organic fertilizers to reduce emissions. Additionally, technical changes in production systems and practices, such as manure management and rice farming provide options to reduce GHGs (FAO, 2006).

To avoid emissions in the agricultural sector, the energy efficiency in many systems needs improvement. There is a diversity of different GHG mitigation strategies, which are highly specific to location and management practice (Schneider and Smith, 2009). Through efficient household energy systems, GHG emissions can be displaced at a relatively low cost.

According to IPCC (2007), the main potential for mitigation lies in enlarging carbon sinks. There are different approaches, such as increasing biomass (and carbon) by incorporating trees and bushes to farming systems, for example, silvo-pastoral or agroforestry systems. Great potential lies in increasing the carbon content of soils. Through the restoration of degraded soils, especially in vast grassland and pasture areas, by regulating animal numbers and pasture improvement, the soil carbon sequestration rate is improved. There is a significant mitigation potential that can be tapped by adopting farming practices that increase the organic matter content of the soils.

The co-benefits that arise from the adoption of the mitigation techniques can form a basis for the economic rationale to support the uptake of new practices. They are varied and often specific to regions and systems. For example, by improving the organic matter content of soils, the water retention capacity and nutrient content can be improved, agroforestry systems can allow to diversify income sources and enhance productivity, and diversified production systems, such as integrated rice-livestock systems can increase the resilience of farming systems. Agricultural mitigation options need to benefit adaptation, food security and rural development in order to be sustainable for farmers in the long term.

To identify farming systems, practices and technologies that should be incorporated into future work, it is important to obtain an overview of the diversity of agricultural mitigation projects and understand their driving forces and entry points, as well as the agro-ecological zones that have been covered.

3. Results of the survey

This section gives an overview of the results of the survey, which has been divided into two parts. First, a very brief analysis of all registered projects is given. There were 50 valid and complete responses (out of 74), some of which were not specifically designed as agricultural mitigation projects but all of which involve agricultural activities that reduce, avoid or sequester GHG emissions through the implemented activities. The second part gives an overview of the results of the 22 projects that specifically have a GHG mitigation objective.

3.1 Entire survey

Main characteristics of projects

Among the 50 responses to the survey, different **types of projects** were identified: one is a regional project, three are research projects and two focus on awareness raising and training of farmers. Six projects are implemented by the Consultative Group on International Agricultural Research (CGIAR) institutions, while the remainder are implemented by a variety of international and national non-governmental organizations (NGOs), universities and research institutions.

The **regional distribution** of these projects is as follows: 20 in Africa, 14 in Asia and the Pacific, 15 in Latin America and the Caribbean, and one in Eastern Europe. The highest number of projects (four) is carried out in Brazil, and three projects each are located in Kenya, Nigeria and India.

The **size** of the project sites ranges from 0.7 to 5 million ha, with an average of 150 000 ha. Excluding the two largest projects of 5 million ha and 250 000 ha, the average is 5 500 ha.

The **projects are all at different stages:** approximately 50 percent of the projects are in the implementation (22) and payment (two) phases, 15 percent are in the planning phase, 15 percent in the feasibility and 10 percent in the monitoring, reporting and verification (MRV) phase.

Land use practices

Out of all the projects, 74 percent incorporate agricultural activities (37), of which some are mixed with agroforestry (nine), forestry (four) or bioenergy (3) activities. Only four projects are pure agroforestry projects, three are agroforestry and forestry/bioenergy projects, three are forestry projects, and one is a fisheries (mangrove) project (Figure 1).

The **entry point** for many projects are agricultural practices which prove to be unsustainable in the specific region, such as slash and burn, overharvesting, conventional/traditional agriculture, low input (rainfed rice), intensive farming systems, as well as degraded land. The projects generally brought a shift to agricultural practices, such as conservation agriculture, compost production, organic agriculture, agroforestry, improved management (coffee, livestock, manure), as well as afforestation, reforestation, forest conservation and bioenergy.

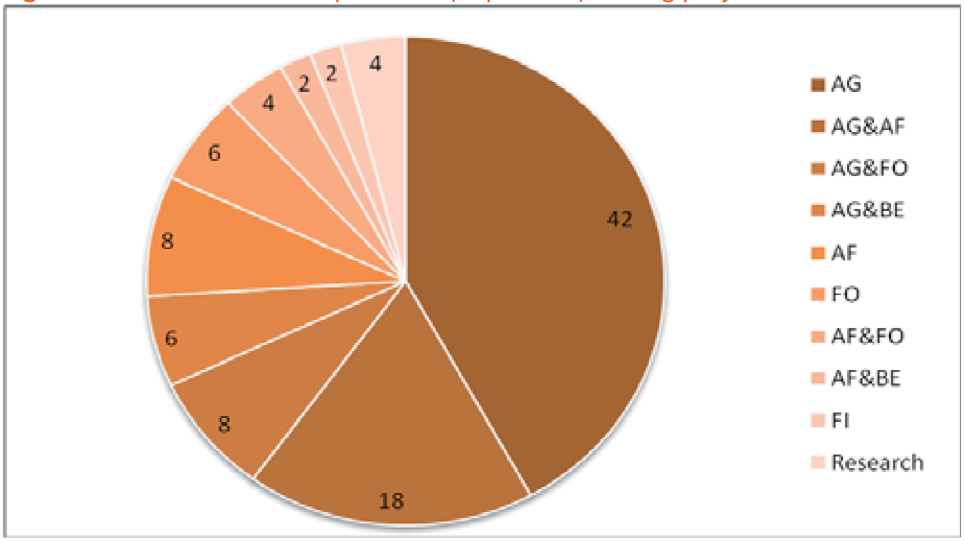
3.2 Carbon projects

Out of the 50 registered projects, 22 have a GHG mitigation component and aim to actively reduce carbon emissions or provide a sink.

Main characteristics of project

The **regional distribution** of these projects is as follows: nine in Latin America and the Caribbean, seven in Africa , five in Asia and the Pacific and one in Eastern Europe. Three are located in Brazil, two in Zambia and two in Mexico.

Figure 1. Different land use practices (in percent) among projects



Note: AG=agriculture, AF=agroforestry, FO=forestry, BE=bioenergy, FI=fishery

The **area** covered by these projects ranges from 5 to 60 million ha, with an average of 300 000 ha. Excluding the two very large projects, the average size of the mitigation projects is 8 000 ha.

The **number of households** concerned by the projects ranges from 20–150 000, with an average of 20 000 households.

The **project duration** ranges from two to 50 years, averaging 17 years.

The carbon projects are at different **stages**, two already in the payment phase and six being implemented. Three projects are in the MRV stage; five are still in the planning stage; and four in the feasibility stage.

The projects were classified into **climatic zones**. Only one project is located in the arid zone, the majority (40 percent) are in the semi-arid zones and 32 percent in the subhumid zones and 23 percent in the humid climate zones.

Furthermore, the projects were allocated to five **land use types** (Table 1): there are 11 projects with annual crops, nine with perennial crops, seven with grazing land and four with forest systems, whereas 15 have other land use types such as savannah, degraded lands, mangrove, peatland, shrub land and compost. The land use types are mixed in most projects, as shown in detail in Table 1 .

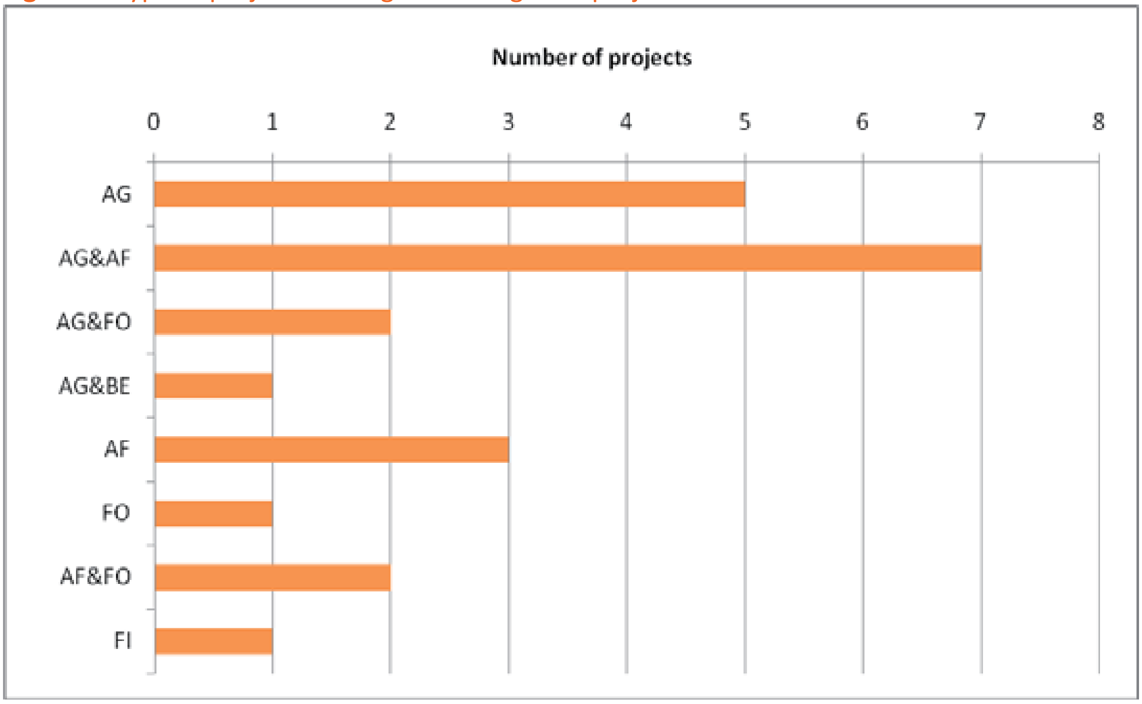
Table 1. Land use type combinations

Land use type	No. of projects	Land use type	No. of projects
Annual crops	3	Perennial crops and forest	1
Annual crops and perennial crops, grazing land and other	1	Perennial crops and other	1
Annual crops, perennial crops, forest and other	1	Perennial crops and forest and other	1
Annual crops, grazing land and other	3	Grazing land	1
Annual crops and other	1	Grazing land and other	1
Annual crops, perennial crops and other	2	Grazing land, forest and other	1
Perennial crops	2	Other	3

Land use practices and project activities

About 70 percent of the projects involve agricultural activities, out of which 30 percent are a combination of agroforestry and agricultural activities (Figure 2).

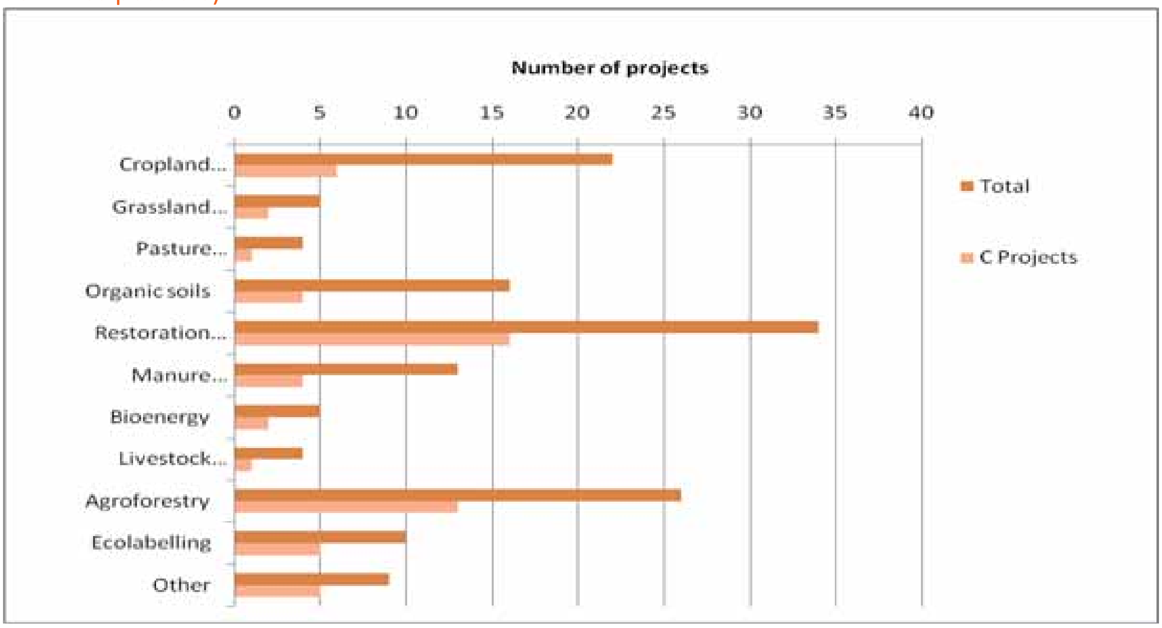
Figure 2. Type of projects among GHG mitigation projects



Note: AG: agriculture, AF: agroforestry, FO: forest, BE: bioenergy, FI: fisheries

The predominant **activities** in the projects are restoration of degraded soils and agroforestry (Figure 3). Cropland management and ecolabelling are also relatively frequent activities. Activities included among "Other activities" are mainly forest management activities (conservation/plantation/forest restoration/non-wood forest management/nurseries), mangroves, rain water harvesting, organic manure and composting.

Figure 3. Main activities carried out in carbon projects (C Projects) and total projects (multiple activities possible)



The **objectives** of the carbon projects were analysed and categorized (Table 2); this was not easy, because many projects have cross-cutting and multiple objectives. As can be expected from the above-mentioned activities carried out in the projects, they range from agriculture, agroforestry and bioenergy to forestry. Agroforestry is an important activity, which is a component in most projects, since it is one of the obvious activities contributing to GHG mitigation through the sequestration of carbon dioxide. Also, it can contribute directly to adaptation objectives (control of soil erosion, soil cover improvement, increased resilience to climate extremes), financial insurance (diversification of income sources and the provision of income buffers) and food security (enhancing productivity, provision of food).

Table 2. Objectives of the carbon projects

Objectives	No. of projects
Agricultural adaptation and mitigation practices (watershed management)	4
Agriculture, agroforestry (conservation agriculture and organic farming)	3
Agroforestry and bioenergy	4
Grazing systems	1
Compost	1
Forest conservation	1
Forestry and agroforestry	3
Reforestation	1
Jatropha plantation	1
Mangroves offset project	1
Agriculture, forestry, agroforestry	1
Research (soil carbon, crop management techniques)	1

In order to determine the **entry point** of the projects, there was an attempt to capture the change in the land use practices due to the project. As mentioned in 3.1, when the entry points for all projects were described, most of them were unsustainable or low productivity agricultural practices (extensive farming, overgrazing, overharvesting, slash-and-burn, low yields), as well as degraded land. The implemented projects aim to improve agricultural practices through various techniques: the introduction of conservation agriculture; the set-up of agroforestry systems; improvement of coffee, cocoa and livestock management systems; and the introduction of afforestation, reforestation, compost production, organic farming, bioenergy (jatropha cultivation).

The benefits of the projects

The benefits generated through the agricultural projects are numerous. There was an attempt to discern who receives which types of benefits with respect to the output of the project. As seen in Table 3, it is mainly the farmers who will receive benefits, either in the form of payments or as a result of increased agricultural productivity. Similarly, in addition to payments and increased agricultural productivity, the community benefits through the recognition of its land use rights and carbon rights. Carbon rights in most cases remain with the company.

Table 3. Benefits received by different recipients through the projects

	What type of benefits?								Total
Who receives the benefits?	Payments	PES* biodiversity	PES* watershed: conservation	Recognition of land use rights	Non-timber forest products	Carbon rights	Increased agricultural productivity	Other	
Farmers	12	1	1	0	4	2	10	2	32
Community	2	1	1	2	1	2	2	3	14
NGO	3	0	0	0	0	2	0	3	8
Company	3	0	0	0	1	4	0	2	10
Other	0	0	0	1	0	0	0	1	2
	20	2	2	3	6	10	12	11	66

*PES - Payments for ecosystem services

Other benefits or beneficiaries mentioned were:

- *Benefits for communities* are: capacity building, workshops, training on native seedlings, nursery techniques, training of fire brigades, environmental education activities, mapping of social networks and strengthening of the communities' leaderships, jobs related to forest restoration, and an increased awareness of ecosystem services.
- *Benefits for farmers are*: the perception of carbon finance as a means to improve the climate change resilience of rural farmers.
- *Benefits to others*: benefits received by central government in terms of planning management of carbon credit systems in the country; indirect benefits by the local government benefits through land tax.

Carbon management

In very few cases, the **carbon payments per hectare (ha) per year** have been determined at this stage. The numbers provided range from US$10 to 180 per ha per year, whereas in most cases, they are not fixed yet since they depend on sales. In one case, contract growing is used and a standard offer is made to the farmers. In another project, 66 percent of the payments received will go to the sellers (farmers). In some cases, the money derived from the carbon payments is used to support technical services and training rather than for making direct payments to farmers. Other projects provide indirect benefits through additional employment possibilities, as well as increases in product sales, which contribute to the households' income.

With respect to the **GHG mitigation potential** of the projects, the carbon sequestered is estimated at 1.37 to 140 tonnes per ha per year, with an average of 20 tonnes/ha/year, depending on the activities carried out by the project. The total amount of CO_2 sequestered by the projects is 20 000 to 8.4 million tonnes, with an average of 1.3 million tonnes. The annual carbon sequestration is estimated at 13 to 181 000 tonnes, with an average of 33 000 t CO_2 per year[1].

Five carbon pools need to be considered for **carbon sequestration potential**: biomass above- and below-ground, dead wood, litter and soil organic matter. The sequestration potential of any practice depends greatly on a variety of factors: the land use category, the combination of practices carried out, soil, climatic variables and the implemented changes. Table 4 gives an overview of the GHG mitigation potential of different practices in different regions, which differs between practices and climate zones. In Annex I, further examples are provided from different case studies of the carbon sequestration and mitigation potential of different land use systems.

[1] The figures are the sole responsibility of the respondents.

Table 4. Annual mitigation potential for different climate regions for agricultural practices

Improved land management practice	all GHG (t CO2eq/ha/yr)			
	Cool-dry	Cool-moist	Warm-dry	Warm-moist
Agronomic practices	0.39	0.98	0.39	0.98
Soil nutrient management	0.33	0.62	0.33	0.62
Tillage and residuemanagement	0.17	0.53	0.35	0.72
Water management	1.14	1.14	1.14	1.14
Set-aside and land cover (use) change	3.93	5.36	3.93	5.36
Agroforestry	0.17	0.53	0.35	0.72
Grazing, fertilization, fire	0.13	0.80	0.11	0.81
Restoration of organic soils	33.51	33.51	70.18	70.18
Restoration of degraded soils	3.53	4.45	3.45	3.45
Application of manure/bio-solids	1.54	2.79	1.54	2.79
Bioenergy (soils only)	0.17	0.53	0.35	0.72

Source: IPCC, 2007

All projects use **different methodologies**: in two projects, the Voluntary Carbon Standard (VCS) methodology for the adoption of sustainable agricultural land management (SALM) by farmers is used ; in four projects, Clean Development Mechanism (CDM) methodologies are used; in several projects, the Plan Vivo Standards are used; and in four projects, their own measurements are carried out with carbon accounting through forestry assessment, IPCC guidelines and carbon soil determination methodologies. (See Annex II for more information on the methodologies.)

The majority of projects (14) concentrate on the voluntary carbon market, and only one project targets the regulatory (CDM) market. Out of these 14 projects, eight have an agricultural component, two are pure agroforestry projects, two are agroforestry and forestry projects, one is a forestry project and one is a fisheries (mangrove) project.

Table 5 gives an overview of the objectives of these projects.

Table 5. Objectives of the 14 projects developed for carbon markets

Agriculture	1
Agriculture, agroforestry (conservation agriculture and agroforestry)	2
Agroforestry (and bioenergy)	3
Agriculture, forestry, agroforestry	1
Compost	1
Forest conservation	1
Forestry, agroforestry	2
Jatropha plantation	1
Mangroves offset projects	1
Reforestation	1

Funding of projects

A variety of financing institutions and investors are involved in the projects, including international and national NGOs, private investors/companies, international donors and national agencies.

Environmental and socio-economic impacts

The survey also tried to determine the general expected impact of the project, both in terms of environmental, as well as socio-economic impacts.

Environmental Impacts

a. Off-site environmental benefits

The main off-site environmental benefits that can be attributed to the projects is reduced downstream siltation, followed by reduced transport sediments, reduced river pollution and reduced downstream flooding (Table 6).

Table 6. Off-site environmental benefits

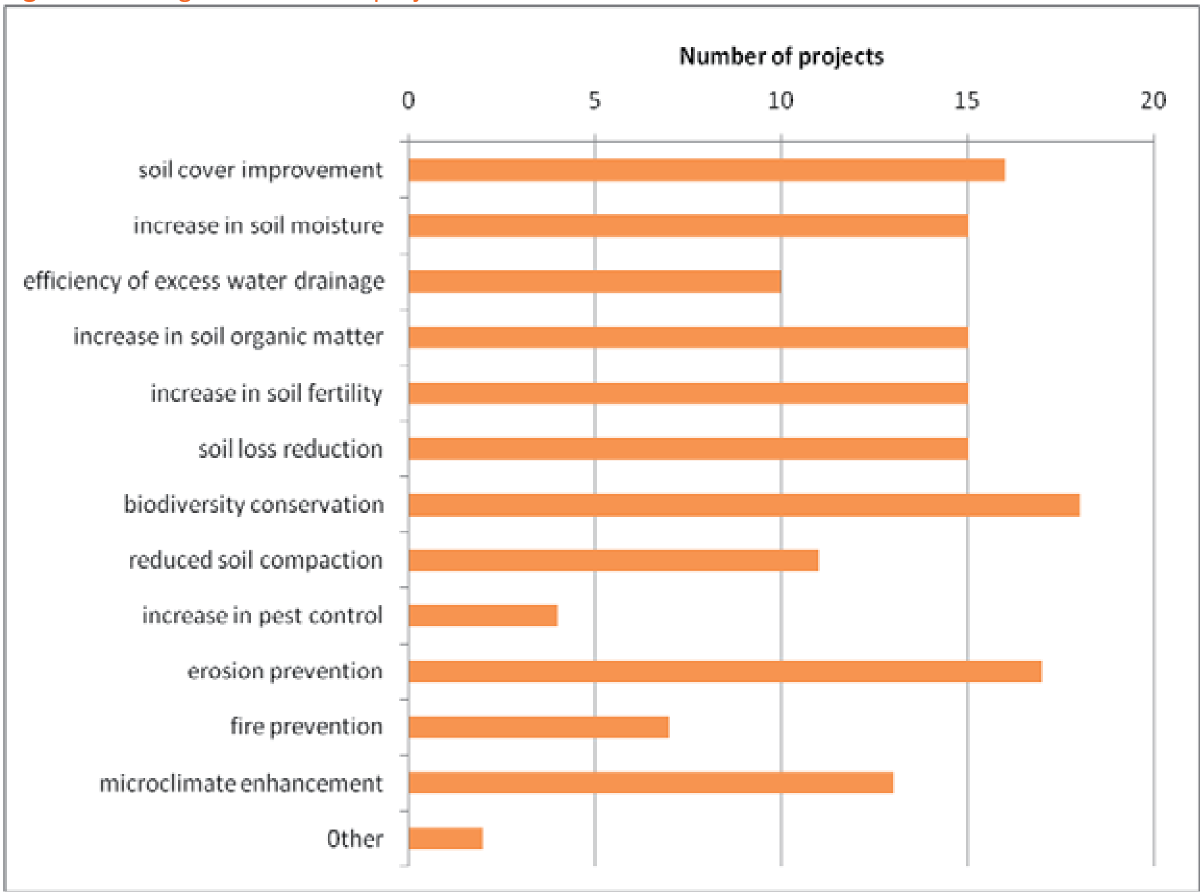
Reduced downstream siltation	Reduced downstream flooding	Reduced transport sediments	Reduced river pollution	Increased dry season streamflow	Other
10	8	8	8	4	3

Other off-site benefits mentioned are risk avoidance regarding infiltration capacity, lower vulnerability against dry seasons and hurricanes, decreased waste dumping and associated pollution, and reduced transport/mechanized agriculture pollution through combustion of fossil fuel.

b. Ecological benefits

Most of the projects have biodiversity benefits, as well as providing erosion prevention and soil cover improvement (Figure 4).

Figure 4. Ecological benefits of projects



Other ecological benefits mentioned are an increase of the natural habitat, reduced deforestation, in situ conservation of indigenous trees and nature conservation in general.

Production, socio-economic and socio-cultural impacts

Most of the projects anticipate an increase in farm income, as well as an increase in crop yields and fodder production (Table 7). Among the socio-cultural impacts, the implemented projects provide both improved knowledge of practices and help to strengthen the community institution. Other benefits mentioned were that the projects improve the local communities' livelihoods and make it possible to retain the subsistence and cash value of the ecosystem services.

Table 7. Socio-economic impacts

Production impacts				Socio-cultural impacts	
Farm income increase	Crop yield increase	Fodder production increase	Reduced labour and energy inputs	Improved knowledge of practice	Strengthened community institution
17	13	10	8	18	13

4. Agricultural mitigation projects

This chapter provides a short overview of all agricultural mitigation projects that include a carbon sequestration objective. There is a wide variety of different approaches, activities and/or techniques in the projects.

1. Libra/Sekem composting project

Location
Egypt

Objectives

- Aerobically compost unused biomass from agriculture, such as harvest residuals, fruit/food waste, pruning material, manure that otherwise, in the absence of the project, would have been disposed anaerobically in municipal solid waste disposal sites or other landfills.

  This project contributes to methane avoidance. The compost is applied on farms as a soil conditioner and organic fertilizer, replacing synthetic fertilizer, reducing erosion, sequestering carbon and improving soil fertility as well as increasing the water holding capacity of soils.

Implementing organization and partners
Soil and More International BV/The Netherlands and
Sekem Group/Egypt, South Pole Carbon Asset Management/Switzerland

Length of project
30 years (2007–2028)

Project stage
Payment phase

Activities and implemented change
The compost is sold to farms, both organic and conventional, that suffer from soil loss due to previous non-sustainable soil management.
The farms receiving the compost either directly apply the compost to the soil or mix it into their fertilization scheme. The farming system moves gradually to lower synthetic fertilizer applications as soil fertility increases and the compost, subsidized with the carbon credits revenues, is commercially more attractive than the synthetic fertilizers. Consequently, the soil carbon stocks increase and less water is used.

No. of households
Directly ten (compost production), indirectly approximately 3 000 (compost application)

Size
n.a.

Estimated CO_2 benefits per ha per year
n.a.

Estimated total amount of CO_2 benefits
1.26 million tonnes CO_2e

Contact and website
http://traceablevers.mh5.projektserver.de/e/2582/

2. Scolel'Te

Location
Mexico (Chiapas and Oaxaca)

Objectives

- Protect the environment.
- Offset atmospheric CO_2.
- Improve rural livelihoods.
- Build local capacities.
- Develop PES through integrated projects.

Implementing organization and partners
AMBIO and Investigation and academic centres: ECOSUR
NGOs: Mexican Fund for the Conservation of Nature, Conservation International, Reforestamos Mexico, Critical Ecosystem Partnership Fund
Governmental bodies: CONAFOR, CONANP, Corredor Biologico Mesoamericano Mexico Charity/standard provider: Plan Vivo Foundation
External Verifier: Rainforest Alliance through its programme Smartwood

Project duration
20 years (1997–2018) (technical specifications cover over a period of approximately 100 years, i.e. 1997–2097, and the duration of the project is 100 years)

Project stage
Payment phase

Activities and implemented change
Before the project, slash-and-burn activities were widely practised in the States of Chiapas and Oaxaca. The land was mainly used for maize cultivation and pasture, and there was secondary vegetation.
After the project implementation, the following new activities are practised: improved fallow, living fences, forest restoration, forest management, improved coffee plantation, taungya.

No. of households
2 294

Size
8 127 ha

Estimated CO_2 benefits per ha per year
49.99 t CO_2/ha/yr

Estimated total amount of CO_2 benefits
406 313 tonnes CO_2

Contact and website
Sandie Fournier: s_fournier@hotmail.fr
www.ambio.org.mx

3. Limay Community Carbon Project

Location
Nicaragua

Objectives
- Diversify and improve subsistence farmers' income.
- Restore critical watershed and soil fertility.
- Improve land productivity.

Implementing organization and partners
Taking Root Nicaragua and the Municipality of San Juan de Limay

Project duration
11 years (2009-2020)

Project stage
Implementation phase

Activities and implemented change
Before the project, crop rotation occurred and the land was used for pasture.
The project is establishing a productive, multi-purpose reforestation projects on the underused/unproductive portions of subsistence farmers’ land.

No. of households
20 (new participants are recruited into the project on an annual basis)

Size
7 600 ha

Estimated CO_2 benefits per ha per year
20 t CO_2/ha/yr

Estimated total amount of CO_2 benefits
289 000 tonnes CO_2

Contact and website
Khalil Baker: kahlil@takingroot.org
www.takingroot.org

4. Carbon storing in the Andean peatlands of Peru

Location
Peru

Objectives
- Monitor soil carbon content and quality in agricultural systems and develop soil protection strategies to mitigate the greenhouse effect caused by the release of carbon into the atmosphere.
- Enhance income generation through a system of payment for environmental services that promotes good stewardship of the land by poor farmers in developing regions.

Implementing organization and partners
International Potato Center (CIP) and the Peruvian Ministry of the Environment

Project duration n.a.
Project stage Implementation phase
Activities and implemented change n.a.
No. of households n.a.
Size 250 000 ha
Estimated CO_2 benefits per ha per year n.a.
Estimated total amount of CO_2 benefits n.a.
Contact and website www.cipotato.org/publications/pdf/004995.pdf
5. Coping with climate variability in dryland agriculture; community-based watershed development
Location India
Objectives • Adapt to climate change and implement watershed management.
Implementing organization and partners International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and several projects funded by Central and State Governments of India and the Sir Ratan Tata Trust; Sir Dorabji Tata Trust; Stockholm Environment Institute
Project duration 5 years (2009–2014)
Project stage Implementation phase
Activities and implemented change
No. of households 28 000
Size Watersheds of various sizes up to 500 ha
Estimated CO_2 benefits per ha per year n.a.
Estimated total amount of CO_2 benefits 2 800-5 600 t C yr^{-1}
Contact and website S. Wani, ICRISAT www.icrisat.org
6. Emiti Nibwo Bulora (Trees sustain life)
Location Tanzania, Kagera Region
Objectives • Diversify income. • Improve land use. • Reduce poverty. • Practise soil conservation. • Improve water quality and management. • Develop capacities • Adapt to climate change.
Implementing organization and partners Vi Agroforestry Programme (project coordinator) and local farmer groups (producers) and Plan Vivo Foundation (carbon standard)
Project duration 11 years (2009–2020)

Project stage
Implementation phase

Activities and implemented change
The main economic activity in this region was agriculture before the project was implemented. The main cash crops are bananas and coffee. Bananas and beans are the staple food in the area, which are also traditional food and cash crops. Coffee is commonly grown as a cash crop despite problems of inputs and markets.
As a result of the project, the following agroforestry activities have been implemented: boundary planting, dispersed interplanting, fruit orchards and woodlots

No. of households
20 (expected to increase to 1 000 in the next few years)

Size
1 100 ha

Estimated CO_2 benefits per ha per year
For a 25-year rotation period:
Boundary planting=5.6; dispersed interplanting=61; fruit orchards=17; woodlots=140

Estimated total amount of CO_2 benefits
90 000 tonnes CO_2

Contact and website
Bo Lager, Vi Agroforestry Programme
www.viskogen.se
www.planvivo.org/?page_id=2418

7. Improving livelihoods of smallholder farmers

Location
Cambodia

Objectives
- Improve livelihoods through sustainable agriculture and general rural development.
- Mitigate climate change by: (i) replacing chemical fertilizers with organic matter; (ii) planting trees; and (iii) introducing systems of rice intensification.
- Develop methods for monitoring and reporting climate change mitigation and adaptation with the participation of smallholder farmers.

Implementing organization and partners
Nordeco and CEDAC (Cambodian NGO), Oellingegaard (organic dairy in Denmark)

Project duration
4.5 years (2008–2012)

Project stage
Implementation phase

Activities and implemented change
Before the project, the agricultural activities were rainfed rice (one crop/season), and free-ranging cattle and smaller animals.
As a result of the project, a system of rice intensification was implemented, cut-and-carry cattle feeding, enclosed chicken, vegetable farming, rice-fish. There are now some multi-purpose (integrated) farms.

No. of households
2 500 (but growing)

Size
2 500 ha

Estimated CO_2 benefits per ha per year
Approx. 3 t CO_2/ha/yr

Estimated total amount of CO_2 benefits
Approx. 20,000 tonnes CO_2

Contact and website
www.carbonconnectgroup.org/

8. Poverty Alleviation, mangrove conservation and climate change: carbon offsets as payments for mangrove ecosystem services in the Solomon Islands

Location
Solomon Islands

Objectives
- Explore whether mangroves could be included in offset projects.
- Address the question of whether conserving or replanting mangroves and using them sustainably could qualify

- the rural poor along tropical coasts to be integrated into the global carbon market, thereby earning an income that may be invested by communities to use for educational, health and conservation uses.
- Provide a roadmap for local communities, NGOs and governments to guide them in identifying the ecosystem services that their mangroves provide, as well as quantifying carbon sequestration, credit registry and fund management, since trading and registry procedures are not yet well established for the nascent voluntary offset market, especially for mangroves.

Implementing organization and partners
The World Fish Center and Solomon Islands Ministry of Environment, Conservation and Meteorology

Project duration
3 years (2009–2012)

Project stage
Implementation phase

Activities and implemented change
Before the project, there was overharvesting of mangroves for firewood, building materials or clear felling. The project provides mangrove management options to be established by community land owners.

No. of households
n.a.

Size
n.a.

Estimated CO_2 benefits per ha per year
n.a.

Estimated total amount of CO_2 benefits
n.a.

Contact and website
www.worldfishcenter.org/resource_centre/WorldFish%20project%20brief-%201945.pdf

9. Western Kenya smallholder agriculture carbon finance project

Location
Kenya, Western and Nyanza Province

Objectives
- Promote and implement a package of sustainable agricultural land management (SALM) practices among smallholder farmer groups.
- Create reductions of emissions of GHGs through carbon sequestration by trees and soil.
- Introduce sustainable agricultural practices such as manure management and use of cover corps, returning composted crop residuals to the field, and introducing trees into the landscape as methods for increasing the carbon stocks on the land.

Implementing organization and partners
Vi Agroforestry Programme and Unique Forestry, World Bank

Project duration
30 years (2010–2029)

Project stage
Implementation phase and project validation preparation

Activities and implemented change
Prior to the project, farmers were not using SALM practices on their farms. Soil erosion and nutrient mining were widely observed in the project region, and as a result, agricultural production was relatively low. Knowledge on best agricultural and agroforestry practices was also unavailable.
The project will enhance GHG removals by: increasing the amount of soil organic carbon (SOC) and tree carbon by adopting sustainable agricultural practices such as terracing, use of cover, mulch and fodder corps, and manure management; returning composted crop residuals to the field; and introducing multi-purpose trees across the landscape. The adopted practices will also increase climate resilience by improving soil structure, water infiltration and storage capacity.

No. of households
65 000

Size
45 000ha

Estimated CO_2 benefits per ha per year
1.37 tCO_2e/ha/yr (average considering a none-year project roll-out period)

Estimated total amount of CO_2 benefits
1.2 million tonnes CO_2e

Contact and website
Bo Lager, Vi Agroforestry Programme
www.viskogen.se
Elly Baroudy and Johannes Woelcke, The World Bank
www.worldbank.org

10. Emas Taquari biodiversity carbon project

Location

Brazil

Objectives

- Reforest degraded areas with native tree species for CO_2 removal.
- Connect remaining Cerrado (Brazilian Savannah) fragments in order to generate employment and income for traditional and rural communities.
- Protect biodiversity and fresh water resources.

Implementing organization and partners

Conservation International Brazil and Oreades Geoprocessing Center

Project duration

7 years (2008–2015)

Project stage

Validation phase

Activities and implemented change

Before the project, the area was used for extensive crop farms such as soya, cotton and sugarcane and cattle ranching.
As a result of the project, the deforested areas were planted with native trees that had been used illegally for livestock and crop production rather than set aside for conservation according to Brazilian environmental law.

No. of households

n.a.

Size

681 ha

Estimated CO_2 benefits per ha per year

11.6 tCO_2/ha/yr

Estimated total amount of CO_2 benefits

236 846 tonnes CO_2

Contact and website

Artur Paiva: a.paiva@conservacao.org
www.climate-standards.org/projects/files/goias_brazil/PDD_Emas%20Taquari_CCBA_English.pdf
www.conservacao.org

11. Forest conservation, carbon and coffee in Sumatra

Location

Indonesia

Objectives

- Examine, understand and explain the relationship between coffee growing and forest conservation (deforestation), and determine an appropriate strategy to promote basic coffee sustainability and forest conservation in North Sumatra.
- Explore the use of the carbon market as a sustainable funding source.

Implementing organization and partners

Conservation International and Starbucks, coffee cooperatives, the district government, village communities.

Project duration

3 years (2008–2011)

Project stage

Feasibility phase

Activities and implemented change

Prior to the implementation of the project, there was limited technical expertise on coffee production in North Sumatra, which had low yields. A strong link was observed between coffee production and deforestation.
As a result of the project, practices are supported that improve yield and extend the productivity of coffee stands, e.g. organic fertilizer, the use of shade trees, improved stand maintenance.

No. of households

128

Size

1 679 ha

Estimated CO_2 benefits per ha per year

n.a.

Estimated total amount of CO_2 benefits

n.a.

Contact and website

Terry Hills: t.hills@conservation.org

12. Community Markets for Conservation (COMACO)

Location
Zambia

Objectives

- Increase food and income security for rural shareholders.

Implementing organization and partners
COMACO and the Wildlife Conservation Society

Project duration
30 years (2009–2039)

Project stage
Feasibility phase

Activities and implemented change
Before the project, the practices were traditional *chitemeni* (slash-and-burn shifting agriculture) using tillage but very low levels of inorganic fertilizer. Croplands are under increasing agricultural pressure due to declining soil fertility and in-migration. In the plateau areas, a mix of conservation and traditional techniques is found, with cotton and tobacco representing a significant proportion of crop activity and leading to declining soil fertility.
The project aims at conservation farming with intercropping of Faidherbia Albida Trees.

No. of households
51 000

Size
19 583 ha

Estimated CO_2 benefits per ha per year
7.6 tCO_2/ha/yr *

Estimated total amount of CO_2 benefits
4,4 million tonnes CO_2 *

Contact and Website
www.itswild.org

* subject to change, as project is still in planning stage

13. Dunavant cotton carbon project

Location
Zambia

Objectives

- Interplant nitrogen-fixing Faidherbia Albida trees on agricultural fields that will grow maize/soya/groundnuts/cotton, etc. This will substantially increase maize production and remove the need for fossil fuel-based fertilizers.
- Leverage the voluntary carbon markets supports food and income security objectives.
- Province a financial incentive to maintain the tree stand and conservation agriculture practices, while also inherently integrated in a self-sustaining monitoring and evaluation process through the MRV of the credits.

Implementing organization and partners
Dunavant, ACCE and USAID PROFIT providing technical support for carbon asset creation

Project duration
40 years (2010–2050)

Project stage
Feasibility phase

Activities and implemented change
Implementation of agroforestry systems combined with conservation agriculture practices because the land is degraded in the project area .

No. of households
12 000

Size
12 000 ha

Estimated CO_2 benefits per ha per year
7.6 tCO_2/hh/yr *

Estimated total amount of CO_2 benefits
3 648 000 tonnes CO_2 *

Contact and website
www.africacce.com

* subject to change, as project is still in the planning stage

14. Sustainable grazing project

Location
China

Objectives
- Increase the resilience of alpine grazing systems using carbon finance.

Implementing organization and partners
FAO and Chinese national counterparts

Project duration
9 years (2011–2020)

Project stage
Pre-feasibility phase

Activities and implemented change
Before the project, there was strong overgrazing in the region. The project aims at: setting aside degraded pasture; reseeding and fertilizing; and implementing auxiliary measures to increase productivity (e.g. warm sheds to reduce winter mortality, improved feed, develop marketing).

No. of households
150 000

Size
11 000 ha

Estimated CO_2 benefits per ha per year
5.05 tonnes CO_2/ha/yr

Estimated total amount of CO_2 benefits
1 111 726 tonnes CO_2e

Contact and website
leslie.lipper@fao.org
www.fao.org/es/esa/PESAL/index.html

15. Afforestation with hazelnut plantations in western Georgia

Location
Georgia

Objectives
- Reclaim abandoned lands with afforestation for sustainable production of food for local and export markets.
- Provide employment opportunities and technology transfer to local communities.
- Use carbon finance to increase economic returns and reduce risk.

Implementing organization and partners
Agrigeorgia, LLC, Georgia and GET-Carbon USA (project developer); communities in Samegrelo Region of Georgia

Project duration
50 years (2007–2057)

Project stage
MRV phase

Activities and implemented change
In Soviet times, the land was used for intensive tea plantations. After the collapse of the system, tea production was abandoned and the land was left largely unused due to lack of resources, unclear property rights, lack of investment opportunities and a poor resource base. Gradually, original windbreakers were cut down for wood and fuel, and small areas were slashed and burned for grazing and sparse maize production, leading to soil compaction and unsustainable land management practices. In addition, abandoned waste accumulated at several locations, causing severe localized pollution problems.
By contrast, the project establishes tree plantations for nut production, following sustainable, low input agricultural criteria. Degraded areas have been cleaned and replanted with hazelnuts, using a large cultivar set of over ten varieties, including both local varieties (hazelnut is endemic to Georgia and the nearby Black Sea coast) and international varieties. Grass will be kept between tree rows with no land disturbance over the project lifetime. Nature conservation areas covering 200 ha of total project land are an integral part of the project activity and will be protected during the project's lifetime. Finally, a large part of the local population has found employment and training opportunities within the project.

No. of households
250

Size
2 800ha

Estimated CO_2 benefits per ha per year
2.4 t CO_2 /ha/yr on average

Estimated total amount of CO_2 benefits
300 000 tonnes CO_2

Contact and website
Francesco N. Tubiello, GET-Carbon
franci@get-carbon.com (website under construction)

16. Greenhouse gas emissions and organic agriculture

Location
Costa Rica

Objectives

- Determine GHG mitigation on small organic farms to finance agro-ecological management.
- Determine the environmental services, such as carbon sequestration in soils, and nitrous oxide avoidance provided through organic farming practices.
- Promote energetically efficient agriculture.

Implementing organization and partners
Corporación Educativa para el Desarrollo Costarricense (CEDECO, Educational Corporation for Costa Rican Development) and the Humanist Institute for Development Cooperation, HIVOS, Holland.

Project duration
8 years (2003–2011)

Project stage
MRV phase

Activities and implemented change
Before the project, there was a decreasing number of organic farmers and organic production in the region. The benefits of organic farming to reduce GHG and to sequester carbon were not recognized. Due to the project implementation, the farms use organic production techniques in harmony with a certification system, such as the United States Organic Program, European Union Regulations and Japan Agriculture Standard (JAS) Regulations).
The project focuses on adapting and creating methodologies to determine the benefits from organic farming to reduce greenhouse gases and improve carbon sequestration in the farming systems. The project does not propose immediate changes in the organic management, but rather, initiatives are developed to keep and increase environmental benefits and organic production in different regions.

No. of households
50 at present; more than 800 are expected

Size
59.5 ha

Estimated CO_2 benefits per ha per year
80 t CO_2/ha/yr

Estimated total amount of CO_2 benefits
n.a.

Contact and website
www.climaagroecologico.org/documentos.htm
www.cedeco.or.cr

17. Much Kanan K´aax

Location
Mexico

Objectives

- Promote and protect the recovery process of Yucatan Peninsula´s culturally and ecologically significant Mayan forest.
- Generate additional income for community members who live on forest land in order to carry out restoration and protection activities through the sale of carbon credits.

Implementing organization and partners
A.C. UYOOLCHE and United States Agency for International Development (USAID), United Nations Development Programme (UNDP), Federal Government of Mexico

Project duration
14 years (2006–2020)

Project stage
MRV phase

Activities and implemented change
The project promotes a shift from traditional Milpa systems to agroforestry systems.

No. of households
n.a.

Size
1 230 ha

Estimated CO_2 benefits per ha per year
n.a.

Estimated total amount of CO_2 benefits
n.a.

Contact and website
www.uyoolche.org

18. Projeto Viva Rios

Location
Brazil

Objectives

- Generate income from payments for environmental services (PES) and carbon credits for farmers and foresters.
- Rehabilitate degraded areas.
- Introduce rural landowners to environmental credits markets.

Implementing organization and partners
Ação Verde and various Brazilian ministries, universities and federations

Project duration
11 years (2007–2017)

Project stage
Planning phase

Activities and implemented change
Before the project implementation, slash-and-burn was practised, and overgrazing and lack of soil management occurred. New technical agricultural management practices were available, but the small landholders adopted few new techniques and alternatives to increase production.
Due to the implementation of the project, nursery plants have been produced, and the project partners with institutions to implement PES.

No. of households
3 000

Size
5 000 000 ha

Estimated CO_2 benefits per ha per year
12 t CO_2/ha/yr

Estimated total amount of CO_2 benefits
2 000 000 tonnes CO_2

Contact and website
www.acaoverde.org.br/v2/
ftp://ftp.fiemt.com.br/A%E7%E3o%20Verde/

19. Carbon sequestration and rural alternative energy in the Tshilenge Savannah, Kasal Oriental

Location
Democratic Republic of the Congo

Objectives

- Create a carbon sink in the Tshilenge Savannah with the plantation of Jatropha Curcas in order to revalue the marginal soils, provide a renewable energy source and create new economic activities for the local population.
- Use the residuals from the oil extraction as organic fertilizers to be added to the soil and applied to maize and vegetables.

Implementing organization and partners
Community Development Objective/APROPADEK
Congo Basin Partnership Fund and the rural communities in 28 villages in the Tshilinge District

Project duration
2 years (2009–2011)

Project stage
Planning phase

Activities and implemented change
Currently, the land is not used. As a result of the project implementation, Jatropha Curcas is cultivated to support food production and rural energy provision to replace the forest products (charcoal) that are traditionally used. Intercropping Jatropha with food crops on unproductive, marginal land and soil amended by Jatropha grain press residue will sustain the food production, while oil extracted from press will provide alternative domestic energy sources.
Four main activities planned are: (i) the establishment of communal plantations of Jatropha Curcas; (ii) distribution of manual presses for oil extraction and its marketing; (iii) the installation of rural energy systems operating with Jatropha Curcas oil; and (iv) parallel development of handicraft activities (e.g. soap production with the Jatropha Curcas oil).

No. of households 5 400
Size 14 000 ha
Estimated CO_2 benefits per ha per year 20 t CO_2/ha/yr
Estimated total amount of CO_2 benefits 8 400 000 tonnes CO_2
Contact and website

20. Lig afforestation project

Location Ethiopia
Objectives • Produce wood lots that would address the demand for different uses: industrial, construction and fuelwood. • Stabilize the ecosystem of the area through the mitigation of soil erosion. • Serve as an alternative income-generating activity for the communities living around the selected site. • Conduct an environmental business in agricultural CDM.
Implementing organization and partners Bager Safe Environment for Health Services Plc, the community and the local government
Project duration 5 years (2010–2015)
Project stage Planning phase
Activities and implemented change Before the project, the farming practices around the project area were mainly categorized by mixed farming crops and livestock. The project will be implemented on land area where land degradation is prominent. Soil conservation-based agricultural development will be executed. Agroforestry practices will be the main farming practices of the proposed project.
No. of households 50
Size 106 ha
Estimated CO2 benefits per ha per year n.a.
Estimated total amount of CO2 benefits n.a.
Contact and website

21. Increasing forest habitat and connectivity along the Ipanema/Caratinga/Sossgeso corridor

Location Brazil
Objectives Restore forests on degraded lands. • Expand forest habitat and connectivity to conserve endangered forest species and protect freshwater resources. • Promote human welfare through with the use of best production practices.
Implementing organization and partners Associação para Preservação do Muriqui and Conservation International; Fundação SOS Mata Atlântica; Instituto Estadual de Florestas (MG)/ Programa de Apoio ao Desenvolvimento Sustentável da Zona da Mata de Pernambuco (PROMATA); Prefeitura Municipal de Caratinga; Citi Foundation
Project duration 30 years (2010–2040)
Project stage Planning phase
Activities and implemented change Before the project, there were traditional coffee plantations; extensive pastures were used for cattle; and the farming practices did not comply with Federal and state environmental legislations. The project aims to stimulate compliance with federal and state legislations (mostly with respect to the protection of freshwater resources and erosion prone lands) and support forest restoration demands. Best coffee and cattle ranching practices will be stimulated through certified market opportunities.

No. of households
40–50

Size
Target of 600 ha of reforestation; activities spread throughout a territory of approximately 60 000 ha

Estimated CO_2 benefits per ha per year
8.95 tCO_2e/ha/yr

Estimated total amount of CO_2 benefits
61 100 tonnes CO_2e

Contact and website

22. Climate Plus: Sustainable farm management practices that mitigate climate change and help farmers adapt to its impacts

Location
Multiple – El Salvador, Guatemala, Ghana, Kenya, United Republic of Tanzania, Indonesia and Brazil

Objectives

- Build on existing criteria and indicators for climate-friendly farming practices and develop new ones to be coordinated with the Sustainable Agriculture Network (SAN) Standard – a rigorous standard against which farms are audited to achieve Rainforest Alliance certification.
- Identify current and new criteria and indicators that demonstrate best practices that farmers can implement to contribute to climate change mitigation and increase their farms' resilience and adaptation to a changing climate. The criteria and indicators developed will be bundled as an add-on, voluntary module to the current SAN Standard against which farms achieve Rainforest Alliance certification. This module will facilitate farmer implementation of practices that reduce GHG emissions, enrich on-farm carbon storage, mitigate climate change impacts on communities and ecosystems and help farmers adapt to climate change.
- The project's focus will be: (i) research on the climate impacts of farming practices by crop and in certain locations; (ii) selection of criteria and consultation on the criteria around pilot sites; (iii) demonstration of the value of the criteria in practice; and (iv) creation of training materials to make climate-friendly farming accessible for farmers and agronomists.

Implementing organization and partners
Rainforest Alliance and members of the Sustainable Agriculture Network (i.e. Fundación Interamericana de Investigación Tropical), Efico, the Efico Foundation, Anacafe (National Coffee Association of Guatemala) and the Universidad del Valle of Guatemala initiated project activities in Guatemalan coffee farms. With support from Caribou Coffee and other institutions, the project is now being expanded to new countries and crops.

Project duration
2.5 years (2009–2011)

Project stage
Planning phase (project activities in Guatemala are expected to conclude in July 2010; in El Salvador by August 2010; and in other countries, by March 2011)

Activities and implemented change
Project activities include: measuring carbon storage on selected farms; testing assumptions regarding best management practices to reduce GHG emissions; conducting comparative farm research; holding stakeholder workshops and consultation events; and carrying out pilot audits of the climate module.
Capacity building for climate change mitigation and resilience strategies among farmers, technicians, and auditors of the Sustainable Agriculture Network Standard is another key project activity.

The project will incorporate a variety of practices including:
Mitigation practices: more efficient energy use; optimized fertilizer use; carbon stock management; reforestation; biological corridors; advanced water management; Integrated Pest Management; waste management; and ecosystem conservation.
Adaptation practices: identification of climate change risks and practices for adaptation; implementation of tools and methods to monitor climate change; and definition of farm resources to contribute to community climate change programmes.

No. of households: n.a.

Size: na

Estimated CO_2 benefits per ha per year
n.a.

Estimated total amount of CO_2 benefits: n.a.

Contact and website
Rainforest Alliance: climate@ra.org
www.rainforest-alliance.org/climate
Efico: Katrien Delaet -info@efico.com
www.efico.com, www.eficofoundation.org

5. Summary and outlook

This report provides a sample of the ongoing projects targeting the mitigation of GHGs in agriculture. The sample overview gives an important learning opportunity for understanding the meaning of mitigation efforts, their scope, emphasis, ideas and innovations.

The short introductions to some of the initiatives, and the overview of all projects show the variety and diversity of initiatives under way in terms of implemented activities, objectives, carbon market orientation, size and location. Most of the initiatives are recent and under development. The entry points to the projects are all linked to unsustainable or low productivity land management practices, having caused land degradation. The projects' direction is generally towards improving the agricultural or forestry practices by introducing new techniques, as well as rehabilitating degraded soils. Agroforestry is a practice that is part of many of these GHG mitigating projects, because it contributes both above- and below-ground to carbon sequestration, as well as providing other important co-benefits. Conservation agriculture is another technique that plays an important role in climate friendly projects, as well as organic production techniques and bioenergy.

Some of the projects from this inventory have a carbon market orientation as they aim to generate carbon credits to be sold on markets. These are all at different stages, with only two projects in the payment phase. Several projects are in the feasibility or planning phases and still need to undergo the preparation of the documentation material for a carbon project to be submitted to the voluntary or regulatory market. In addition, there are several projects aiming to reduce the release of GHGs by introducing new techniques and providing carbon sinks but that do not foresee generating carbon credits from these activities.

A striking feature of the survey projects is the multiplicity of benefits in terms of adaptation, productivity increases and support to development objectives. Many important environmental benefits are seen off-site. They seem to be a generic feature of mitigation practices and should be taken into account when considering possible mechanisms for the payment of environmental services.

It makes eminent sense to adopt climate smart farming practices with important synergies between productivity, adaptation and mitigation. The environmental services provided by the farmers should be remunerated in some way. The specific demands of the agricultural production, the need for investments for improved farming practices, the slow process of the accumulation of carbon and the time lag for increased productivity all create a challenge for financial mechanisms that could facilitate the transformation of current agricultural systems to climate smart agriculture. Similarly, the sheer number of the farming units and their generally relatively small size and modest amount of carbon accumulated per hectare all call for innovative rethinking in financing systems. The lessons learned from PES schemes can already provide some indications for the direction to follow, and additional lessons can be drawn through these new types of projects; however, there is also need to quickly adjust financing and accounting systems in order to integrate smallholder farmers into agricultural mitigation activities so that they may reap the full benefits. Therefore, it will be truly significant to follow the activities and, it is hoped, increase opportunities for all those interested to share lessons and learn from each other.

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Annex

Annex I

GHG mitigation potentials of different land use systems – some examples

Example 1: Rangelands

Table 8 summarizes 304 published reports of the carbon sequestration effects of various management practices in diverse rangelands globally.

Table 8. Carbon sequestration potential of rangeland management practices

Management practice	Mean change in tCO_2e/ha/yr
Vegetation cultivation	9.39 tCO_2e/ha
Avoided land cover/land use change	0.40 tCO_2e/ha
Grazing management	2.16 tCO_2e/ha
Fertilization	1.76 tCO_2e/ha
Fire control	2.68 tCO_2e/ha

Source: Tennigkeit and Wilkes, 2008.

Example 2: Agroforestry systems

In agroforestry systems, the carbon sequestration potential depends on a variety of factors: the type of systems, species composition, age of component species, geographic location, environmental factors and management practices. Some examples of studies are given here, but since different methodologies might have been used, real comparisons are difficult. The original sources should be consulted for more information:

- Fodder bank agroforestry systems in West Africa: 1.06 tCO_2/ha/yr (Nair, Kumar and Nair, 2009)
- Homegardens in Sumatra, Indonesia: 29.3 tCO_2/ha/yr (Nair, Kumar and Nair, 2009)
- Mixed species stands in Puerto Rico 55.77 tCO_2/ha/yr (Nair, Kumar and Nair, 2009)
- Agroforestry systems in the United States: soil carbon: 2.45 t/CO_2e/ha/yr; land emissions, N_2O and CH_4: 2.42 t CO_2e/ha/yr; process and upstream: 1.52 t CO_2e/ha/yr => Total 6.37 t CO_2e/ha/yr (Eagle *et al*., 2010)
- Coffee-based systems in Kenya: 1.8 tCO_2/ha/yr (Forest Trends, 2010)

Example 3: Conservation tillage

Different reviews assess the impact of conservation tillage on soil carbon sequestration:

- Global analysis (global database of 67 long- term cultivation agricultural experiments, consisting of 276 paired treatments): change from conventional tillage to no-tillage sequesters 2.09 ± 0.51 t CO_2/ha/yr (West and Post, 2002)
- The United States of America: soil carbon: 1.17 t CO_2e/ha/yr; land emissions, N_2O and CH_4: -0.18 t CO_2e/ ha/yr; process and upstream: 0.14 t CO_2e/ha/yr => Total 1.12 t CO_2/ha/yr (Eagle *et al*., 2010)

Example 4: Other farming systems

Maize-based systems in sub-Saharan Africa with residue management, crop residue composting and application as manure and plantation of fuelwood trees: 2.1 tCO_2/ha/yr (Forest Trends, 2010)

Example 5: Savannahs

Sequestration rates range from 1.83 tCO_2e ha/yr in temperate steppe and 2.57 t CO_2e/ha/yr in tropical dry savannas to 12.47 tCO_2e/ha/yr in tropical humid savannas (Parton *et al.,* 1995, as cited in Tennigkeit and Wilkes, 2008).

Annex II

Methodologies

(1) VCS Methodologies

a) Adoption of Sustainable Agricultural Land Management (SALM)

The methodology is aimed to estimate and monitor greenhouse gas (GHG) emissions of project activities that reduce emissions in agriculture by applying sustainable land management practices (SALM). Carbon stock is enhanced in agricultural areas in the above-ground, below-ground and soil carbon pool. This methodology is applicable to projects that introduce SALM into an agricultural landscape subject to conditions such that soil organic carbon would remain constant or decrease with time in absence of the project. The methodology is based on the project activity "Western Kenya Smallholder Agriculture Carbon Finance Project" in Kenya. The baseline study and the project document are being prepared by the foundation *Vi Planterar trad* ("We plant trees"), with assistance from the Unique Forestry Consultants Ltd., the Swedish International Development Agency (Sida) and the International Bank for Reconstruction and Development as Trustee of the BioCarbon Fund.

The methodology uses input parameters for analytic models accepted in scientific publications to estimate the organic soil carbon density at equilibrium in each of the identified management practices in each of the land use categories. The applicability conditions of the methodology limit the leakage that may occur because of the project.

www.v-c-s.org/docs/SALM%20Methodolgy%20Final_%20validation.pdf

b) Agricultural Land Management (ALM) Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing

This methodology is applicable to projects that introduce sustainable adjustment of the density of grazing animals and the frequency of prescribed fires into an uncultivated grassland landscape. The methodology shows how to determine additional carbon offsets through grassland soil sequestration and/or reduction in methane emissions as a result of reducing fire frequency and altering the density and/or activities of grazing animals.

www.v-c-s.org/docs/AFOLU%20ALM%20Adoption%20of%20Sustainable%20Grassland%20Management%20through%20Adjustment%20of%20Fire%20and%20Grazing.pdf

(2) CDM Methodologies (AM= approved large-scale methodology; AMS= approved small-scale methodology; ACM= approved consolidated methodology) http://cdm.unfccc.int/methodologies/index.html

Agriculture:

- AM0073 - GHG emission reductions through multi-site manure collection and treatment in a central plant
- ACM0010 - Consolidated methodology for GHG emission reductions from manure management systems

Small scale simplified baseline and monitoring methodologies:

- AMS-III.A. - Urea offset by inoculant application in soybean-corn rotations on acidic soils on existing cropland
- AMS-III.D - Methane recovery in animal manure management systems
- AMS-III.R. - Methane recovery in agricultural activities at household/small farm level

Afforestation/Reforestation:

- AR-AM0002 - Restoration of degraded lands through afforestation/reforestation
- AR-AM0004 - Reforestation or afforestation of land currently under agricultural use
- AR-AM0005 - Afforestation and reforestation project activities implemented for industrial and/or commercial uses
- AR-AM0006 - Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land
- AR-AM0007 - Afforestation and Reforestation of Land Currently Under Agricultural or Pastoral Use
- AR-AM0009 - Afforestation or reforestation on degraded land allowing for silvopastoral activities
- AR-AM0010 - Afforestation and reforestation project activities implemented on unmanaged grassland in reserve/protected areas
- AR-ACM0001 – Consolidated methodology - Afforestation and reforestation of degraded land
- AR-ACM0002 - Consolidated methodology - Afforestation or reforestation of degraded land without displacement of pre-project activities
- AM0042 - Grid-connected electricity generation using biomass from newly developed dedicated plantations
- AM0082 - Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system

Small scale simplified baseline and monitoring methodologies:

- AR-AMS0001 - Small-scale afforestation and reforestation project activities under the CDM implemented on grasslands or croplands
- AR-AMS0002 - Small-scale afforestation and reforestation project activities under the CDM implemented on settlements
- AR-AMS0003 - Small scale CDM afforestation and reforestation project activities implemented on wetlands
- AR-AMS0004 - Small-scale agroforestry - afforestation and reforestation project activities under the CDM
- AR-AMS0005 - Small-scale afforestation and reforestation project activities under the CDM implemented on lands having low inherent potential to support living biomass
- AR-AMS0006 - Small-scale silvopastoral - afforestation and reforestation project activities under the CDM

(3) Plan Vivo Foundation Standard

The Plan Vivo Standards are part of a broader Plan Vivo System, which is a framework for planning, managing and monitoring the supply of verifiable emission reductions (VERs) from community-based land-use projects.
The project participants are small-scale producers and communities in developing countries. They create sustainable land-management plans by combining current land uses with additional eligible project activities:

- Afforestation and reforestation

- Agroforestry
- Forest restoration
- Avoided deforestation

http://planvivo.org.34spreview.com/documents/standards.pdf

(4) Other methods:

CO2FIX

The development of the current, stand-level carbon budget model CO2FIX considers:

- aspects of climate change mitigation projects at the landscape level;
- reliability of modelling tree growth and soil carbon;
- choices and definitions of adopted articles of the Kyoto Protocol;
- permanence, accounting and cost efficiency of carbon sequestration;
- bioenergy options.

The developed CO2FIX model is intended to provide users with a tool to analyse the outcome of different afforestation and reforestation, and forest management options as specified in the Kyoto Protocol. It is a user-friendly tool designed to calculate all carbon fluxes in forest stands, forest-derived products and bioenergy technologies based on forest slash and industrial residues.

www.efi.int/projects/casfor/

This global survey of agricultural mitigation projects provides a summary of the state-of-the-art of different projects currently developed in this sector. It contains data on 50 agricultural projects focusing on climate change, of which 22 were developed specifically with a greenhouse gas (GHG) mitigation objective. The data on the projects were submitted to an online survey in April 2010. The inventory is by no means meant to provide a complete picture of all currently developed agricultural mitigation projects, but rather aims to provide an overview of the status of activities within this field. The analysis reflects on the focus of these projects, their objectives and main activities, the entry points for their establishment, as well as the management of the carbon benefits. More in-depth information is provided on 22 case studies. The report contributes to the current discussion on finding ways to integrate smallholder farmers into agricultural mitigation activities, and calls for developing financial mechanisms that could facilitate the transformation of current agricultural systems to climate-smart agriculture.

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