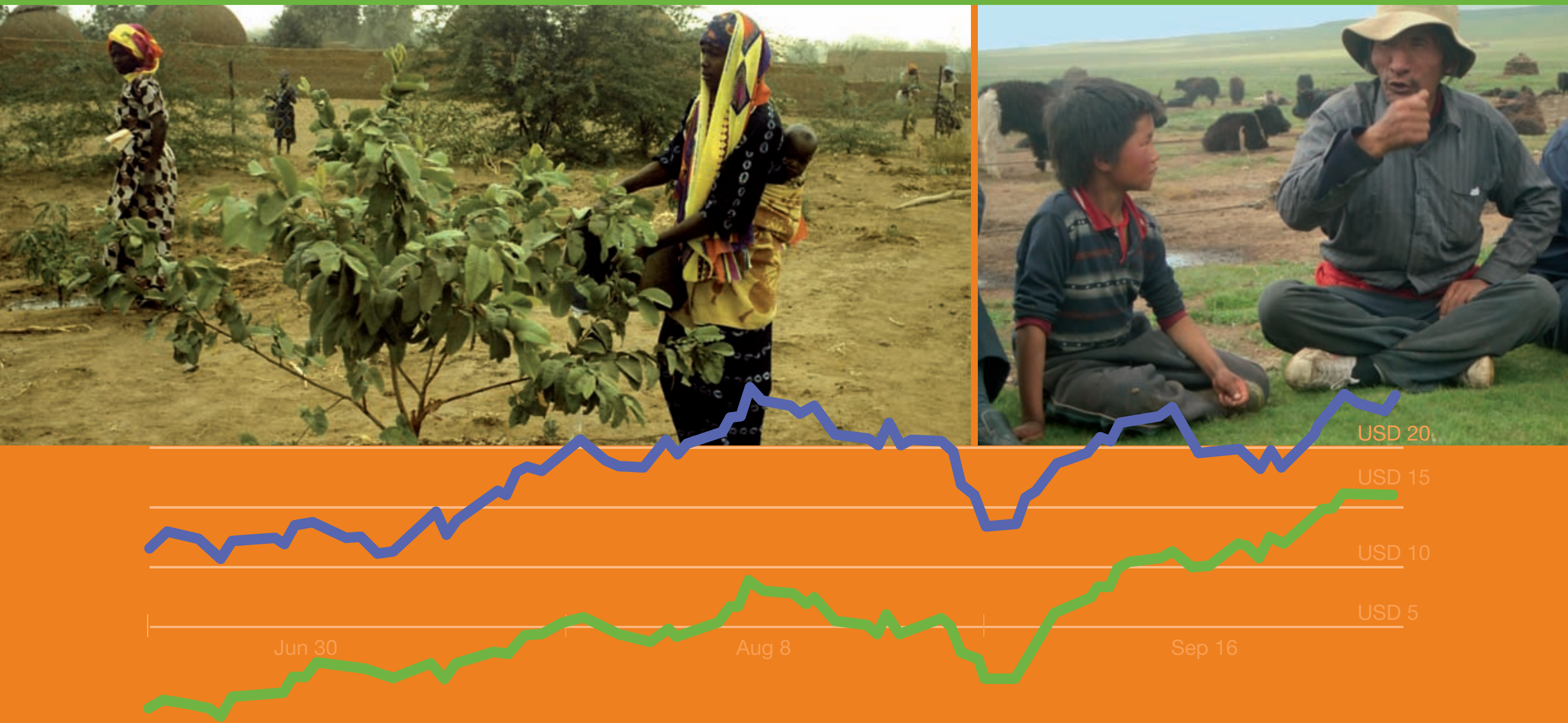
# Climate Change Mitigation Finance for Smallholder Agriculture

## A guide book to harvesting soil carbon sequestration benefits



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# Acknowledgements

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# Acronyms and abbreviations

| | |
|---|---|
| AFOLU | Agriculture, forestry and other land use |
| ALM | Agricultural land management |
| APD | Avoiding planned deforestation |
| AR4 | Fourth Assessment Report (of the IPCC) |
| ARR | Afforestation, reforestation and revegetation |
| AUFDD | Avoiding unplanned frontier deforestation and degradation |
| AUMDD | Avoiding unplanned mosaic deforestation and degradation |
| AWG-LCA | Ad-Hoc Working Group on Long-term Cooperative Action under the Convention (see UNFCCC below) |
| AWG-KP | Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol |
| BioCF | BioCarbon Fund (World Bank) |
| BNDES | Banco Nacional de Desenvolvimento Econômico e Social (Brazilian Development Bank) |
| C | Carbon |
| CAR | California Climate Action Reserve |
| CCBA | Climate, Community & Biodiversity Alliance |
| CCX | Chicago Climate Exchange |
| CDM | Clean Development Mechanism |
| CERs | Certified emissions reductions (under CDM) |
| CF | Carbon Fund |
| CGLC | Cropland and grassland land-use conversions |
| $CH_4$ | Methane |
| $CO_2$ | Carbon Dioxide |
| COP | Conference of the Parties (under UNFCCC) |
| DFID | Department for International Development (United Kingdom) |
| DNA | Designated national authority |
| DNDC | DeNitrification-DeComposition |
| ECCM | Edinburgh Centre for Carbon Management |
| ECOSUR | El Colegio de la Frontera Sur (Mexico) |
| ENCOFOR | ENvironment and COmmunity based framework for designing afFORestation, reforestation and revegetation projects in the CDM: methodology development and case studies (EU funded) |
| ERs | Emissions reductions |
| ERA | Extended rotation age/cutting cycle |
| ERPA | Emissions reduction purchase agreement |
| EU-ETS | European Union Emissions Trading System |
| EX-ACT | Ex-Ante Appraisal Carbon-balance Tool |
| FAO | Food and Agriculture Organization of the United Nations |
| FAS | Fundação Amazonas Sustentável (Brazil) |
| GCF | Green Climate Fund |
| GDP | Gross domestic product |
| GHG | Greenhouse gas |

| | |
|---|---|
| GtC | Gigatons of carbon |
| ICM | Improved cropland management |
| ICRAF | World Agroforestry Centre |
| IFC | International Finance Corporation |
| IFI | International financial institution |
| IFM | Improved forest management |
| IGM | Improved grassland management |
| IPCC | Intergovernmental Panel on Climate Change (UN) |
| LDCs | Least-developed countries |
| LULUCF | Land use, land-use change and forestry (precursor to AFOLU) |
| LtHP | Low- to high-productive forest |
| LtPF | Logged to protected forest |
| Mha | Millions of hectare meters |
| MRV | Measurement, reporting and verification |
| NAMA | Nationally appropriate mitigation action |
| NAP | National allocation plan |
| NAPAs | National adaptation programmes of action |
| $N_2O$ | Nitrous oxide |
| NGO | Non-governmental organization |
| NRM | Natural resources management |
| NSW GGAS | New-South Wales Greenhouse Gas Reduction Scheme |
| PDD | Project design document |
| PES | Payment for environmental services |
| PIN | Project idea note |
| PoA | Programme of activities |
| PS | Panda Standard |
| REDD | Reducing emissions from deforestation and forest degradation (UN) |
| REDD+ | Includes the role of conservation, sustainable management of forests, enhancement of forest carbon stocks and support to local communities dependent on forests |
| RGGI | Regional Greenhouse Gas Initiative (Northeastern and mid-Atlantic US states) |
| RIL | Reduced impact logging |
| SALM | Sustainable agricultural and land management |
| SBSTA | Subsidiary Body for Scientific and Technological Advice (under the UNFCCC) |
| SD-PAMs | Sustainable development policies and measures |
| SGM | Sustainable grassland management |
| SOC | Soil organic carbon |
| $tCO_2e$ | Tonnes of $CO_2$ equivalent |
| UNFCCC | United Nations Framework Convention on Climate Change |
| US | United States of America |
| VCS | Verified carbon standard |
| VERs | Verified emissions reductions (voluntary market) |
| WCI | Western Climate initiative (covers 11 US states and Canadian provinces) |

# Context and overview

Globally, the agricultural sector is an important source of greenhouse gas (GHG) emissions, and projections indicate that these emissions will increase if agricultural growth and development proceeds under a 'business-as-usual' model of technology and resource use. For example, agricultural nitrous oxide ($N_2O$) emissions are projected to grow by 35-60% up to 2030 due to increases in both nitrogen fertilizer use and animal manure production (FAO 2003 cited in IPCC 2007). The Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC) notes that food demand and dietary shift projections indicate that annual emissions of GHGs from agriculture may escalate further (IPCC 2007). At the same time, agricultural growth is a key component of economic development and food security strategies for developing countries, where the agricultural sector is often the largest sector in terms of gross domestic product (GDP) and employment. In the next 20 years, major transitions in developing country agriculture will inevitably occur in response to growing populations, and changes in national and global economies, markets and climate. These transitions will necessitate innovations in agricultural technologies and practices as well as institutions, and there exists a range of options that could be pursued to meet these challenges.

At present, there is increasing interest in 'climate smart agriculture' (CSA) options, particularly in developing countries that incorporate necessary adaptation into agricultural growth strategies for food security and poverty reduction, and that also capture potential mitigation co-benefits (FAO 2010). Low-emission agricultural growth strategies will entail different levels and types of investment, as well as operating and opportunity costs. Assessing GHG emissions associated with various trajectories of smallholder agricultural development and related public and private costs of reducing them is thus an important requirement for achieving CSA. This presents an opportunity to identify solutions that generate both private (food security, returns to agriculture) and public (mitigation) benefits. Financing for mitigation services generated by the sector could provide a potentially significant additional funding source to support investments to assist developing countries in adopting low emissions pathways to agricultural development and poverty reduction.

The AR4 identifies soil carbon sequestration as the highest potential source of mitigation from the agricultural sector – from both technical and economic perspectives (Smith et al 2007). Two main features of soil carbon sequestration drive this conclusion: the tremendous area and thus aggregate levels of sequestration that could be achieved by increasing carbon in soils, and the low costs associated with this form of emissions reduction, since the changes in farming practices required to increase carbon in agricultural soils often generate benefits to agricultural production in the long run, as well as mitigation benefits. Although this potential synergy between mitigation and agricultural development has generated much interest (FAO 2009), concerns about the lack of ability to achieve a system for the MRV of emissions reductions (ERs) from this source have hampered progress in tapping this potential means of mitigation.

To date, there is still relatively little field experience with crediting mitigation from soil carbon sequestration in agricultural systems in a project setting. There are also very few methodologies and approaches for crediting such benefits from smallholder agricultural systems, but there is a small and growing body of experience being built. So far, the contribution from agricultural soil carbon sequestration to climate change mitigation efforts has been mostly limited to two experimental programmes in developed countries, namely, the Chicago Climate Exchange (CCX) in the United States (US), and the Alberta Carbon Exchange in Canada. In developing countries there has been some progress with costly project-based approaches to generating offsets for the voluntary market, in anticipation of their eventual acceptance into compliance markets. The low prices, however, for agriculture, forestry and other land use (AFOLU) offsets results in relatively few opportunities to capture agricultural mitigation benefits in developing countries in this manner. While information on the biophysical potential for GHG abatement strategies is growing, the implementation potential in general, and in particular the involvement of smallholders, continues to face substantial challenges.

Thus, at this stage, it becomes important to take stock of the opportunities and obstacles of the project-based approach for the agriculture sector, and distil lessons to inform the development of broader mechanisms that can combine mitigation objectives with development goals.

Building on FAO policy advice and incorporating lessons from ongoing agricultural carbon finance projects of FAO and other organizations, this document aims to provide an overview of potential mitigation finance opportunities for soil carbon sequestration. The first part provides an overview of the opportunities for climate change mitigation from agricultural soil carbon sequestration, the emerging policy options and consequent institutional mechanisms for financing such mitigation, and the opportunities for smallholders to participate in them. The second part is aimed primarily at carbon project developers and decision makers at national level concerned with environmental and agriculture policies and incentives, and non-governmental organizations (NGOs) and farmers' associations working towards rural development and poverty alleviation. It provides step-by-step practical support to project development.

This FAO publication focuses on climate change mitigation financing for smallholders. The Organization, however, fully recognizes that adaptation may be the imperative and priority over the short and medium term for many smallholders in circumstances where climate change may adversely impact their efforts to overcome poverty and food insecurity. In many cases, most countries will need to deal with both adaptation and mitigation. FAO is supporting national efforts on CSA which seek to enhance the capacity of the agricultural sector to sustainably support food security, livelihoods and growth under climate change, incorporating the need for adaptation and the potential for mitigation into development strategies. Climate change mitigation financing can play a role, along with other sources of financing, in enabling climate smart agriculture.

Overview of the structure of this guidebook:

## PART I

### Climate change mitigation finance for smallholder agriculture in the context of agricultural development and poverty reduction

1. The role of mitigation finance in meeting challenges facing developing country agriculture
2. Agriculture greenhouse gas (GHG) emissions and mitigation potential
3. Overview of current status of carbon finance for smallholder agriculture: Where are the opportunities?
4. Measurement, reporting and verification (MRV) of agricultural mitigation activities
5. Capturing agricultural mitigation benefits from smallholder agriculture: What next?

## PART II

### A guide to developing soil carbon sequestration crediting projects in smallholder agriculture

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9. Conclusions and lessons from experience with project-based offsets

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# PART I

## Climate change mitigation finance for smallholder agriculture in the context of agricultural development and poverty reduction

# The role of mitigation finance* in meeting challenges facing developing country agriculture

1

Food insecurity and climate change challenges are increasingly seen as being interdependent – shaped by a confluence of different pressures that converge within the agriculture sector – population size and commensurate food demand are increasing; competition for food, land, water, energy and carbon storage is intensifying; degradation of natural resources is expanding; and solutions for climate change are becoming more urgent. Different agricultural practice and policy options may result in trade-offs and synergies across the two challenges. Mitigation finance is progressively being looked at as a new opportunity to support farmers in improving agricultural production and land management to enhance productivity as well as the capacity of the sector to adapt to and mitigate climate change.

The agricultural sector in developing countries is called upon to deliver multiple benefits – food, income, employment and environmental services – under increasing demand from rising populations, particularly in areas of greatest food insecurity. These increasing demands are occurring in the wake of decades of declining investments in the sector. Bruinsma (2008) projects that a 70% increase in agricultural production will be needed to meet food demands by 2050, and most of that increase will need to come from agricultural intensification. At the same time, analyses of near-term effects of climate change indicate that developing country agriculture, particularly in sub-Saharan Africa, is likely to experience increased variability and incidence of severe climate shocks, thus reducing productivity and livelihoods (Lobell et al 2008; Fischer 2009). These projections indicate the pressing need for widespread transitions in smallholder agricultural systems in developing countries—to improve productivity, resilience in the face of variability and, ultimately, the benefits farmers can realize from their systems.

According to IPCC 2007, agriculture is currently responsible for about one third of the World's GHG emissions[1] and this share is projected to grow, especially in developing countries. At the same time, the sector also has high mitigation potential, particularly through improvements in land-use management: 89% of IPCC-identified technical potential lies in enhancing soil carbon sinks. Initial studies indicate that the long-term social costs of adopting such measures decrease as agricultural productivity, stability and ultimately profitability increase (FAO 2010; McKinsey 2009; FAO 2009). There are, however, substantial costs and barriers to overcome in the short run to realize the level of change required to achieve significant mitigation benefits (McCarthy et al 2011; Thornton and Herrero 2010).

*Mitigation finance can be inclusive of a broad range of: (i) financing sources, i.e. public, private, innovative, and possibly combinations of these; and (ii) financing mechanisms, including compliance cap-and-trade systems such as the Clean Development Mechanism (CDM), voluntary markets which have a higher portion of land-based credits, and public funds such as that of the Global Environment Facility (GEF) and other climate finance instruments used by the World Bank, as well as Fast Start Climate Finance and the Green Climate Fund (GCF).

1 This includes impact of agricultural expansion on land use change and emissions.

Thus, enhancing carbon in smallholder agricultural systems, particularly in soil carbon stocks, has the potential to generate synergies between food security, adaptation and mitigation (FAO 2009). Financing is a key means of capturing these synergies, which explains the interest in the concept of linking mitigation finance to carbon-rich[2] transitions in smallholder agricultural systems. The carbon finance model is one type of Payment for Environmental Services (PES).[3] This guide has been developed to provide an overview of the potential and requirements for linking mitigation finance to changes in land management in smallholder agriculture, as well as more practical guidance on how to proceed in field-based situations.

As we will argue in this report, however, mitigation financing modalities based on project-based offsets are unlikely to become a significant channel of financing to smallholder agriculture in developing countries in the short run. This is due to three main factors: the relatively low demand for such credits, the high transactions costs relative to potential value generated, as well as the potential conflicts between mitigation and development objectives that can arise in the context of achieving additionality and permanence.[4] Today, carbon finance transactions for the Agriculture, Forestry and Other Land Use (AFOLU) sector remain limited in regulated cap and trade emissions reduction markets such as the Clean Development Mechanism (CDM). They play a larger role, however, in the voluntary carbon market. The potential for new dedicated public funds possibly combined with private sector funding for nationally appropriate mitigation actions (NAMAs) in developing countries, currently under discussion in the United Nations Framework Convention on Climate Change (UNFCCC) negotiation process, increases the importance of looking carefully at the potential opportunities and barriers to linking carbon finance to the AFOLU sector at this time.

## 1.1 Agriculture, food security and climate change in post-Copenhagen UNFCCC processes [5]

Article 2 of the UNFCCC[6] acknowledges that, in establishing a timeframe for achieving stabilization of greenhouse gases (GHGs) in the atmosphere, economic development, ecosystem resilience and food production (all of which relate to agriculture in a large number of developing countries) would need to be taken into account.

Heightened awareness of the potential of agricultural mitigation has generated broader interest by a growing number of parties in having agriculture included in ongoing international work on climate change, as was reflected during international negotiations under the UNFCCC. That being said, in both

2 In contrast to usual references to "low-carbon" transitions or pathways, we use the term "carbon-rich smallholder transition" to indicate the importance of increasing carbon stocks in agricultural development.

3 Payment for Environmental Services (PES): A concept linking the provision of an environmental service, e.g. adoption of improved land management resulting in less soil erosion, with the generation of revenues for the provider of such services, so that the provider is compensated for potential income reductions resulting from the adoption of the improved practices. The buyer, through investment in improved practices, profits from the enhanced environmental conditions and services rendered, e.g. from reduced silting downstream. Thus, all parties benefit from the investment in sustainable land management practices. Smallholders are offered an option to change their practices without income loss and to improve their livelihoods, and are made equal partners in a win-win deal.

4 See section 4.8 for definitions of permanence and additionality.

5 Text from FAO info note: http://foris.fao.org/static/data/nrc/InfoNote_PostCOP15_FAO.pdf

6 "*...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system… should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner*."

Copenhagen 2009 (COP15) as well as in Cancun 2010 (COP16), text on agriculture – including the proposal for a work programme on agricultural mitigation under the Subsidiary Body for Scientific and Technological Advice (SBSTA) – was excluded from the outputs of the Conference of the Parties (COP).

Agriculture, however, has already figured prominently in national adaptation programmes of action (NAPAs) formulated by least-developed countries (LDCs). NAPAs are now to inform new national adaptation plans which – in accordance with the Cancun Agreements – are to be prepared by developing countries.[7] Also, following COP15, a number of developing countries indicated their intention to undertake NAMAs related to agriculture.

The Cancun Agreements outlined in a very general way a number of steps that are to enhance adaptation and mitigation. How countries might move from an international agreement to national implementation with regard to agriculture is still not clear in the absence of explicit guidelines, policies and frameworks for early action. At the same time, the design of international enabling mechanisms, including financing mechanisms such as the Green Climate Fund (GCF), will need to be informed by realities on the ground and the specificities of agriculture in the context of climate change.

Under the Cancun Agreements related to mitigation, developing countries will: (i) undertake NAMAs in the context of sustainable development; (ii) report action seeking international support to the Secretariat to be recorded in a registry; (iii) establish the MRV of agricultural mitigation activities of internationally supported actions;[8] and (iv) be encouraged to develop low-carbon development strategies or plans. The Cancun meeting also resulted in progress on reducing emissions from deforestation and forest degradation (REDD) and REDD+ (which includes reducing emissions from conservation, sustainable management of forests and enhancement of forest carbon stocks), proposing that the Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UNFCCC conduct work on the evidence base on drivers of deforestation. This includes identifying and analyzing agricultural mitigation options which also increase productivity, and which could potentially help to curb the expansion of agricultural lands into forested areas.

The commitment to mobilizing fast-start financing in the Copenhagen Accord was confirmed in the Cancun Agreements. Regarding longer-term financing, a decision was taken to establish a GCF which would manage resources committed to support adaptation and mitigation efforts in developing countries. The Cancun meeting also formally recognized NAMAs—a vehicle for developing countries to receive financing, technology and capacity building to support emissions reduction relative to a business-as-usual emissions scenario for 2020 (World Bank 2011). Thus far, 20 developing countries have submitted NAMAs which include mitigation from agriculture (Meridian Institute 2011). These are likely to form the basis of programmes and projects for Fast Start Climate Financing. The details of longer-term financing under the GCF are still to be developed, but there are expectations that a portion of the targeted amount of US$100 billion per year by 2020 would come from private sources mobilized through carbon markets (World Bank 2011).

7 FCCC/CP/2010/7/Add.11/CP.16, para 16
8 See chapter 4.

There is increasing interest in developing CSA strategies for developing countries that include adaptation, as well as potential mitigation co-benefits in the design of agricultural investments for food security, growth and poverty reduction (see Box 1 below). Identifying measures and strategies that enable countries to address adaptation, food security and mitigation in an integrated fashion is thus important for allowing countries to achieve commitments made, and to access new streams of climate finance. Given the importance of aligning mitigation activities with sustainable development objectives, it is likely that MRV approaches of emissions from agriculture – and particularly soil carbon sequestration – will become an increasingly important issue, albeit for a range of crediting options (not just for offsets). This guidebook is intended then to contribute to the identification of important design features needed to link mitigation finance to agricultural mitigation, focusing on agricultural soil carbon sequestration using lessons learned from emerging pilot projects.

Box 1:
**Transitioning to climate smart agriculture to improve resilience**

**Climate smart agriculture (CSA)** seeks to increase productivity and food security sustainably, strengthen farmers' resilience to climate variability and change, and reduce and remove GHG emissions. One of the main features of CSA is increasing resilience in agricultural production systems to climate shocks such as drought and flooding. FAO 2010c highlights several different examples of how this can be accomplished in diverse situations. Improving soil quality is one of the fundamental activities of CSA, as higher quality soils are better able to retain moisture and reduce runoff—two important features in responding to drought and flooding.

Source: FAO 2009 cited in FAO 2010

# Agriculture greenhouse gas (GHG) emissions and mitigation potential

2

## 2.1 Agriculture's carbon footprint

According to IPCC 2007, the agricultural sector contributes about 14% of total global GHG emissions. If we include the additional 17% resulting from deforestation in tropical areas, which is mainly led by conversion of forestland into crop and pasture land, the sector is responsible for about 31% of total GHG, with energy and industrial-related emissions representing the rest.

If we take an integrated view of the entire food chain for agricultural products, however, overall emissions would be even higher because some of its major emissions sources are reported under transport and other industries. For example, Steinfeld et al (2006) use this approach to calculate emissions from the livestock sector (see Figure 1).

While in the Forestry sector most emissions are from the release of carbon dioxide, agriculture (crop and livestock) is the source of more potent GHGs[9] such as $N_2O$ from fertilized soils and $CH_4$ from organic waste and livestock (Figure 2). Agriculture is responsible for almost half of all anthropogenic $CH_4$ and $N_2O$ emissions, and both of these are projected to increase considerably in the future, particularly in developing countries. $N_2O$ is projected to increase by 35-60% and $CH_4$ by 60% up to 2030 (IPCC 2007a).

Figures 1 and 2 below give an indication of the GHG emissions associated with agriculture's entire food chain (Figure 1) and the relative share of GHG from the sector, compared with other major sources (Figure 2).

### IPCC attribution of GHG emissions from agriculture along the entire value chain

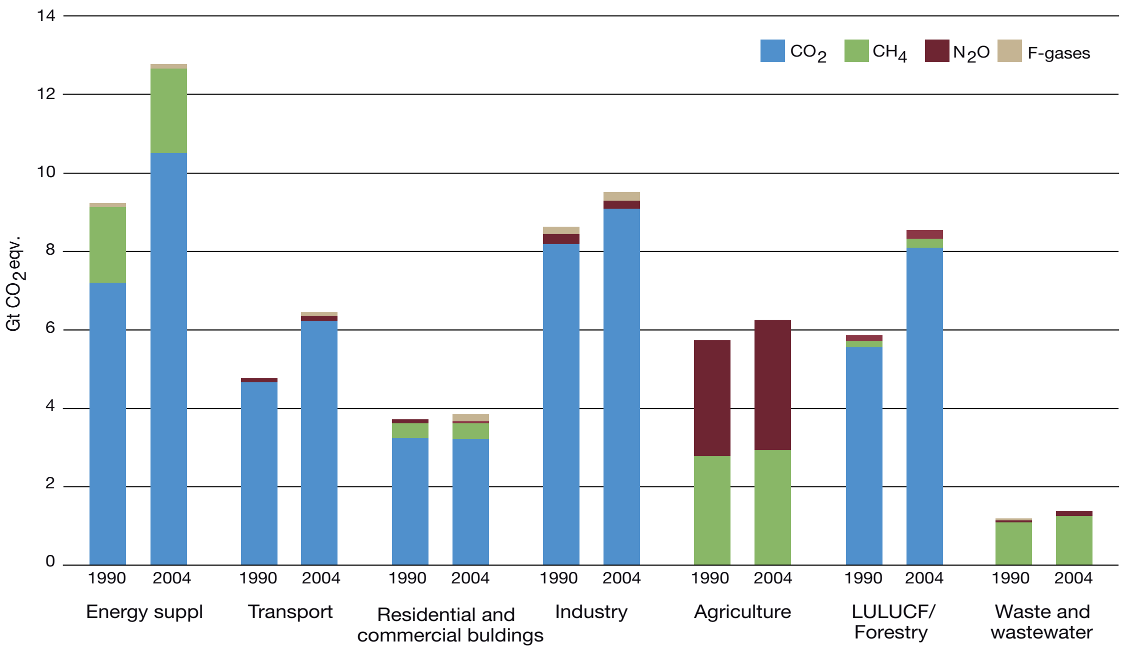
**Figure 1: A life-cycle look into the livestock agriculture sub-sector**

| **Life cycle attribution** | **IPCC attribution** |
|---|---|
| Emission from **feed** production | |
| • Chemical fertilizer fabrication ← | Industry and energy |
| • Chemical fertilizer application ← | Agriculture |
| • On-farm fossil fuel use ← | Energy |
| • Livestock-related deforestation ← | Forestry |
| • C release from ag. solis ← | Agriculture |
| Emission from **livestock rearing** | |
| • Methane from enteric fermentation ← | Agriculture/livestock |
| • Methane and Nitrous Oxide from manure ← | |
| **Post harvest** emission | |
| • Slaughtering and processing ← | Industry and energy |
| • international transportation ← | Transport and energy |

Source: Gerber, P. 2010. *Livestock and the Environment-Addressing the Consequences of Livestock Sector's Growth*. In: J. Estany, C. Nogareda and M. Rothschilde (editors), *Proceedings of the "Adapting Animal Production to Changes for a Growing Human Population: International Conference*" Lleida, May 2010 Unversitat de Lleida.

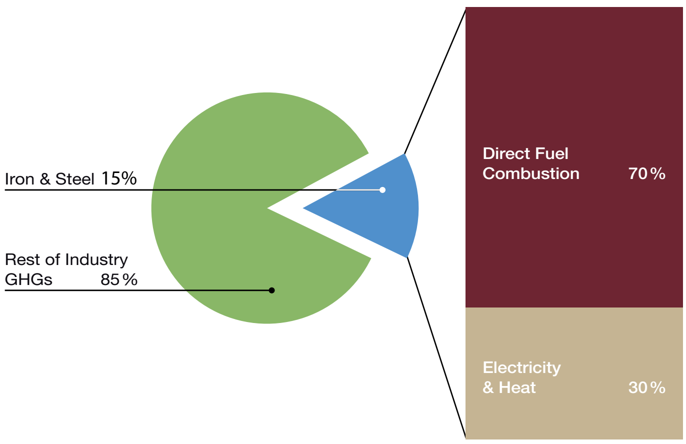
9 The global warming potentials of $CH_4$ and $N_2O$ are 21 and 310 times, respectvely, that of $CO_2$ over a 100-year time horizon (IPCC 2007b).

**Figure 2: Contribution of agriculture, land-use change and forestry to GHG emissions**




Source: IPCC 2007c, TS2a

**$CO_2$ from Iron and Steel**




Source: Baumert et al. 2005, fig 15.1. IEA, 2004a,b. See Appendix 2.A for sources and Appendix 2.B for subsector definition. Absolute emissions in this subsector, estimated here for 2000, are 1,319 MtCO

## 2.2 Agricultural mitigation potential

In this section we summarize information provided by the AR4 about the mitigation potential from changes in land management in the agricultural sector that generate soil carbon sequestration, supplemented with some external references. There are several other forms of mitigation – aside from soil carbon sequestration – that the sector can provide, including reductions in methane ($CH_4$) emissions from livestock and rice production through improved management, or reductions in $N_2O$ emissions from fertilizer use through the practice of integrated nutrient management. These are not discussed here, as mitigation from soil carbon sequestration is the focus of this report.

### 2.2.1 Land-based activities that generate agricultural mitigation

According to the AR4, about 89% of agriculture CC mitigation technical potential can be achieved by soil carbon sequestration through improved grazing land management, improved cropland management, restoration of organic soils and degraded lands, bioenergy and water management. The following paragraphs provide a more detailed description of the land-based activities included in these categories as well as some indication of their costs of implementation and potential co-benefits in the form of increased agricultural productivity, resilience and contribution to adaptation.

#### 2.2.1.1 Improved cropland management

Improved cropland management has high global mitigation potential spread over all regions. In terms of food insecure areas, potential mitigation is particularly high in South America, Eastern Africa, South Asia and Southeast Asia. It includes:

- improved agronomic practices (using improved crop varieties, extending crop rotations, avoiding use of bare fallow, using green manure and cover crops) which generate higher inputs of C residue, leading to increased soil C storage (Follett et al 2001);
- integrated nutrient management (e.g. precision farming and improved fertilizer application timing) which can reduce emissions on-site by reducing leaching and volatile losses, and improve nitrogen (N) use efficiency;
- water management (e.g. soil and water conservation, drainage and irrigation measures) which increases water available in the root zone and enhances biomass production, increases the amount of aboveground and root biomass returned to the soil, and improves soil organic C concentration;
- tillage management practices (e.g. minimal soil disturbance and incorporation of crop residues) which decrease soil C losses through enhanced decomposition and reduced erosion, and which tend to increase soil C (residues are the precursors of soil organic matter); and
- agroforestry systems management (e.g. combining crops with trees for timber, firewood, fodder and other products, and establishing shelter belts and riparian zones/buffer strips with woody species) which increases C storage and may also reduce soil C losses stemming from erosion.

#### 2.2.1.2 Improved grassland management

Despite the low C density of grazing land, practices in this category have a high potential for C sequestration because of the large amount of land used as grassland.[10] Also, improving pasture productivity can avoid further land conversion and concomitant C loss. According to IPCC (2007a), potential gains are particularly high in almost all regions of Africa and Asia, as well as South America. It includes:

- improving grassland productivity through increasing nutrients for plant uptake and reducing the frequency or extent of fires (e.g. improvements in forage quality and quantity, seeding fodder grasses or legumes with higher productivity and deeper roots, reducing fuel load by vegetation management); and
- improving grazing management by controlling intensity and timing of grazing (e.g. stocking rate management, rotational grazing, and enclosure of grassland from livestock grazing).

10 Data from FAOSTAT indicate that global pasture area accounted for 3,488 Mha in 2002 (69% of global agricultural land) (FAO 2009).

### 2.2.1.3 Restoration of organic soils

These C-Class (very dense) soils are often important in developing countries; for example, Andriesse (1988) estimated that the South East Asian region contains the largest expanse of peat deposits. The second most important area is the Amazon basin and the basins bordering the Gulf of Mexico and the Caribbean. These soils are also found in the wet equatorial belt of Africa. Since draining organic soils for cultivation leads to high GHG emissions, avoiding drainage is the best option in terms of reduced GHGs. Other practices to minimize emissions include avoiding row crops and tubers, avoiding deep ploughing, and maintaining a shallower water table (Freibauer et al 2004).

### 2.2.1.4 Restoration of degraded lands

There is a large potential to increase C sequestration in South America, East and West Africa, and South and Southeast Asia through mitigation options falling within this category: degraded land due mainly to erosion was calculated to affect 250 millions of hectare meters (Mha) of land, including 112 Mha in Africa, 88 Mha in Asia, and 37 Mha in Latin America (Oldeman 1994). Carbon storage in degraded lands can be partly restored by practices that reclaim soil productivity (Lal 2004), e.g. re vegetation; applying nutrient amendments and organic substrates such as manures, improved fallow, bio solids, and composts; reducing tillage and retaining crop residues; and conserving water.

### 2.2.1.5 Reducing agricultural expansion

The expansion of cropping activities onto forest and grasslands is a major source of GHG emissions at almost 20% of the global total. Reducing emissions from deforestation and forest degradation (REDD+) is one of the areas where considerable discussion has already been conducted on the development of institutions and mechanisms to support mitigation activities. In many countries, agriculture is the most important driver of deforestation and forest degradation and, as such, has an important role to play in achieving REDD+ objectives. Bruinsma (2008) estimates that globally, 15% of agricultural production increases were achieved in the period 1961-1999, but with highly uneven distribution: in Latin America and the Caribbean the figure is 46% as compared with 35% for sub Saharan Africa. Reducing these rates of expansion to decrease emissions from deforestation will require significant increases in agricultural productivity on existing lands in production. Grieg-Gran (2010) estimates that under an extreme scenario of no further agricultural land expansion, the productivity of farmland devoted to cereal crops in developing countries would need to grow at 1.07% per year. She points out that this level is below the 2.2% annual growth in crop productivity that was obtained in 1961-2007. Yield growth, however has slowed in recent years, and growth rates in areas of highest risk of deforestation have not been high (e.g. sub-Saharan Africa). Hence, increasing agricultural productivity has great potential to reduce pressure on remaining forest lands, although it is not an automatic and universal outcome – in some cases increased agricultural productivity can actually lead to increased expansion (Angelsen and Kaimowitz 1999). According to their review of more than 140 economic models analyzing the causes of tropical deforestation, they find that the nature of the technology utilized for intensification, as well as the output and input market elasticities, are key determinants of the relationship between agricultural intensification and deforestation, and that a positive relationship between the two may often be expected. On a global scale, however, Burney et al (2010) find that the net effect of higher agricultural yields on GHG emissions has avoided emissions of up to 161 gigatons of carbon (GtC) (590 $GtCO_{(2)}e$) in the period 1961-2005.

### 2.2.1.6 Avoided degradation of agricultural lands

Avoided degradation of agricultural lands is not currently under discussion as a creditable source of mitigation from agriculture, due to the complexity of devising a system to measure and credit such actions. Defining and identifying degradation on agricultural lands is controversial – subject to both human and natural causes – and relatively little information and data is available for developing countries. Recent work by FAO, however, indicates a significant threat of continuing and expanded land degradation arising from poor agricultural practices across many regions of the world, particularly in sub-Saharan Africa (FAO 2011). Many of the same issues related to identifying and crediting emissions from avoided forest degradation apply in the context of avoided land degradation, and could potentially be a significant source of mitigation in the future.

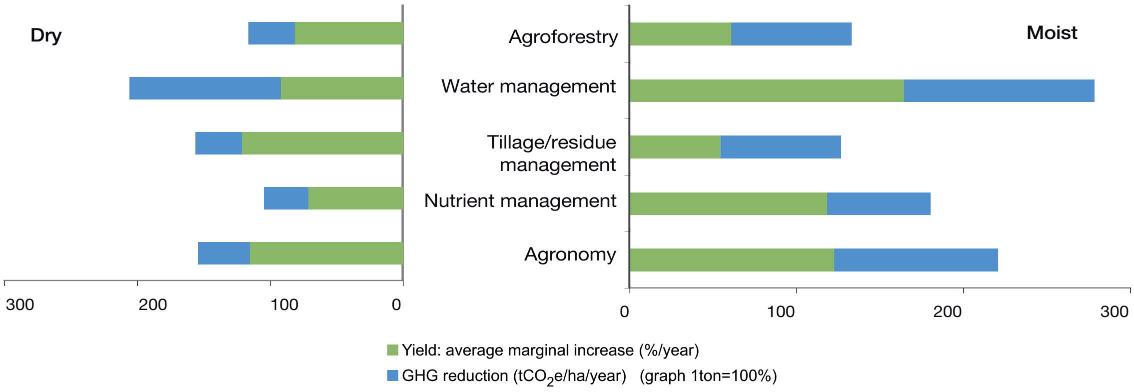
## 2.2.2 Food security benefits of land-based agricultural mitigation actions

Many of the agricultural mitigation options discussed above are also able to provide benefits in terms of increased adaptation and crop productivity (FAO 2010). To a large extent, land use changes needed to generate climate change mitigation are the same as those that improve agricultural productivity and increase system resilience, at least in the long run (FAO 2009). Long-term impacts are expected to be positive for increasing both the average and stability of production levels.

The potential for synergies between agriculture mitigation and food security is generally site specific, depending on the previous land use, type of farming system and institutional capacity. Some practices with high potential for synergies over a wide range of circumstances can, however, be identified, for example: avoiding bare fallow; incorporating crop residues; diversifying crop rotations to incorporate food-producing cover crops and legumes; increasing fertilizer use efficiency (e.g. integrated fertility management or precision fertilizer applications); improving fodder quality and production; expanding low-energy irrigation; expanding agroforestry; and adopting soil and water conservation techniques that do not take significant amounts of land out of food production. Agro-ecological conditions play a major role in determining whether synergies between mitigation and food security can be obtained. In particular, there is a major difference between humid verses dry areas in terms of the relative mitigation/food security impacts of changes in agricultural practices. Figure 3 below is based on a recent synthesis of the literature done by Branca et al (2011) which summarizes the evidence base of different sustainable land management practices aimed at increasing and stabilizing crop productivity in developing countries—showing some examples of the synergies between mitigation, adaptation and food security from changes in agricultural practices, and distinguishing between dry and humid zones.

Essentially, the food security benefit in the form of yield increases from soil carbon are found to be higher in dry areas, while the soil carbon benefit per hectare lower, and vice versa for humid areas. If considering the potential merit of soil carbon sequestration activities solely from a mitigation point of view, humid areas have a comparative advantage due to higher obtainable rates per hectare. If our lens for assessing mitigation, however, is the contribution to food security, then soil carbon sequestration in dry areas is important. The differences in amounts obtainable per hectare have important implications for the type of crediting approach for mitigation benefits that is feasible (FAO 2009; Lipper et al 2010).

**Figure 3: Synergies between food security and CC mitigation for ICM practices in dry and humid areas**




Source: Branca et al 2011

Equally important in terms of assessing the food security impacts of mitigation actions is the timeframe over which benefits can be obtained. For several of the agricultural mitigation options described above, short-term impacts may be negative depending on underlying agro-ecological conditions, previous land use patterns, and current land use and management practices. For example, crop and grassland restoration projects often take land out of production for a significant period of time, reducing cultivated or grazing land available over a period up to ten years, but leading to overall increases in productivity and stability in the long run. This is an important feature to consider when trying to capture synergies between food security and mitigation, and one that is revisited in Section 2.3 on costs below.

### 2.2.3 Other environmental benefits from land-based agricultural mitigation actions

Most agriculture mitigation options have a positive impact on water resources and management. Improved cropland and grazing management can increase water storage and infiltration, reducing loss through runoff, leading to greater water availability in the soil (Molden 2007) and enhancing ecosystem water balance (Unger et al 1991). This is true also for manure application and, in general, for other approaches which maintain or increase soil organic matter (Tilman et al 2002; Miller and Donahue 1990). Additionally, conservation agriculture often reduces evaporation from the soil, especially in drier environments. Since the combined water loss through runoff and evaporation often leaves less than half of the rainfall (or irrigated water) available for crops, the adoption of these technologies can increase crop yields and food production. Other technologies are more explicitly related to water management, e.g. water conservation and harvesting, and efficient irrigation can effectively increase the soil C pool (FAO 2008). Terraces and contour farming also have big impacts on water, providing for storage of rainfall and discharging excess runoff through a drainage system (WOCAT 2007). Nevertheless, in areas where water management focuses on drainage to lower water tables for crop and forage production, such as for organic soils that tend to be highly fertile, there is the risk of exposing soil organic matter to aerobic decomposition, promoting substantial losses of soil C (Conant 2009). Other practices increase or maintain water quality: technologies that sequester C in grassland soils tend to maximize vegetative cover and reduce water induced erosion and sediment load (Conant 2009). Enhanced soil moisture should also reduce vulnerability to low rainfall and drought conditions, thus increasing the capacity of farming systems to adapt to climate change. Much of the concern over water resources in agriculture stems from a lack of moisture to maintain crop or forage production at optimal levels. This issue is particularly acute in dry land agricultural systems. Irrigation is the most common and direct way for producers to reduce water stress to crops and forage grasses, but improved cropland and grazing management have also been viable alternative strategies to improve soil water regimes. Also, in much of the world maintaining adequate moisture during extreme events is perhaps the most important aspect of adapting to future, warmer climates (FAO 2009).

Changes to land use and agricultural management with mitigation benefits can positively affect biodiversity (Smith et al 2007; Feng et al 2006; Xiang et al 2006). Key examples of agricultural mitigation options that can deliver biodiversity benefits, include conservation tillage and other means of sustainable cropland management, sustainable livestock management, agroforestry systems, reduction of drainage systems in organic agricultural soils, improved management of fertilizers, and maintenance or restoration of natural water sources and their flows including peat lands and other wetlands. The restoration of degraded cropland soils, for example, may increase soil carbon storage and crop yields, while contributing to the conservation of agricultural biodiversity, including soil biodiversity (Secretariat of the Convention on Biological Diversity 2009). Perennials/agroforestry systems to restore degraded areas can increase biodiversity (Berndes and Börjesson 2002). However it is important to note that agricultural mitigation practices could also reduce biodiversity – depending on how and where the practice is implemented.

## 2.3 Costs of agricultural mitigation actions

We have summarized the potential mitigation, food security and other benefits that can be derived from this selected set of changes in agricultural practices, but the costs associated with achieving them are also critical to understanding synergies and tradeoffs. There are wide ranges in cost estimates by different sources, reflecting the large diversity amongst regions and also depending on which costs were considered in the analysis. For instance, McKinsey (2009) provides cost estimates for mitigation from crop and grassland management, restoration of organic soil, and restoration of degraded land. Average costs per ton of carbon equivalent abated to the year 2030 are computed to be negative for crop- and grassland-nutrient management, and tillage and residue management, indicating that the activity generates higher benefits than costs discounted over the relevant time frame. This type of analysis is useful in indicating which practices will be self-sustaining in the long run. It does not, however, indicate the magnitude of the initial investments required to make the changes, which is one of the main barriers to realizing the implementation of these practices.

In Table 1 below, we present some estimates of up-front investment costs, as well as estimates of maintenance costs that must be met by increased yields in the future to ensure continued use.

This table of indicative costs shows that there is a considerable range in both establishment and maintenance costs across the different types of actions, but also for similar actions across different sites. It also highlights the importance of conducting site-specific analyses in identifying potential synergies between food security and mitigation in land-based actions, as well as indicating the substantial costs involved in making transitions to sustainable land use management systems.

Perhaps the most important costs to be considered are the opportunity costs of making transitions, e.g. the foregone income, food production and food security that farmers would have to bear in making a transition. As noted in Section 2.2. above, in many cases actions that generate a long-term net benefit to food security can entail tradeoffs with food security in the short run. For example, restoring degraded land offers high mitigation potential, however, during initial phases of restoration it often involves a reduction in agricultural production activities which in turn generates opportunity costs to the adopters. Table 2 below

**Table 1. Examples of establishment and maintenance costs of land-based agricultural mitigation options**

| Technology options | Practices | Case study | Establishment costs US$/ha | Average maintenance costs US$/ha/year |
|---|---|---|---|---|
| Agro-forestry | Various agro-forestry practices | *Grevillea agroforestry system*, Kenya | 160 | 90 |
| | | Shelterbelts, Togo | 376 | 162 |
| | | Different agroforestry systmes in Sumatra, Indonesia | 1,159 | 80 |
| | | Intensive agroforestry system (high input, grass barriers, contour ridging), Colombia | 1,285 | 145 |
| Soil and water conservation | Conservation agriculture (CA) | Small-scale conservation tillage, Kenya | 0 | 93 |
| | | Minimum tillage and direct planting, Ghana | 220 | 212 |
| | | Medium-scale no-till technology for wheat and barley farming, Morocco | 600 | 400 |
| | Improved agronomic practices | Natural vegetative strips, The Philippines | 84 | 36 |
| | | Grassed *Fanya juu* terraces, Kenya | 380 | 30 |
| | | *Konso* bench terrace, Ethiopia | 2,060 | 540 |
| | Integrated nutrient management | Compost production and application, Burkina Faso | 12 | 30 |
| | | *Tassa* planting pits, Niger | 160 | 33 |
| | | Runoff and floodwater farming, Ethiopia | 383 | 814 |
| Improved pasture and grazing management | Improved pasture management | Grassland restoration and conservation, Qinghai province, China (1) | 65 | 12 |
| | Improved grazing management | Rotational grazing, South Africa | 105 | 27 |
| | | Grazing land improvement, Ethiopia | 1,052 | 126 |

(1) Project estimates
Sources: Wocat 2007, Liniger et al. 2011, FAO 2009, Cacho et al. 2003

**Table 2. An example of opportunity costs of implementing improved grazing management practices**

| Size of herd | Baseline net income ($/ha/yr) | NPV/HA over 20 years ($/ha) | No of years to positive cash flow (number of years) | No of years to positive incremental net income compared to baseline net income (number of years) |
|---|---|---|---|---|
| Small | 14.42 | 118 | 5 | 10 |
| Medium | 25.21 | 191 | 1 | 4 |
| Large | 25.45 | 215 | 1 | 1 |

Source: Wilkes 2011

presents information from Qinghai China on the short-term opportunity costs herders face in adopting practices that restore degraded grazing lands. In the long run, these actions generate a net positive benefit to livestock production as well as significant mitigation benefits. There is, however, a time lag before the benefits are realized. In the case of large producers, this lag is relatively short—one year for producers with large herds and four years for medium-size producers. However, for households with the smallest herd sizes– which can be expected to fall into the lowest income group – there is a lag of ten years before the improved practice generates a higher return to livestock production than the current system on degraded lands. This indicates not only the importance of carefully considering the time frame over which opportunity costs occur in adopting land based practices that generate food security and mitigation benefits, but also how they vary between income groups.

## 2.4 Overcoming barriers to adopting practices that sequester soil carbon in smallholder agricultural systems

A striking feature of many of the sustainable land management practices that are likely to generate synergies between food security and mitigation and investments is that they are generally not new techniques, and their adoption rates have generally been low, particularly in food insecure and vulnerable regions in sub-Saharan Africa and Southeast Asia. There are a number of potential explanations for this failure to adopt (and indeed, for continuing practices that lead to further degradation), including the presence of opportunity costs as discussed in the previous section. There is a substantial literature documenting research on barriers to adopting sustainable land management techniques and the findings can be grouped into the following major categories:

i. delayed return on investments;
ii. collective action failure; and
iii. lack of tenure security.

### 2.4.1 Delayed returns on investments

Delayed returns on investment when transitioning to sustainable land management systems is a major barrier to adoption (McCarthy et al 2011). Two issues stand out in particular, with regard to smallholder agricultural producers: opportunity costs of foregone income over the transition period extend over a number of years and these tend to be higher for smaller size operations (McCarthy et al 2011; Wilkes et al 2011). Addressing this issue requires different types of institutional solutions than those required to overcome investment barriers. For the latter, credit programmes or subsidized input programmes are generally applied to enable farmers to overcome a one-off investment barrier. However, income support during an extended transition phase requires a broader range of instruments, and generally will require public sector support. Activities may include: upfront payments for environmental services to be delivered in the long term through adoption, and measures to increase the returns to income during the transition through marketing improvements or development of alternative income sources. A brief description of what each may entail follows below:

A. Upfront payments for sequestration benefits to be delivered in the long term. One possible way of supporting income over a transition is to design PES programmes to include payments even before services are generated. Essentially, adopters are rewarded for making production changes in anticipation of the external benefits that arise over the long term. While attractive, this option is difficult to implement, since buyers are often not willing to assume the risk of paying in anticipation of delivery of the service, or demand a discount for doing so. In addition, given the relatively small share of overall returns to the farm that sequestration payments represent in many contexts, even if payments are front loaded, they may not be sufficient to cover the costs.

B. Increasing returns to agricultural production change through marketing improvements. During the transition phase from a baseline agricultural system to one that generates carbon sequestration, agricultural production is still undertaken, but the productivity may be temporarily reduced as the ecosystem is restored and adjusts to a new equilibrium. Increasing the returns to the agricultural production that is still ongoing is possible through improving the marketing of these products to obtain higher prices. For example, in cases where carbon sequestration is generated through rangeland restoration, reduction in stocking rates is often required. Improving the marketing and prices paid for the smaller numbers of animals that can be marketed reduces the decline in farm income. Marketing improvements could range from the development of community marketing cooperatives, to the identification of new and higher value marketing chains.

C. Development of alternative income sources. Developing off-farm income sources to support farm households during a transition from conventional to a sustainable land management practices. These could include establishing agricultural processing activities that generate employment – such as cheese or yoghurt production or carpet and woven goods enterprises. Smaller scale employment activities could include the development of handicrafts or sales of non-wood forest products.

### 2.4.2 Collective action failures

Marshall (1998) defines collective action as "an action taken by a group (either directly or on its behalf through an organization) in pursuit of members' perceived shared interests" (cited in Meinzen-Dick et al 2004). Meinzen-Dick et al note that there are various definitions of collective action and that the main feature they have in common is they all refer to an action which calls for the involvement of a group of people with a shared interest and a common action to pursue. They also note that such action should be voluntary. There are several levels and types of collective action required for adoption of land-based agricultural mitigation actions themselves, as well as for the MRV of mitigation benefits derived from such actions. We focus on the former in Section I and the latter in Section II.

Many, if not most, of the land-based mitigation actions from agriculture require collective action to implement and realize benefits from. Benefits from improved land management practices are often realized in the form of a "local public good",[11] such as reduced pest and disease pressures, improved hydrological functions, and reduction in erosion or degradation. Generating these benefits often necessitates action on a minimum scale and at specific sites, and generally requires collective action to achieve, particularly in areas with small and fragmented land holdings. In addition, in many situations the rights to natural resources such as land, water, trees or grazing are held in common and thus collective action is needed to implement changes in the management of these resources.

Meinzen-Dick et al (2010) propose a conceptual framework for assessing different levels of collective action, and their potential respective providers, depending on the spatial and temporal scale for benefits to be realized in the context of climate change. The framework indicates that actions whose implementation and benefits are realized from farm to community level are those which are most likely to require some form of collective action that falls outside of the sphere of the state, implying a need for local and non-governmental forms of organization. The ability to take collective action depends on social relations and social capital in an area, as well as local institutional development and capacity.

Lipper et al (2010) look at the issue of collective action in the context of crediting carbon sequestration from degraded grazing areas in West Africa and conclude that there is considerable opportunity to build on existing organizations at local level to facilitate collective action. They provide an example from a community-based Natural Resource Management project in Burkina Faso to illustrate the point.

11 A public good is a good that is non-rival and non-excludable. Non-rivalry means that consumption of the good by one individual does not reduce availability of the good for consumption by others; and non-excludability that no one can be effectively excluded from using the good (Coase 1974).

### 2.4.3 Lack of tenure security

Smallholder tenure rights are highly relevant to the development of carbon finance projects in agriculture. Project developers require that smallholders can ensure that carbon sequestering land uses are not reversed at a future date. Buyers will also require assurance that land users have rights over the carbon assets sold. Ill-defined or insecure tenure rights are common in many developing country contexts. To take the example of rangelands, the appropriateness of different rangeland tenure policies has long been contentious in many parts of the world. Where land use rights have been privatized (e.g. most of Latin America and China, parts of east Africa) and where land right holders are able to exclude other users, this may facilitate eligibility for carbon finance. This may be found in areas where land use rights are communal but legally recognized (e.g. parts of China, some countries in West Africa) as well as where rights are held at the household level. Where pastoralists' traditional land use rights do not have legal recognition, or where pastoralists are unable to exclude others from land use, significant challenges for implementing carbon finance projects exist (Roncoli et al 2007). Where smallholders lack formal land use rights, or where legal land rights exist but are not yet enforced, demonstrated potential for producing mitigation benefits may potentially aid in farmers' lobbying for their land use rights. As it has been found in some other PES schemes, this may prove to be the most significant benefit of carbon finance projects in some areas. However, as with biofuels and other projects that increase the value of land, there is also the risk that Carbon Finance projects would promote privatization and exclusion of those with traditional rights. In many cases it will be necessary for agricultural mitigation projects to directly address this issue in the design of crediting projects.

# 3 Overview of current status of carbon finance for smallholder agriculture: Where are the opportunities?

At present there is considerable uncertainty – as well as new developments – in the world of mitigation finance and carbon markets. There are likely to be a range of possible sources and mechanisms for channeling mitigation finance to the agriculture sector of developing countries, from public sector financing through the GCF to private sector purchases of emission offsets through the voluntary carbon market. In this section we focus on the potential from carbon market developments considering both regulatory driven offset markets as well as voluntary offset exchanges as a source of mitigation finance to smallholder agriculture.

Options for further expanding the inclusion of agricultural credits in carbon markets depend on the form of future carbon markets. Carbon market development is driven by expectations of future regulatory requirements, and future market opportunities depend on developments in international and national regulatory regimes. The Kyoto Protocol considers all forms of terrestrial carbon in national GHG inventories, but developed countries have the option to consider only some carbon pools in their national accounting system (Kyoto Protocol 1998).[12] In the wake of Copenhagen 2009 and Cancun 2010 negotiations – and their failure to achieve a new binding treaty on emissions reduction in anticipation of the expiration of the Kyoto Protocol in 2012, as well as ongoing instability in financial markets – there is considerable uncertainty over the future of carbon finance.

There is also uncertainty about the potential role of agricultural mitigation in carbon markets. It may be that a wider range of agricultural offsets (including soil carbon) is eligible under a post-2012 global climate agreement. Alternatively, there may be no global convention but instead the establishment of a range of different national cap and trade systems and climate funds. These systems and funds may or may not be interlinked. No matter what the outcome is, agricultural credits have to ensure a high level of credibility through quality standards in order to be accepted. Land use based agricultural credits are still in their very early stages. Achieving a significant level of financing for agricultural mitigation will require national and international stakeholders to cooperate in developing widely accepted protocols that ensure the credibility of agricultural offsets while also reducing the barriers to smallholder participation in carbon markets.

## 3.1 Overview of C market development relevant for agricultural mitigation from smallholder agriculture

The Kyoto Protocol only provides a legally binding commitment for ERs until the end of 2012. The US, which is the second largest emitter globally, has not signed the Protocol, and several emerging

12 http://unfccc.int/resource/docs/convkp/kpeng.pdf Within the EU, only Denmark, Spain and Portugal have opted to monitor cropland emissions, and only Denmark and Portugal to monitor grazing land emissions (EU Commission report 12/2006, required under Article 7(1) of Decision 280/2004/EC).

economies that are important emission sources are not under any emissions reduction requirements in the Kyoto Protocol.

In the Bali Action plan, which was adopted in December 2007, all countries reached consensus that an Ad Hoc Working Group on Long-term Cooperative Action should develop the basis for an international post-Kyoto climate change agreement. The initial deadline was to reach consensus in Copenhagen in December 2009. In Copenhagen 2009, and again in Cancun 2010, no consensus on a new agreement was reached. The difficulties of achieving such an international agreement at present are quite substantial, considering the uncertainty for countries like China to predict the impact of adopting ER pathways on their economy and without domestic climate legislation in place in the US.

From a carbon finance perspective this regulatory uncertainty at the international level, as well as in major potential sources of offset demand such as the US, reduced the demand for carbon offsets from developing countries. In addition, it remains unclear how the transition finance promised for developing countries, i.e. US$10 billion per year for the period 2010-2012 and 100 billion per year (public and private) by 2020 will be structured, although the Cancun Agreements have shed some light on this. Considering that 29 of the 43 developing countries that submitted NAMAs under the Copenhagen Agreement are related to agriculture, it is likely that some of the pledged transition financing will be invested in agricultural mitigation and adaptation. If only part of this investment is underwriting the regulatory risks related to carbon offsets, however, a substantial increase in the demand for agricultural offsets can be expected before 2013. Most likely, transition financing will be earmarked for capacity building to develop NAMAs, NAPAs and national baselines, much as what occurred during the REDD readiness process.

The carbon market is evolving rapidly. This section describes current carbon markets and highlights initiatives of relevance to smallholder agricultural carbon finance, especially in developing countries.
The carbon market exists because of requirements on, or voluntary desire of market participants to reduce GHG emissions. The carbon market can be classified into different market segments:

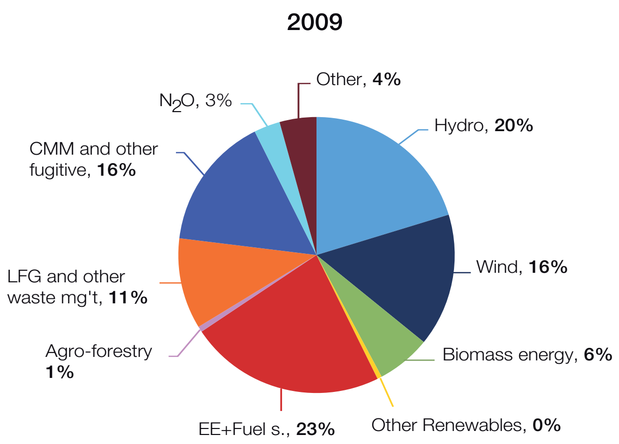
- *Kyoto compliance market*
- *Sub-national compliance markets*
- *Voluntary carbon market*

Compliance markets originate from governmental or intergovernmental regulations determining a cap on emissions of carbon and other GHGs like $CH_4$ and $N_2O$. These regulations are the main driver of demand for the rapidly growing carbon market. OECD, China and India are also the main suppliers of ERs through technological innovations and terrestrial carbon capture through land-based activities.

### 3.1.1 Kyoto compliance market

The Kyoto Protocol provides a regulatory requirement for Annex 1 countries (i.e. most-developed countries and countries in transition) to reduce GHG emissions. The Clean Development Mechanism (CDM) established under the Protocol provides a mechanism for generating ERs in non-Annex 1 countries (i.e. developing countries) with financial and technical support from developed countries. In the Agriculture, Forestry and Other Land Use (AFOLU) sector, only temporary ERs from afforestation and reforestation activities are eligible for the CDM (compare Figure 4). In the European Union Emissions Trading System (EU-ETS), ERs from AFOLU activities – including improved cropland and rangeland management – are not tradable even if they are eligible under the Kyoto Protocol because of the

**Figure 4: CDM project types in 2009, as share of volumes supplied**




Source: World Bank 2010

perception that the system cannot deal with the risk of non-permanence of ERs from land use activities.[13] There is strong support, however, among some countries to include selected land use activities in a global post-2012 agreement.[14] Methane capture, e.g. through small-scale biogas installations, and ERs through renewable energy sources, are eligible for the CDM and several projects have been transacted but at very low volumes.[15]

### 3.1.2 Sub-national compliance markets

Other compliance markets exist in Australia, Canada and the US at state level, such as the New-South Wales Greenhouse Gas Reduction Scheme (NSW GGAS) in Australia, covering electricity retailers and allowing afforestation/reforestation CDM compliant Verified Emissions Reductions (VERs, in the voluntary market, see below), the Alberta Offset System in Canada, the California Climate Action Reserve (CAR) and the Regional Greenhouse Gas Initiative (RGGI) in Northeastern and mid-Atlantic states of the US. The Western Climate Initiative, covering 11 US states and Canadian provinces, is currently under design.

### 3.1.3 Voluntary carbon market

The voluntary market mainly trades ERs known as Verified Emissions Reductions (VERs) that cannot be used for regulatory compliance. The market also serves as an incubator for innovative mitigation crediting activities that are not currently eligible under any compliance market regime. The voluntary market is tiny compared to compliance markets. In 2009, Hamilton et al. (2010) estimated market transactions in this sector to be 94 million $tCO_2e$, of which 41 million $tCO_2e$ were transacted by the Chicago Climate Exchange (CCX). Starting in 2007, in close cooperation with US farmers' organizations, the CCX allowed trades in VERs from conservation tillage, grass planting and rangeland management

13 See Chapter 4 on MRV.

14 Under the UNFCCC working group dealing with commitments post Kyoto Protocol (AWG-KP), a number of African nations (Republics of the Gambia, Ghana, Lesotho, Mozambique, Niger, Senegal, Swaziland, Uganda, Zambia and Zimbabwe) have flagged the importance of soil carbon sequestration and suggested that one way forward is the expansion of the CDM to include agricultural land uses (UNFCCC, 2010c).

15 See http://cdm.unfccc.int/Projects/projsearch.html.

activities. As of 2011 the CCX electronic trading platform is no longer operating, however, a new offsets registry programme has been initiated.[16]

The vast majority of the buyers of voluntary carbon credits are private businesses. In 2009, European companies made 41% of voluntary market purchases, while US companies were responsible for almost 49%. The largest number of voluntary market projects is in the US, while Asia generated most of the credits (Hamilton et al 2010). Although the US is the largest single supplier and purchaser of voluntary credits, voluntary markets in other countries are also growing. The first domestic trade in voluntary credits in China was made in 2011 under the Panda Standard, which is initially dedicated to agriculture and forestry based on the recognition of the Chinese government that offsets from these sectors trigger the greatest rural co-benefits.

### 3.1.4 Development of carbon markets: Which way now?

The traditional project-based carbon financing model associated with CDM and voluntary markets is currently challenged by a number of new developments. Transaction costs related to stand-alone projects can be high, and expectations that they would decrease significantly after an initial learning stage have not been realized.[17] Greater interest is now being focused on reforming the CDM by simplifying standards through the use of standardised baselines and by developing methods for larger programmatic or sectoral approaches. It is also expected that new financing mechanisms for NAMAs will evolve from the Cancun Agreements in the framework of the Green Climate Fund (GCF). NAMA monitoring systems are expected to be more cost effective than project-based approaches. The development of the voluntary carbon market will be influenced by developments in the compliance market. Considering that compliance markets are developing quite slowly, it is likely that the voluntary market will continue to grow. It will always provide a niche for innovative new carbon mitigation activities, but probably the limited financial depth will remain.

## 3.2 Current demand for AFOLU credits in carbon markets

Table 3 below summarizes the eligibility of a range of smallholder- and agriculture-relevant emissions reduction activities in different carbon market segments. To date, eligibility of agricultural land use offsets is extremely limited in the major compliance markets. The CDM only recognizes a limited range of smallholder- and agriculture-relevant activities, and agricultural soil carbon is not one of them. The EU-ETS – the major market for CDM credits – does not allow trade in land -use offsets, even if they are eligible for the CDM, as is the case for afforestation and reforestation activities. Hence, demand for agricultural offsets has been limited.

### 3.2.1 Compliance and pre-compliance markets

Under the CDM, methodologies for crediting ERs are developed by project developers, and then undergo a process of public comment and approval by the CDM board. The CDM has a category of simplified methodologies for small-scale projects. The CDM Board has approved more than ten

16 See http://www.chicagoclimatex.com/docs/offsets/CCX_Soil_Carbon_Offsets.pdf; and http://www.theccx.com/info/advisories/2010/2010-13.pdf.

17 http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/Carbon_Fund_12-1-09_web.pdf

Table 3. Market segments and respective standards, and their eligibility for cropland and grassland credits

| Market segment | Cropland and grassland mitigation | Methane ERs (biogas) |
|---|---|---|
| *Compliance market* | | |
| CDM | Agroforestry, silvopastoral systems, fertilizer replacement | Yes |
| ETS | No | Yes |
| RGGI, US | No | Yes |
| CAR, US | No | Yes |
| New South Wales, Australia | No | Yes |
| Alberta Offset system, Canada | Yes (but only from domestic activities) | Yes |
| *Pre-compliance market* | | |
| *Voluntary carbon market* | | |
| VCS | Yes | Yes |
| Panda Standard | Yes | Yes |

methodologies for ERs from small-scale energy interventions, and a methodology for $CH_4$ recovery at household level,[18] as well as under confined livestock production conditions.[19] Two land-based agricultural project methodologies have also been approved, both of which require that non-forest is turned into forest.[20,21] A CDM small-scale project methodology replacing synthetic fertilizer with inoculants stimulating nitrogen fixation was recently approved.[22]

In addition to project approaches, the CDM also allows a Programme of Activities (PoA) in which a pre-defined set of activities can be applied over a large scale, an approach which seems particularly relevant to aggregating ERs from smallholder farmers. The PoA approach has been applied to biogas digester projects and electric lighting in rural areas, and a number of other applications are under consideration.[23]

Methane capture and activities that reduce emissions from rural energy use are typically also eligible for other compliance markets. Among other compliance markets, agricultural land use activities are only eligible in the Alberta Offset system. To date, the Albert Offset system has approved protocols for livestock feed, $CH_4$ capture, and soil tillage, and a number of other agriculture protocols are under consideration.[24] International offsets, however, are not eligible under the Alberta Offset System. The evolving US compliance emissions reduction system is also considering land-based agricultural offsets, but only in the domestic market.

At present, the main markets for which agricultural land use offsets are eligible are the various voluntary standards, which as we have seen account for a very small proportion of total global trade in emission reductions. The Verified Carbon Standard (VCS) has announced guidelines for AFOLU activities that include sustainable agricultural land management and rangeland management, though no projects under these categories have yet been registered. The CCBA in principle also accepts agricultural land use projects, but in general the CCBA is not considered as a stand alone carbon standard, focusing instead on verification of the co-benefits of mitigation.

18 AMS III.R: http://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMS6TO7KR3EIBF6Y1PYA7NPY84I2V76QB

19 AMS.III.D: http://cdm.unfccc.int/UserManagement/FileStorage/MF0L1YGEXC4WO2PKQBDH9NVS53JZ8T

20 AR-AMS0004: http://cdm.unfccc.int/UserManagement/FileStorage/LXB75FO38Z9NW1IEGH6V0TSUKD4JYM

21 AR-AMS0004: http://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMSN7QQ0QUDOX8XOHZH8V5RSMGPFJ4HAG

22 AMS III.A. Offsetting of synthetic nitrogen fertilizers by inoculant application in legumes-grass rotations on acidic soils on existing cropland which is based on a bacterium that stimulates biological nitrogen fixation (BNF) within soya plants.

23 See http://cdm.unfccc.int/ProgrammeOfActivities/index.html

24 http://carbonoffsetsolutions.climatechangecentral.com/offset-protocols/other-protocol-areas-under-consideration

### 3.2.2 States and national governments

Governments of most industrialized countries have signed the Kyoto Protocol and committed to reducing GHG emissions compared to the baseline year 1990 ('Annex 1 countries'). If caps on their emissions are exceeded, they can either buy carbon credits internationally to meet their obligation,[25] or pay a penalty of 50 per $tCO_2$ in excess of quota.

In the first commitment period of the Kyoto Protocol (2004-2008) industry in EU Member States was over-allocated emissions allowances which caused a collapse in the price of ERs. In the second period (2008-2012) reduction targets in national allocation plans (NAPs) are more ambitious, so the carbon price had been rising until the financial crisis and economic recession caused a collapse in the price. In the future, most countries with a reduction target plan to auction emission allowances, which is expected to result in higher prices for carbon credits.

Governments purchase carbon credits either at dedicated exchanges or internationally directly from project developers via dedicated national procurement vehicles. Some governments have established funds from the revenues of emissions allowance auctions, and use these funds to support the development of new project types with strong sustainable development benefits. One example is the German Climate Protection Fund,[26] although this Fund currently supports only AFOLU forestry activities.

In North America, most governments have explicitly expressed interest in buying carbon credits from domestic agricultural mitigation activities and a number of initiatives are underway to reach consensus on methodological issues to pave the way for credible standards.[27] Within the EU, the need to adapt farming patterns to climate change from both an adaptation and mitigation perspective is receiving increasing attention, and statements by the EU Commissioner for Agriculture and Rural Development in November 2009 indicate the inclusion of agriculture within an emission trading scheme is a possible future option.[28] Initiatives to link farmers to carbon markets, however, are much less advanced compared to North America.

### 3.2.3 The private sector

Demand from the private sector to purchase carbon credits results primarily from government regulations setting emissions reduction targets for energy intensive sectors that private firms must comply with. Under these systems firms may either change production processes to reduce emission or buy carbon credits on the market in order to meet their emissions quota, or a mix of the two. After national governments, companies regulated under national climate change policies in the EU and Japan are the biggest traders in compliance credits. Some companies with a high carbon offset demand (e.g. in the energy sector) have established carbon trading facilities.[29] However as discussed above, unless a wider range of agricultural carbon credits can be used to meet compliance targets, demand for this type of offset will remain quite limited.

25 To achieve the emission reduction target only 5%, can be achieved by using flexible mechanisms like CDM.
26 http://www.bmu.de/english/climate_protection_initiative/general_information/doc/42000.php
27 e.g. Technical Working Group on Agricultural GHGs coordinated by Duke University. http://nicholas.duke.edu/institute/t-agg/index.html
28 www.euractiv.com/en/cap/agriculture-pay-climate-price/article-187458
29 AES, a US-based global power company, or Électricité de France (EDF) www.aes.com, www.edf.fr

In principle, the regulated private sector has a huge demand for cost effective compliance credits, and is willing to take a limited risk by buying pre-compliance assets at a discounted price. Given the potential niche for agricultural carbon credits under the proposed US energy and climate bill, a small demand for compliance assets in Alberta and on the voluntary market (e.g. through the VCS) has arisen.

Voluntary carbon assets are purchased mainly by the unregulated private sector as part of their carbon neutral strategy. Some companies offer climate neutral services in conjunction with carbon funds (e.g. British Airways offers carbon neutral flights and Morgan Stanley provides the equivalent amount of carbon credits). The private sector either purchases carbon credits directly from projects or through carbon funds. Some private sector companies (e.g. Syngenta Foundation, Unilever and Danone) are supporting the development of agricultural carbon credits in developing countries as part of their corporate strategies to reduce emissions and to offset unavoidable emissions in ways that are beneficial for farmers. Growing consumer awareness of the emissions from producing products consumed, and possible future expansion of product emission labeling schemes, may drive further expansion of this source of demand.

Some types of smallholder mitigation activities are already operative in the CDM and other market segments. This indicates that these smallholder activities are already taking place in a context which facilitates the linkage between smallholders and technology providers, as well as between smallholders and carbon markets.

Direct partnerships between companies investing in agricultural carbon offsets and supporting rural development and project developers aggregating carbon assets and linking smallholders with buyers can result in mutually beneficial partnerships where both sides can learn from each other. This direct contact will also provide a face to the carbon credit which will ultimately increase the market value.

### 3.2.4 REDD+

Reducing emissions from deforestation and forest degradation (REDD+) refers to projects which achieve ERs through five main types of activities: (i) reducing emissions from deforestation; (ii) reducing emissions from forest degradation; (iii) conserving forest carbon stocks; (iv) managing forest sustainably; and (v) increasing forest carbon stocks (Calmel et al 2010). Since agricultural activities are the most common driver of deforestation and forest degradation, REDD+ activities can represent a source of carbon income to agricultural producers who reduce emissions by taking actions that reduce agricultural land expansion and/or forest degradation. Calmel et al (2010) identified a total of 133 existing REDD+ projects. *The Meridian Institute Report on Agriculture and Climate Change: A Scoping Report*, gives a detailed comparison of the current state of institutional development for REDD+ mitigation crediting compared with agricultural mitigation (Meridian Institute 2011).

The Cancun COP16 made significant progress in realizing the potential for REDD+ financing through an international agreement for financial support for this source of mitigation. Much work remains to actually operationalize this source of funding, however, and several key barriers must be overcome. Firstly, REDD+ actions must demonstrate effective safeguards for the right of indigenous peoples and local communities dependent on forest resources. Secondly, modalities for establishing reference levels and crediting procedures have yet to be agreed. A recent breakthrough on this was achieved by the World Bank BioCarbon Fund (BioCF) and the Brazilian NGO Fundação Amazonas Sustentável (FAS). The new methodology – officially approved in July 2011 by the Verified Carbon Standard (VCS) Association – allows projects in the voluntary market to calculate avoided emissions by reducing deforestation either on the edge ("frontier") of large cleared areas, like agricultural zones, or in a patchwork ("mosaic") within standing forests (World Bank Press Release, 14 July 2011).

The magnitude of financing necessary for REDD+ indicates that private sector involvement will be required. The role of carbon markets in mobilizing funding, however, has not been agreed and is currently not clear (World Bank 2011). The "readiness" phase of realizing this source of mitigation, including Phase I (national strategies and capacity building) and Phase II (implementation of strategies and investment in demonstration activities), will be financed through public sources—both bilateral and multilateral (World Bank 2011).

## 3.3 Trading channels

A number of options are available to trade carbon offsets and the choice is dependent on the developer of the project. The next section highlights the key options available at present.

### 3.3.1 Credit return funds

The World Bank operates the biggest family of credit-return funds on behalf of private sector companies and governments. The World Bank BioCarbon Fund is dedicated to buying carbon credits from AFOLU projects. BioCF started in 2004 and has an investment budget of about US$100 million[30] with over 20 ongoing projects, including REDD and soil carbon (emerging), but mostly forest-based (see Annex 2 for more details).

### 3.3.2 Country-led climate financing mechanisms

The Brazilian Amazon Fund,[31] the Mexican Green Fund and the Indonesian Climate Change Trust Fund (ICCTF) of the National Planning Agency (Bappenas) are potentially deep financing mechanisms which could also be used for agricultural mitigation financing in developing countries. The Amazon Fund, established in 2005 and hosted by the National Bank for Economic and Social Development (BNDES), is operational. The Government of Norway committed US$1 billion, US$136 million of which has already been invested. The Government of Germany invested US$21 million.[32] The Fund has a governance structure comprised of federal government, local government and civil society representatives. The BNDES has an A2 Moony credit rating, demonstrating the quality of its fiduciary standards. The Brazilian Government is committed to financing 50% of ERs from deforestation and forest degradation (REDD+) and will sell the remaining 50% at a price of US$10/t$CO_2$ through the Amazon Fund. The Government is liable for the permanence of the credits issued. The Amazon Fund provides financial incentives for forest protection and sustainable production as well as research and development, including for agriculture, which is the main driver of deforestation in the Amazon.

30 www.carbonfinance.org
31 http://www.amazonfund.gov.br/
32 http://www.amazonfund.gov.br/FundoAmazonia/fam/site_en/Esquerdo/doacoes.html

### 3.3.3 Return-on-investment carbon funds

Return-on-investment carbon funds are either single purpose exchange traded companies that are involved in project development and carbon asset management, or funds established by investment banks that invest in projects or shares of companies active in the carbon market. Commercial return-on-investment carbon funds have a very limited interest in AFOLU projects because most project types do not generate compliance credits. Even forestry credits are still not traded at major exchanges and are not considered to be lucrative assets to develop. However, this will change if activities related to reduced emissions from deforestation and forest degradation can generate compliance grade offsets.

In general, two types of carbon funds may be interested in AFOLU projects. One type is credit-return funds with the mandate to purchase AFOLU credits, like the BioCF. The other are highly specialized funds that develop and aggregate carbon assets from AFOLU projects with the long-term expectation that these assets will fetch a premium price in the future. Private carbon funds are willing to take a higher risk by investing early in the project development cycle to maximize the margin between the bulk purchasing costs (currently US$3-8/t$CO_2$e) and retail value (currently US$15-25/t$CO_2$e). To maintain liquidity, however, they often have to sign forward purchasing contracts with strict delivery dates, therefore, they require projects to minimize risks to project performance, compliance and delivery, which can be difficult in this early phase of AFOLU credit development.

### 3.3.4 Carbon retailers

Retailers are companies that sell small quantities of carbon credits directly to unregulated companies or individuals aiming to offset or retire their emissions. The buyers are interested in 'charismatic' carbon assets, i.e. assets with an appealing story behind the emissions reduction project. This market segment prefers to buy voluntary carbon credits. Major carbon retailers include Climate Care and Terra Pass.[33] Much of the benefits of carbon trading to carbon retailers is derived from their public reputation and image, thus they rely on rigorous standards and approved methodologies that are well recognized among civil society and consumers. Offsets are traded on-line to reduce transaction costs.

33 http://sustainability.tufts.edu/downloads/TCI_Carbon_Offsets_Paper_April-2-07.pdf

# Measurement, reporting and verification (MRV) of agricultural mitigation activities[34]

4

## 4.1 MRV basics

To credit and finance mitigation actions, it is necessary to have a system for the MRV that mitigation benefits actually are achieved. MRV is a key issue in assessing the potential for linking mitigation finance to smallholder agricultural systems, since they involve significant costs and they affect the uncertainty factors and risk associated with any specific action. There are a number of ways that MRVs for land based agricultural mitigation activities could be designed – including land based accounting (e.g. changes per unit land area) or performance based standards (e.g. changes per unit output/product). In the context of carbon finance, the focus has been mostly on land-based accounting standards, which is the main focus of this section as well.

MRV systems are needed to ensure environmental and social integrity of mitigation actions, and vary depending on scale and degree of confidence associated with the estimates they provide. The costs also vary depending on these same factors, as well as by different types of mitigation actions. In this section, existing and proposed MRV options for various financing mechanisms are presented and discussed in relation to their application to agricultural mitigation actions. This is followed by a brief overview of the cost implications related to different MRV systems.

## 4.2 MRV levels of accuracy

According to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories different levels, also referred to as Tiers, exist for carbon accounting. The higher the Tier, the higher the accuracy, but this comes with a cost, and in many cases lack of data is also a major issue in effectively applying higher Tier level analyses. MRV approaches are generally divided into 3 main categories based on their level of detail and accuracy (see Table 4). Tier 1 is the basic method that relies on pre-defined default values. Tier 2 is an intermediate method and Tier 3 is the most demanding level in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate. For carbon market offset projects, Tier 3 levels of accounting are generally required. For national level carbon accounting for national communications to the UNFCCC or potential studies in most countries, however, only Tier 1 or Tier 2 are applied.

**Table 4. Definition of Tiers**

| Tier | Definition | Applications |
|---|---|---|
| 1 | Basic approach using IPCC default factors when no country-specific peer-reviewed studies available. | Sectoral or project-level mitigation potential studies, tools like EX-ACT[35] are based on this approach. |
| 2 | Intermediate approach using data from studies, e.g. modeled/estimated reflecting national circumstances. | State of the art reporting standard for national level GHG inventories. |
| 3 | Most sophisticated approach using validated models and/or direct measures of stock change through monitoring networks | Required by CDM and VCS for project-based mitigation actions. |

Source: Modified from IPCC 2006

34 Substantial sections of text in this chapter are taken from the FAO 2009 publication entitled "Food security and agricultural mitigation in developing countries: options for capturing synergies" http://www.fao.org/docrep/012/i1318e/i1318e00.pdf

35 See http://www.fao.org/tc/exact/en/

## 4.3 National GHG inventory

Annex I[36] parties to the UNFCCC are required to provide national GHG inventories on an annual basis to the Convention. Countries are not required to report on land based emissions from agriculture, but may choose to do so under Article 4.3 of the Kyoto Protocol.

The IPCC Good Practice Guidelines (2003) for land use, land-use change and forestry (LULUCF) published detailed GHG inventory and monitoring guidelines for all land-based emissions and removals. National GHG inventories will certainly be needed to monitor the impact of mitigation action at sectoral level in the framework of internationally supported NAMAs, although with a few exceptions, developing countries and most developed countries are currently using Tier 1 emission factors, which have a wide range of uncertainty.

National soil GHG inventories based on Tier 1 approaches require quantitative information on land use, management, and climate and soils distribution in order to predict carbon stock changes related to land-use change and the adoption of changed management activities. Default values for carbon stocks and stock change factors, for specific land use and management options (i.e. activity-based default values) are provided by IPCC (2006). Moving from Tier 1 to Tier 2 requires country-specific estimates of carbon stocks, stock change factors and emission factors. Tier 3 approaches require the most detailed environmental and land use and management data. In most cases, available data, e.g. through FAO and in-country sources, are sufficient for Tier 1 estimates, but capacity and resources for compiling and analyzing the information is the main limiting factor. For higher tiered approaches, additional data collection and research capacity is needed beyond what currently exists in most non-Annex I countries.[37]

## 4.4 MRV for crediting and trading approaches

There is a wide spectrum of possible sources and mechanisms for crediting and financing mitigation, ranging from public funded policies to offset crediting mechanisms—and these also entail a range of MRV options. There is considerable discussion in the UNFCCC process about the MRV required for different approaches, and this has been a key issue in accepting agricultural mitigation as a source of mitigation eligible for crediting and financing—particularly in the context of carbon markets. At present there is considerable interest in exploring the possibility of scaled-up approaches for crediting – at sectoral and sub-sectoral level – due to the high transactions costs and relatively little development of project-based approaches. The discussion about scaled-up approaches is relevant for both carbon markets (e.g. CDM PoA) as well as public funding through NAMAs.

Currently, main potential options for crediting agriculture mitigation under sectoral mechanisms are related to:

- PoA using regional baselines; and
- sector – or potentially sub-sector – approaches based on crediting or trading approaches (e.g. lose or no-lose targets).

36 Annex I parties are defined as industrialized countries and economies in transition. There are 41 Annex I countries and the European Union is also a member. The countries include: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States of America.

37 However, many of the larger non-Annex I countries (e.g. Brazil, China, India, Mexico) have the scientific infrastructure to support higher Tier inventory approaches.

At present there is no agreement on how such scaled-up approaches to crediting mitigation in agriculture could function. Project-based, bottom-up accounting methodologies developed for specific mitigation activities under the CDM can play a very useful role here in providing guidance on:

- methodology applicability conditions;
- the baseline, i.e. carbon stocks and carbon stock changes in a without-project scenario;
- estimating ERs and removals for the project scenario; and
- monitoring ERs and removals.

The development of scaled-up land-based agricultural mitigation methodologies could adapt these existing approaches, with consideration of specific agricultural mitigation characteristics. Baseline development procedures could be informed by ongoing relevant REDD initiatives. The principal approaches – which are important pre-conditions to ensure the environmental integrity of agricultural mitigation, i.e. to prevent leakage[38] and ensure permanence and additionality,[39] – can also benefit from the experience in the forestry sector and the evolving voluntary carbon standards. Considering that land-based accounting may move towards a comprehensive landscape approach (see FAO 2009), the terminology introduced in the context of REDD could be used (Meridian Institute 2008).

One of the most promising crediting approaches for agriculture is a programmatic approach, also referred to as a PoA. Under this approach, a sectoral crediting baseline or cap on emissions levels is set. Activities based on a single approved methodology can be adopted independently from the sector as a whole, and activities can be implemented by different operators, e.g. from the private sector or NGOs, in a specific geographical region. Compared to stand-alone projects, individual activities do not have to demonstrate additionality or be individually validated, and a regional baseline could be used for land-based activities. This would dramatically reduce carbon-related transaction costs. The approach provides the flexibility to scale up promising agricultural mitigation activities, e.g. sustainable rangeland management over millions of hectares, while benefiting from the reduced transaction costs of the programme framework. Furthermore, respective approaches are already eligible with CDM crediting mechanisms, thus can be linked to existing trading systems.

Box 2 below demonstrates the potential of a rangeland PoA Carbon Project in China, where rangelands cover about 400 million ha, or more than 40% of China's territory, and nearly the same proportion of the earth's land area.

## 4.5 MRV for nationally appropriate mitigation actions (NAMAs)

As the NAMA concept is still evolving and to date covers a fairly wide range of financing and crediting proposals, including crediting and trading approaches discussed above, there are a range of MRV approaches that could be required. It has been suggested that NAMAs could provide an over-arching structure for three different action categories differentiated by source of funding:

i. actions undertaken by developing countries and not enabled or supported by developed countries (unilateral mitigation actions);
ii. actions supported by a fund and financed by developed countries (supported mitigation actions); and
iii. actions undertaken to acquire carbon credits (creditable and or tradable mitigation actions).[40]

38 compare Section 4.7.

39 compare Section 4.8.

40 http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/mitigation1bii140808_1030.pdf (Page 4 referring to negotiation text Page 94: Alternatives to paragraph 76: Alternative 2)

Depending on the NAMA category, varying levels of detail and accuracy for MRV might be appropriate. A minimum set of MRV obligations might be considered appropriate for unilateral actions if they are to be internationally recognized. For actions supported by developed countries, additional MRV responsibilities ranging from Tier 1 to 2 are likely to be necessary to ensure that investments have the desired climate impact. Box 3 below gives more information on the three categories and resulting considerations.

BOX 2:
**Concept for a rangeland management PoA in China**

Rangelands cover about 400 million ha or more than 40 percent of China's territory, and nearly the same proportion of the Earth's land area. In China, as elsewhere, large areas of grassland are degraded due to unsustainable management practices. McKinsey (2009) concluded that adopting sustainable grassland management and restoration practices is the most important abatement opportunity in China's agricultural sector up to 2030, with an abatement potential of 80 million tonnes of $CO_2e$.

In provinces like Qinghai, with about 36 million ha of grasslands, a PoA management approach could include a regional baseline established at the province or the prefecture level while project activities could be implemented at country level.

Close horizontal and vertical coordination between government agencies and an integrated planning and funding mechanism would be required. Activity monitoring information could be also aggregated at prefecture level. Carbon modeling to predict the mitigation potential of certain management activities could be produced by local research institutes. At village level, community organizations and village committees with technical support from the county grassland management station could conduct participatory land-use planning. The planning process would define the carbon baseline and the management activities that can be adopted to achieve the dual goal of restoring soil carbon stocks while increasing household incomes.

Source: FAO 2009

BOX 3:
**Three levels of NAMA actions and financing**

**Unilateral NAMAs**: Autonomous actions undertaken and funded by the developing country itself without any international financial or technical support. In particular in the case of the emerging economies, developing countries are increasingly expected to contribute to global mitigation efforts and cover some of those costs with their own budgets. In theory, although not always possible in practice, developing countries could identify the lowest cost mitigation measures – in fact even those generating positive returns such as energy efficiency – and target those as the country's contribution to global mitigation. The reality however is that even negative cost mitigation measures require upfront capital which the country may not have at its disposal.

**Supported NAMAs**: Actions undertaken by the developing country with financial and/or technical support from industrialized countries. It is generally assumed that this support would cover only incremental costs of the mitigation actions, and would stem from developed country government sources. These NAMAs do not generate international offsets and are attributed to the mitigation action of the country in which they occur. Thus the international funding would serve as an incentive to establish performance goals that are more aggressive than those that could be reached exclusively by unilateral NAMAs.

**Credit-generating NAMAs**: Mitigation actions that produce offsets for sale in the international carbon market. ERs achieved under this form of financing are not attributable to the country in which they are achieved but rather sold to the entity which provides the funding, generally thought to be a private sector company in a developed country. In principle, the mitigation measures targeted for the market could be those further up the supply curve.

Source: Climate Focus

## 4.6 Key issues in MRV for land-based agricultural mitigation

An expert meeting held at FAO in 2009 on measuring GHG emissions from agriculture highlighted the large knowledge gaps and variations in data systems underlying assessments and GHG reporting.[41] An improved knowledge base will therefore not only improve GHG emissions assessments and national inventories, accounting and reporting of agricultural emissions, it will also facilitate agriculture sectors to be included in post Kyoto agreements. Furthermore an improve understanding of agricultural mitigation practices would help assessing the "additionality"[42] and allow them to qualify for future Clean Development Mechanisms (CDMs).

A systematic inventory is therefore required to improve the capacity of estimating carbon pools in global forests, agricultural land and other terrestrial carbon pools. Such an effort would not only improve the possibility of developing and validating models and facilitating remote sensing interpretation; it would also allow for the establishment of a relationship between soil carbon/soil quality and agronomic practices/productivity. It will also improve estimations of above and below-ground biomass of trees, which in turn would allow for the establishment of credible baselines. There is a need to expand the coverage of allometric equations for more species and biophysical regions, but also to make the original data from destructive sampling available to ensure that the allometric models are based on adequately large samples of datasets (increasing accuracy and reducing uncertainty). In addition, a generalization of model formulations would be extremely helpful, as most current models are very heterogeneous in their formulation and not standardized. Integration and synthesis of existing data would also be a useful process with near-term dividends for a moderate investment.

## 4.7 Leakage

Mitigation options must control for any potential leakage. For example, reducing stocking rates to increase above and below ground carbon in the project area should not result in more overgrazing and soil degradation in neighboring areas. The potential for any leakage should be mitigated in the project design. For CDM A/R projects the UNFCCC has developed a leakage tool to calculate and deduct emissions outside the project boundary that are attributable to the project.[43] For agricultural projects that support intensification of production practices, emissions occurring off-site due to production of agricultural inputs are an important source of leakage that must be taken into account.

Forest cover within farms and deforestation in neighboring areas for example could be monitored in project sites, where agricultural practices have been promoted in order to observe impacts or leakage of a defined area. Influence from migrating communities (assisted project areas might be attractive to others) however have to be observed and accounted for.

## 4.8 Permanence and additionality

Additionality is a key criterion for crediting mitigation activities – particularly in the context of carbon markets. As part of the project design, the project developer has to outline why the project is additional, i.e. why ERs would not take place in the absence of the carbon finance project. UNFCCC has developed

41 http://www.fao.org/climatechange/19080-0f03c4380615e60d4ee30580c68a724f0.pdf

42 e.g. these ERs should be additional to those that would have been achieved under a “business as usual” scenario.

43 http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-09-v2.pdf

a special tool for documentation of the justification.[44] One important consideration for determining additionality in the context of agricultural mitigation activities that have a net positive return even without carbon finance is the existence of a range of technical, financial and institutional barriers to their adoption. This is important, since there are many forms of agricultural mitigation that fall into this category, as discussed above.

Carbon projects also have to cope with the risk of non-permanence, i.e. the risk that the carbon sequestered is later released, for example due to a grassland fire. Other experience indicate that C sequestration through introduced conservation agriculture measures might be reverted after several years of practice by burning or plowing the farm due to pest, diseases or herbicide resistant weeds. The risk of non-permanence is one reason why carbon buyers often do not buy ERs from AFOLU projects. The risk of non-permanence is addressed in some standards (e.g. the VCS) by requiring land use sequestration projects to assess this risk and retain a risk buffer in which up to 30% of the ERs generated are kept in a separate credit account in case the sequestered carbon is released again. With permanence risks the key question is who is liable (the seller, the buyer, the host country or the party using the ERs), so different approaches for addressing these liabilities can be devised.

## 4.9 Baseline definition, sampling and carbon model application

To generate carbon assets, a baseline or business-as-usual scenario has to be described and compared with the mitigation action scenario. The difference between the two determines the amount of ERs generated by the project. The baseline is determined before the project activities are adopted using a 'frozen baseline' that measures the emissions before the project activities began. Or a 'dynamic baseline' can be used to monitor change in carbon stocks in a with- and without-project comparison. In this case, the baseline (non-adoption) has to be monitored in a paired approach together with the adoption of project activities at regular intervals. The sampling size has to meet minimum accuracy requirements determined in a project methodology.

Carbon removals or ERs have to be monitored against the baseline. For biomass carbon stock changes, in particular for trees, the CDM has developed a comprehensive set of tools and methodologies.[45] However, in agricultural carbon projects often the soil carbon pool has the biggest additional carbon capture potential. Methodologies for monitoring changes in soil carbon stocks against the baseline in agricultural projects are a major focus of recent initiatives to support the development of agricultural carbon projects. Carbon sequestration due to agricultural practices cannot be permanently added, since carbon stocks reach a limit depending on soil structure and soil carrying capacity. Improved practices can reach the limit after about 15 to 20 years as indicated in the following figure: Carbon stock changes can either be monitored using activity-based model estimates, direct measurement approaches or a combination of both. Technology to quantify soil carbon offsets directly through measurements exists and is widely available at reasonable cost. The challenge in measuring soil organic carbon (SOC) stock changes is not in the measurement technology per se but in designing an efficient sampling regime to estimate soil C stocks at the field scale. The spatial variability of SOC is often high and the amount of C present in the soil relative to the additionally accumulated portion is typically high (i.e. low 'signal to-noise' ratio). The sampling density increases with carbon stocks in the baseline. Annual soil carbon stock

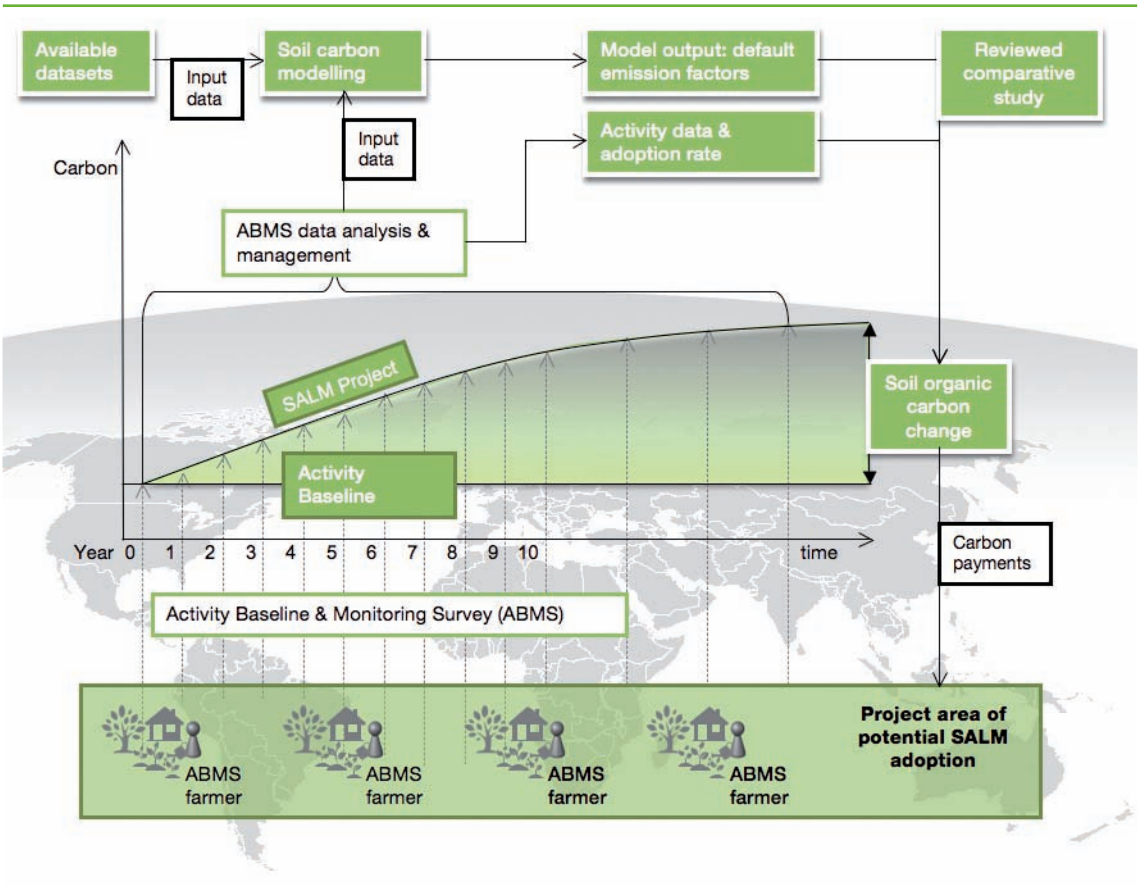
44 http://cdm.unfccc.int/methodologies/ PAmethodoloies/AdditionalityTools/Additionality_tool.pdf

45 http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html

changes are usually less than 10% of the total soil carbon stocks. This means that if the net sequestration is measured with a 10% accuracy level, the total soil carbon content needs to be measured to an accuracy of at least 1% (Willey et al. 2007). This enormously increases the sampling size and related measurement costs. Hence a five- to ten-year period between measurements is typically needed to adequately detect the cumulative change (Conant and Paustian 2002; Smith 2004 cited in FAO 2009).

In all national GHG inventory systems and existing standards like the Alberta Offset System, carbon models are used to predict the soil carbon stock changes based on rates of adoption of C sequestering activities in the baseline and through monitoring of project activities. Where models are used, it is important to calibrate the soil carbon model to the conditions in the target region, based on long-term soil carbon monitoring plots. In countries where such plots are not available – or do not represent management practices or agro-ecological zones sufficiently well – exist opportunities for national agricultural research organizations to play an important role. FAO is currently identifying options to support related country-led initiatives (FAO 2009). The system used in the proposed VCS methodology "Adoption of Sustainable Agricultural Land Management"[46] is presented in Figure 5 below, which shows that an

**Figure 5: Activity-based measuring for sustainable grassland management (SGM) projects**




Source: Kenya Agricultural Carbon Project 2011

46 http://www.v-c-s.org/methodologies/adoption-sustainable-agricultural-land-management-salm

Activity Baseline and Monitoring Survey is used together with participatory land-use planning to estimate the expected adoption of sustainable agricultural land management activities. A carbon model calibrated with available data from long-term monitoring plots or research is used to estimate baseline carbon stocks and stock changes. Initially, it is recommended to monitor the adoption of sustainable grassland management (SGM) practices annually and to link them with performance payments. With increasing confidence – and considering that adoption levels-off over time – survey intervals can be extended. Independent verification is required to confirm the quality of monitoring data derived from this system.

Regarding the credibility of emissions reduction estimates from agricultural land use projects, early experimentation through voluntary markets has provided some indication of possible options to address issues of credibility. There are several sources of uncertainty associated with soil carbon sequestration activities that MRV systems for GHG accounting must explicitly or implicitly address: (i) uncertainty over whether or not an activity is implemented and an accurate accounting of the land area involved; (ii) uncertainty arising from emission factors attributed to mitigation actions, particularly in heterogeneous agricultural landscapes; (iii) uncertainty due to lack of scientific documentation of the impacts of management practices on non-$CO_2$ emissions associated with carbon sequestering processes.

One of the biggest constraints to building viable agricultural MRV systems in developing countries is the lack of research establishing a credible basis for associating changes in soil carbon sequestration with changes in agricultural activities. Some early agricultural mitigation programmes (e.g. under the Alberta offset system, VCS and Climate Action Reserve) give excellent examples of the protocols for estimating ERs that can be set up when a sufficient basis of research information is available.

In the absence of such information, however, there are several options for addressing the problem. One approach would be to conduct very intensive field measurements of soil carbon changes with changes in land practices and to issue credits based on actual measured changes. This approach is not likely to be widely applied, mainly because extensive direct measurements are quite expensive to conduct. Another option is combine detailed activity data with conservative default values for crediting soil carbon sequestration (e.g. IPCC Tier 1). This would have the advantage of low measurement costs, but potentially low accuracy. Starting with a conservative, simple approach would allow for the development of methods via “learning by doing” and increasing the research basis alongside early mitigation actions. One potential objection to this approach is that a very conservative approach may not yield sufficient emissions reduction credits to make agricultural sequestration feasible for crediting, since the reduction in the value of the ERs would be greater than the reduction in transactions costs. Furthermore, field measurements of soil carbon in a smallholder project setting would be subject to a large set of influencing factors and uncertainties, and would not necessarily be an effective way to reduce the uncertainty of soil carbon sequestration estimates.

A third option – which is being used in the development of methodologies for several voluntary carbon standards – is to use a more sophisticated biogeochemical process model, such as the Century, the Rothamsted carbon (RothC) or the DeNitrification-DeComposition (DNDC), which is combined with a limited set of field measurements used to parameterize and validate the model. The difficulty with the use of such models is that although it may be possible to validate the general outputs of the model, long-term experimental data with which to validate model predictions for specific management changes is lacking for most management practices in most agroecosystems worldwide. Discussion on early experiences with this approach has begun e.g. Olander and Haugen-Kozyra (2011), but as yet there are no agreed protocols to ensure transparency in the ways in which such models are manipulated in the process of operation. Further research is needed to validate models across varying agro-ecosystems and farming systems. This will require careful consideration of sampling design, rigorous implementation of study protocols and long term research sites. This is a prime example of where public funding can support the development of agricultural mitigation schemes. Ideally a set of coordinated long term research monitoring plots for soil carbon under transitioning farming systems could be established and maintained by public sector research institutions.

To date, most applications of modelling approaches have occurred in the farming systems of developed economies, where regulatory requirements ensure that farms maintain relatively comprehensive farm records which can provide the basis for activity monitoring data. In most developing countries, such regulatory requirements and other capacities required for accurate activity monitoring often do not exist. To date, insufficient attention has been given to the requirements for precise activity monitoring, although some smallholder pilot projects are developing early examples of monitoring procedures. Irrespective of whether financial support derives from carbon markets or public climate mitigation finance, credible activity monitoring systems are required. Activity monitoring for scaling up adoption would further have to be based on existing agricultural monitoring and evaluation systems. Analysis of an existing agricultural monitoring and evaluation system suggests that they may provide a credible basis for MRV of agricultural mitigation actions where (i) their procedures are encoded in explicit rules that are transparently communicated; (ii) they include provisions for quality control and quality assurance; and (iii) where they are based on institutional arrangements that provide accountability in ways appropriate to the national context (Wilkes et al 2011). Developing country monitoring and evaluation systems are insufficiently documented to allow an assessment of the extent to which existing systems meet these criteria.

## 4.10 Classifying agricultural mitigation practices: a key issue for land-based mitigation accounting approaches

There are a number of different classification systems to classify agricultural practices in general and also for measuring mitigation impacts of transitions. One of the challenges of land-based accounting approaches for agricultural mitigation is to define relevant categories for assessing mitigation impacts that can be linked to observable actions in the field or to specific parameters in models used to estimate impacts.

Three main classification systems for describing changes in agricultural land use management practices are compared in Table 5 below. The first is the current IPCC system of categorization, the second is the FAO system for defining conservation agriculture – a broad range of agricultural practices that are recommended primarily for their benefits to agricultural production – and finally, the categorization of land based mitigation practices in the RothC soil carbon model—one of the leading models used to assess potential mitigation impacts of land-use changes in agricultural systems.

The classification used for the AR4 on agriculture is differentiating categories at three distinct levels: mitigation mechanisms, land use, and management activities. At each level, however, there are overlaps among the categories e.g. more efficient fertilizer application will reduce emissions, avoid emissions and may enhance removals, assuming additional biomass produced is returned to the soil. Furthermore, adopting a set of management activities does not simply mean different management-specific sequestration rates can be added.

Most FAO-supported Conservation Agricultural practices also have mitigation benefits. The broad classification indicates that a classification should be practical in the specific context, but minimum principles are defined for conservation agricultural practices.

Mitigation practices recognized by soil carbon models like RothC focus on the drivers of soil carbon sequestration i.e. biomass production and utilisation/management.

**Table 5. Comparison of classifications of agricultural practices**

| Parameter | IPCC agricultural practices | Conservation agriculture | Mitigation practices recognized by RothC Soil carbon model |
|---|---|---|---|
| **Definition** | Mitigation technologies and categories related to reducing emission, avoiding emissions and enhancing removals in the following distinguished land-use types:<br>• Cropland management<br>• Grazing land management<br>• Management of organic soils<br>• Restoration of degraded soils<br>• Livestock management<br>• Manure/biosolid management<br>• Bioenergy | Defined by FAO as those practices that are successfully adopted by farmers following the three principles which are linked to each other, namely:<br>• Continuous minimum soil disturbance<br>• Permanent organic soil cover<br>• Diversification of crop species grown in sequence or associations. | Biomass and residue production and utilisation, e.g. extracted, left on the field, composted, returned as manure.<br>Yield is used as a proxy for crop biomass production. |
| **Function** | Categories for national GHG reporting | Balancing production and land conservation goals | Project-level carbon accounting |
| **Minimum data requirements (broad categories)** | Annex I countries have the option to report emissions under Article 3.4. Reporting is in general based on activity monitoring and model based default values. Annex II countries are not obliged to report. China is currently implementing national GHG inventory which is considering agriculture. | There is no global system for monitoring the adoption of conservation agricultural practices. Data on tillage practices, residue management and crop rotations from agricultural surveys are a potential source of such data that may be found in some national and sub-national survey datasets. | Activity data related to biomass production and residue management.<br>Soil type, in particular clay content. Meteorological data (rainfall/temperature from nearest station) |
| **Expected accuracy level** | Not defined but accuracy assessment required | Depends on sampling frame of specific datasets | 90-95% |

# Capturing agricultural mitigation benefits from smallholder agriculture: What next?

5

## 5.1 Responding to the opportunities created in Cancun 2010

Commitments made during the Cancun COP16 will generate public sources of fast-start financing for mitigation activities until the end of 2012. From 2013 onwards, additional funds will be available under the new GCF, which was approved in the framework of the same agreement. Also in the Agreement, the need for using markets to enhance cost effectiveness related to mitigation actions was recognised, but a decision to establish one or a number of different market mechanisms is still pending. The decisions taken in Cancun indicate the importance for developing countries to prepare proposals for mitigation activities that could receive fast-start financing.

Carbon finance strategies for the agricultural sector of developing countries clearly must be prioritized by their potential to contribute to sustainable development, poverty reduction and adaptation in these countries, rather than mitigation requirements and costs in developed countries. In this way, mitigation finance will support developing country policy priorities and long-term sustainable development. Approaches for doing so include the adoption of: (i) sustainable development policies and measures (SD-PAMS) that are aligned with development priorities and also contribute to reducing emissions or increasing soil carbon sequestration; and (ii) activities that provide incentives for the private sector to invest in CSA. Since sectoral carbon market mechanisms do not yet exist, financial and political resources should be mainly employed to facilitate CSA investments. A sectoral readiness process should be used to identify promising mitigation options and to design innovative public-private finance mechanisms to capture this potential.

## 5.2 Prioritizing activities

In looking for synergies between agriculture, food security and mitigation, it is necessary to have an understanding of the benefits of improvements to soil quality for each objective under varying circumstances, as well as the costs of making such improvements. Identifying locations, farming systems and farming groups where increasing soil quality is likely to have the greatest impacts on agricultural productivity is a first step in identifying potential synergies. The main benefits to smallholder farmers of adopting soil improving sustainable land management practices include increases in yields per hectare, increases in yield stability over time due to greater resilience, and reduction in production costs (FAO 2009b; FAO 2010). The degree to which any one of these three types of benefits can be obtained by individual farmers adopting sustainable land management practices is quite variable, depending on the specific agro-ecological conditions they are operating under, the past history of land use, as well as their socio-economic environment (including input and output markets, and policies affecting access to land and other inputs), as well as specific household characteristics.

Essentially this analysis suggests that synergies between mitigation and agricultural growth for food security are likely to be the rule with adoption of sustainable land management, however, the degree to which soil improvements generate food security versus sequestration benefits varies. Sustainable land-management practices in drylands are key to food security, with relatively smaller sequestration benefits per hectare.

## 5.3 Moving from project to sectoral approaches

Some lessons from early pilot activities indicate that pilots to develop new classes of project are expensive, although the returns for project participants may potentially be high. Soil carbon accrues slowly over time, while upfront investment costs are often high, making such projects unattractive compared to many other investment options. Looking beyond small-scale pilots, payments for carbon sequestration to smallholder farmers achieved on any large scale will need to be embedded in government programmes. On the one hand, this is because a significant proportion of investment costs in agricultural carbon projects occur upfront, while private buyers of carbon projects are often unwilling to bear the risks of upfront investment. On the other hand, government-funded agricultural extension systems provide an institutional basis for scaling up adoption of agricultural activities.

In this regard, one of the more interesting possible future developments for mitigation financing for developing country agriculture is through nationally appropriate mitigation actions (NAMAs) that are currently under discussion in the UNFCCC process. NAMAs could be structured to be a public sector investment into building long term capacity for accessing a new source of finance for agriculture, be it through carbon markets or public sector incentives for mitigation (including international public sector sources such as the Green Climate Fund (GCF). Since NAMAs are to be proposed by Parties to the UNFCCC, they can consider agricultural and land-use sector development priorities, and integrate with national agricultural programmes, and thus fully aligned with national policy priorities.

# PART II. A guide to developing soil carbon sequestration crediting projects in smallholder agriculture

In the second part of this guidebook we move from a conceptual to a practical level, gathering practical recommendations for project developers, drawing from a limited but growing corpus of experiences. The first section outlines the main steps and considerations for developing carbon offset projects involving smallholder agriculture, focusing primarily on soil carbon sequestration but also drawing from examples of other type of mitigation activities. Recommendations on the assessment of financial viability, risks and institutional arrangements required for such projects are dealt with in the following chapters.

As noted earlier, the development of agricultural carbon assets is still at an early stage and approved methodologies for many activities are not yet available. Therefore, we present the key requirements for generating carbon assets with special reference to cropland and grassland carbon finance projects. We take the case of a pilot grassland restoration carbon project currently under development in FAO to illustrate key issues in developing an agricultural offset project (see Box 4 below).

BOX 4:
**Three Rivers Grassland Carbon Sequestration Project**

The Three Rivers Project, situated in the Qinghai province of China (North), is a pilot project using carbon financing to facilitate grassland restoration and increase livestock productivity. Carbon finance, from the voluntary carbon market, will be used to cover implementation costs, compensate foregone income, and increase productivity. Under the Pilot, herders will be offered a menu of options designed to fit their specific land use, which includes a combination of grassland restoration zoning and stocking rate management, in an incentive-based system. Given the current overstocking rates (about 45%), considerable reductions in animal numbers – and therefore income – are expected during the first years of the Project, for which herders will receive compensation. In the following years, as incomes are expected to grow in response to increased livestock productivity – and possibly from additional small business support measures – compensation will decrease progressively until Year 10, when it will cease altogether.

Overall, in the first ten years of the Project, households will have fewer but more productive livestock. From ten to 20 years, they can increase herds beyond the level of the first ten years, without the risk of overgrazing. Increased availability of forage will enable higher incomes and higher levels of production over the long run, providing a financial incentive for long-term sustainable management. In addition, the Project will develop a number of activities aimed at improving the profitability of livestock rearing thus improve herders' livelihoods. In addition to improvements in animal production (e.g. feeding, winter housing and breeding), it will include the development of processing activities and marketing associations.

This model hopes to break the vicious cycle of overstocking, degradation and building in, thus demonstrating sustainable management options during the Project's lifetime while generating a reduction of approximately 500,000t$CO_2$e, over a period of ten years. It also aims to address some of the key barriers to smallholder access to carbon finance, which includes the lack of appropriate methodologies for crediting, as well as methodologies for cost effective MRV.

The project development is jointly supported by FAO's Animal Production and Health Division (AGA) and Agricultural Development Economics Division (ESA), the Chinese Ministry of Agriculture, and Qinghai Province.

Source: FAO 2010

# 6 Steps to establishing an offset project for smallholder agricultural projects

## 6.1 Eligible activities: standards and methodologies

In Section 2.2.1 we discussed the types of activities with important mitigation potential in agricultural activities. Currently, few of these activities are effectively eligible in the carbon offset market due to the absence of agreement on their inclusion as an allowable source of mitigation, as well as a lack of approved GHG emission accounting methodologies by either CDM or other Carbon Standards in the voluntary market.

Enabling smallholders to access carbon finance requires the adoption of MRV standards to demonstrate that carbon credits are real, additional, quantified and monitored, and have been independently verified.[47] A standard provides general rules and regulations on how to generate carbon credits that are acceptable to the respective crediting institution. A methodology (referred to as an Offset Protocol in North America) describes the detailed accounting and monitoring procedures for a specific mitigation action. Methodologies must be approved by a standard and the ERs verified before they can be applied to a specific project to generate certified/verified ERs. Table 6 below provides an overview of existing agricultural land-use methodologies, and Annex 6 provides a list of CDM methodologies relevant for agriculture.

Currently, methodologies from CDM and VCS are two of the primary options available for smallholder agricultural carbon projects seeking to obtain carbon market finance. The respective methodologies have a range of general, as well as very specific, applicability conditions that have to be considered. For example, all approved CDM methodologies relating to afforestation and reforestation require that an area which can be clearly classified since 1 January 1990 as a non-forest, according to the CDM forest definition[48] is transformed into a forest. The small-scale CDM methodologies can only be applied for projects that generate less than 16,000 $tCO_2e$/year. A portfolio of small-scale projects, however, can be developed assuming that each project has different project participants (groups of smallholders listed in the PDD, compare Section 6.3.2) or projects are registered two years apart from each other or are located 1 km apart from each other.

**Table 6. Overview of agricultural methodologies**

| Standard | Methodology | Source |
|---|---|---|
| UNFCCC/ CDM | Small-scale agroforesty methodology<br>Small-scale silvopastoral methodology<br>Small-scale replacing synthetic fertilizer<br>Methane methodologies | http://cdm.unfccc.int |
| Alberta Offset system | Beef (Feeding) Quantification Protocol<br>Beef (Lifecycle) Quantification Protocol<br>Pork Quantification Protocol<br>Biogas Quantification Protocol<br>Tillage Quantification Protocol | http://carbonoffsetsolutions.climatechangecentral.com |
| VCS | Proposed methodology<br>Adoption of sustainable agricultural land management (SALM) | http://www.v-c-s.org/methodologies/adoption-sustainable-agricultural-land-management-salm |

Source: Modified from IPCC 2006

47 http://www.offsetqualityinitiative.org/
48 http://cdm.unfccc.int/DNA/index.html

The small-scale agroforestry methodology cannot be applied on former grassland. The main advantage of this methodology, however, is that it is using a default value of 0.5tC/ha/yr for soil carbon that a project developer can claim without being required to monitor carbon stock changes in the soil.

In general, a methodology includes a baseline methodology, i.e. accounting rules for estimating the project baseline (emissions that would have occurred in the absence of the project), and a monitoring methodology, i.e. accounting rules for calculating ERs from the project. Below we discuss some of the main requirements for addressing these issues, with a focus on current approaches to addressing them in the context of smallholder agricultural land use projects. Note, however, that many of these methodologies are only recognized by regional standards (e.g. Alberta), and that all methodologies have applicability conditions that limit the range of situations to which the methodology is directly applicable to. Where a promising agricultural practice has been identified but there is no existing methodology to account for ERs from its adoption, a new methodology will have to be developed and approved by a relevant standard.

Each methodology must also define the set of emission sources which are to be accounted for in the methodology. For example, while carbon sequestration in degraded grasslands may be the main target of a project, the related methodology may have to specify methods for accounting for changes in livestock emissions as well as other sources of soil GHG emissions (e.g. $CH_4$ and $N_2O$) in addition to soil carbon stocks. Methodologies also specify the conditions under which certain emission sources can be left unmonitored or conditions under which a leakage assessment must be made.

## 6.2 Project Idea Note (PIN) for engaging a buyer

Investigation of the aspects discussed under 6.1 will lead to production of a PIN (for more on this, see Sections 6.3.1 and 6.3.2). The full project design document (PDD) will take considerable resources to develop. The majority of potential project developers, however, most likely lack these resources. The PIN can be used to seek an investor to cover the costs of detailed project design, or to identify a potential buyer for the project who is willing to invest upfront in the project design and recoup the costs from the purchase of ERs when the project goes into implementation.

BOX 5:
**Agricultural mitigation activities currently eligible in the voluntary carbon market**
**Verified Carbon Standard (International)**

- measures to increase above-ground C stocks – agroforestry
- measures to enhance soil C stocks from practices that increase belowground inputs or slow decomposition:
  - increasing forage productivity (e.g. through improved fertility and water management)
  - and introducing species with deeper roots and/or more root growth
  - and reducing degradation from overgrazing
- measures to reduce soil $N_2O$ emissions by enhancing the N use efficiency of targeted crops, reducing the need for added N as fertilizer or manure:
  - improved timing of application (e.g. split application)
  - and improved formulations (e.g. slow release fertilizers, nitrification inhibitors)
  - and improved placement of N
- measures to reduce $N_2O$ and $CH_4$ emissions via fire management (reducing fire frequency and/or intensity)
- measures to reduce emissions of $CH_4$ and $N_2O$ from grazing animals by:
  - improving livestock genetics
  - and improving the feed quality (e.g. introducing new forage species, feed supplementation)
  - and/or by managing stocking rates and distribution (rotational and seasonal grazing)

Source: FAO 2010

The PIN should contain the information listed in Box 6 below. The PIN should be as well researched and ground truthed. As with all projects, it is good practice to let other stakeholders take part in the design process. Investors in the PDD development and/or in a project will want to see that important stakeholders, including communities, local government, extension agencies and authorities responsible for carbon projects, are supportive of the project. It is also advisable, early on in the project development phase, to check with national designated authorities about regulations covering agricultural carbon trade, to ensure that the proposed project will meet regulatory requirements.

One of the main purposes of a PIN is to attract investors as well as provide an opportunity for all interested parties to screen the proposal to ascertain whether the project may meet a given criteria or standard. In contrast, the PDD serve mainly for the third-party auditing and as a detailed guidance document for project implementation. The PIN should include information investors expect, including information on carbon sequestration activities, the track record of the project developer and implementation partners, first estimates on potential ERs, environmental and social benefits, costs and benefits, financing, legal set up and intended carbon revenue distribution between smallholder and project developer.

Identifying a buyer for a potential project is a problem for many smallholder agricultural organizations seeking to link to mitigation finance. The types of organizations that can help in identifying buyers are:

- Carbon funds with special interest in AFOLU;
- Brokers;
- Organizations that have interest in supporting AFOLU development;
- Corporate social responsibility investors interested in high quality carbon;
- Organizations that have long-term links with major firms that have an interest in AFOLU; and
- Developing countries can develop a financial vehicle for a number of sub-national projects, e.g. in the framework of NAMAs.

The World Bank BioCarbon Fund has developed templates and tools to prepare for the development of PINs and PDDs.[49] The EU-funded "ENvironment and COmmunity based framework for designing afFORestation, reforestation and revegetation projects in the CDM: methodology development and case studies" (ENCOFOR) webpage also provides detailed guidance[50] on how to develop carbon finance projects in the land-use sector.

BOX 6:
**Key information to be contained in the PIN**

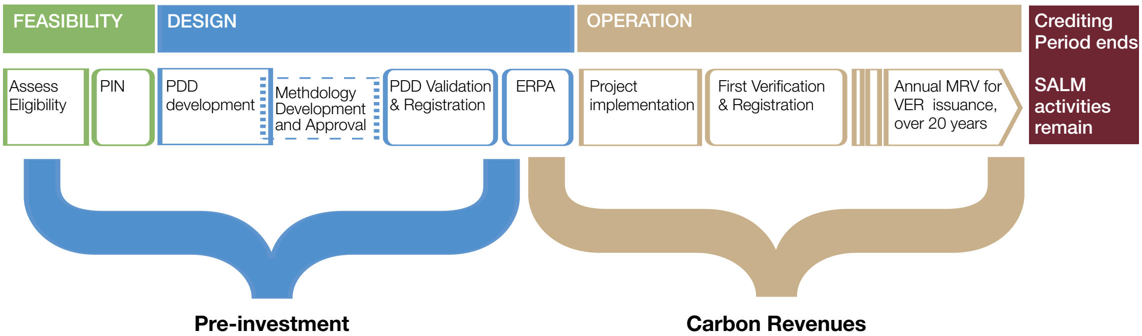
- amount of carbon that can be generated per unit area and in the total project area
- project management and technical capacity and track record of the proponents
- suggested project financing and estimated price of the credits
- scaling up and replication potential of proposed mitigation activities
- mechanism envisaged for the redistribution of the benefits to ensure sufficient incentives for adopting carbon sequestration activities
- available and proposed structures/capacity to provide extension services to introduce suggested sequestration activities
- scientific evidence of sequestration and other benefits (e.g. food security, water resource management) of promoted technologies and their economic viability
- structures in place to monitor and verify GHG mitigation of various technologies
- delivery risk
- beyond: off-farm environmental services, contribution to sustainable development goals

49 World Bank template for soil carbon PINs: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTCARBONFINANCE/0,,contentMDK:21844289~pagePK:64168445~piPK:64168309~theSitePK:4125853,00.html

50 http://www.joanneum.at/encofor/

## 6.3 Steps to developing a project-based carbon finance project

**Figure 6: All steps from feasibility to the end of the crediting period**




### 6.3.1 Formulating a project idea: feasibility assessment to inform PIN development

Project identification can start from the bottom up i.e. the project champion identifies and analyzes the opportunity and, at the same time, initiates engagement with a potential carbon buyer. Alternatively, the process can start from the top down, with a global or national biophysical carbon sequestration potential study and a 'zooming in' exercise to identify project developers in the most promising mitigation areas. Tools like the Geographic Information System (GIS) modeling the Ex-ante Appraisal Carbon-balance Tool (EX-ACT) (http://www.fao.org/docs/up/easypol/768/ex-act_flyer-nov09.pdf) facilitate top-down screening. Top-down approaches do not consider the availability of project champions i.e. individuals/organizations which can aggregate carbon together with smallholders. This is, however, the most important requirement for a successful carbon project, since it requires trust between the organization and the smallholder, and a strong institutional and well-financed organization.

The challenge for the bottom-up approach is that existing projects which have successfully adopted carbon sequestration activities are not additional and eligible for carbon finance. Therefore, existing projects can only use carbon finance to expand or replicate their approach if they demonstrate additionality. In the project identification phase it is important to already have a rough estimate of the carbon sequestration potential in $tCO_2e$ per ha and year, and the costs to adopt the sequestration activities and related revenues. At this stage of a project, access to knowledge and economic analysis skills are crucial to estimate the carbon sequestration potential and the related project costs and revenues, and to decide on whether or not the development of the carbon component will be financially viable.

From within the activities eligible (see Box 5 above for activities eligible under the voluntary C market), it will be important to select those with potential to generate the highest GHG mitigation benefits, that can be measured cost effectively, and can yield the most co-benefits to the farmer and the wider community (including off-farm environmental services, such as reduced sedimentation in water courses). If dealing with a project investor directly, they may also have preference for a specific set of activities, possibly connected with their line of activity or in fostering specific co-benefits.

BOX 7:
**Questions to be asked when selecting activities**

**Q:** Do the practices increase yields?
**Q:** Do the practices reduce the variability of yields?
**Q:** Do the practices increase producers' incomes?
**Q:** Do the practices deliver other significant benefits of value?
**Q:** What are the costs of monitoring the credits generated, compared to the value of the credits?

BOX 8:
**Scoping for a rangeland carbon sequestration project**

FAO contracted the World Agroforestry Centre (ICRAF) to identify a potential project in China's rangelands for development of a pilot carbon sequestration project. A mixture of bottom-up and top-down methods were used to identify and develop the project concept:

**Identification of a potential pilot province**: A review of more than 100 published papers on effects of management practices on SOC was conducted. This gave an indication of which practices have strong sequestration potential, its influencing factors, and where the existing data and research capacity is strongest. Three provinces were further investigated to understand the interest of government and research agencies in developing a pilot project, understand policies and programmes, and identify local and off-site co-benefits of rangeland restoration in each province.

**Identification of a potential project site:** A specific site in Qinghai province was suggested by provincial agencies, who recommended sites where they have a particular commitment to address degradation and livelihood issues. Site visits, workshops with herders, and surveys were used to document vegetation and socio-economic conditions, identify activities herders are interested in adopting, and outline an institutional framework involving local stakeholders.

**Identification of activities to promote sustainable livelihoods**: Based on the earlier suggestions of herders and local technicians, technical experts in grassland and livestock husbandry were engaged to identify specific improved management practices suited to the site conditions and provide cost estimates. Emissions reduction estimates were made on the basis of literature values, which gave the total budget for the proposed project. The outline design of project activities and institutional arrangements were discussed with herder representatives and local officials to ensure the primary stakeholders supported the project concept.

**Development of a PIN to communicate with potential investors**: A PIN was drafted describing the baseline situation (vegetation, carbon stocks, livestock management practices and socio-economic conditions), management practices to be promoted under the project, estimated ERs and other benefits, and outlining the project cost structure. A PowerPoint presentation based on the PIN was used as the main basis for discussions in meetings with potential buyers of the carbon credits.

BOX 9:
**Key elements of the PDD**

- project boundary
- a baseline description to demonstrate the business-as-usual situation and the with-project scenario
- justification of additionality to demonstrate that the project can only be implemented because of the carbon finance component, or why in a business-as-usual scenario these activities would not be adopted
- a leakage assessment to avoid the project resulting in extra new carbon emissions outside the project area, devise mitigation methods using decision trees and establishing standard discount rates to account for leakage (see section 4.7)
- a permanence or reversibility assessment to avoid the re-emission of sequestered carbon, develop long-term incentive structures like easements with land users and use short renewable contracts with regular measurement of C changes
- identifying a credit buffer to cover against the risk of non-permanence (see section 4.8)
- a carbon monitoring plan detailing the monitoring design and intervals

**Figure 7: Project design: from PDD to ERPA**


This phase starts with identifying a project team—from a project coordination unit that can manage project activities on the ground, to the partner institutions that can take the project to the international carbon market arena. This will typically involve a range of actors from government institutions at the local level to international financial institutions (IFIs).

A livelihoods study will need to be carried out to establish a socio-economic baseline and establish baseline land use and soil carbon levels. The project team needs to hold participatory consultations with the community to discuss and clarify issues of tenure, rights to carbon assets, and rules for participation. Such a process should also help identify which community members can generate more GHG benefits, present lower risk of non-permanence and leakage (see section 5.4.4 on risk management), to reach a minimum size of the project to yield the required amount of carbon credits to offset the investment.

The PDD lays out the project description and objectives, roles and procedures. Carbon crediting standards normally provide a template PDD form that project developers can follow. The templates for CDM PDDs can be found at http://cdm.unfccc.int/Reference/PDDs_Forms/PDDs/index.html and for VCS at http://www.v-c-s.org/sites/v-c-s.org/files/VCS%20Project%20Description%20Template%2C%20v3.0_0.doc.

### 6.3.2 Legal structure for project investments and carbon credits

The project developer and the carbon investor usually start negotiating a contract based on a detailed PIN including information on estimated ERs project costs and revenues (see above). A term sheet, which usually creates no rights in favor of, and no obligations upon any entity, is often used to document the discussion on the most important terms of the transaction. It should clarify the carbon standard to be applied, price, volume, delivery schedule, if a sales contract or only an option for future ERs is envisaged, any agreement and milestones for advance payments and the responsibility and risk sharing arrangements. The latter often includes a definition of the force majeure when the project developer is not responsible for any project loss, and rules on how to calculate the loss and any loss payment in case the project developer cannot deliver the promised ERs because of poor management. Later on the term sheet is converted into an Emissions reduction purchase agreement (ERPA). An ERPA is a purchase and sales agreement. Large Carbon Funds such as managed by the World Bank have developed their own standard ERPAs, but there are also free open source ERPAs standards available.[51] ERPAs for voluntary and CDM transactions are slightly different. In general it is advisable to engage a legal carbon expert to negotiate an ERPA since the terminology is quite complex and difficult to understand for the project developer.

An important aspect of ensuring that communities reap the benefits of carbon credits is providing legal advice on the community's carbon rights and implications for the design of project contracts. Including budget in project development costs to support this service is essential. Such legal assistance will contribute to community capacity for entering into contracts with "prior informed consent."

51 http://www.cerspa.com/

Important lessons on approaches to guaranteeing community rights to carbon can be learned from the REDD+ process where this issue has considerable prominence. REDD-net, an international knowledge forum for southern civil society organizations is one source for relevant information. Box 10 below reproduces a set of questions they suggest for communities to address to ensure their carbon rights in the REDD+ process, which are essentially the same that will be needed for agricultural soil carbon rights.

### 6.3.3 Project commissioning and operation

Validation and verification

To ensure transparency of project design, the methodology to be used to certify the ERs and the PDD must be validated by an independent third party certifier accredited by the specific carbon standard. The selection of the accrediting standard should be based on criteria relevant to both the project proponent and the buyer. It should address the competing requirements to deliver verified, sound ERs while minimizing project preparation and other transaction costs.

Standards usually provide a list of accredited certifiers among which the participants can select the most experienced in the areas concerned by the project.

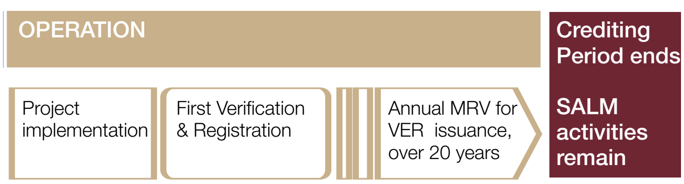
BOX 10:
**What questions must communities ask when navigating carbon rights?**

When NGOs, communities and their legal advisors establish the ownership of carbon rights of a REDD+ project, they should clarify the following under local laws:

1. Are there existing REDD+ policies, laws or regulations in their country?
2. Are they under common law or civil law jurisdiction?
3. Under domestic law who has access and ownership rights over land and forests?
4. What needs to be done to gain title over carbon rights i.e. purchasing, leasing or registering land, etc.?
5. What restrictions are associated with these rights i.e. specified timeframes, restrictions against sales, etc.?
6. Under domestic law is compensation due if rights over carbon are removed or restricted?
7. What specific property is owned? Carbon properties may take the form of:
   - sequestered carbon;
   - carbon sinks (different legal rights and responsibilities apply for land above ground, land below ground, and trees);
   - carbon sequestration potential (including the right to manage the carbon sink to maximize this); and
   - carbon credits generated from the project.
8. Who owns which carbon-related property rights? The Government may reserve certain carbon property rights for itself. Private citizens or businesses may have some, all, or no rights to forest carbon property rights.
9. Who will benefit from a forest carbon project, and what form will the benefits take?
10. Who will bear liability if forest carbon fails to materialize?
11. What dispute resolution mechanisms are in place?
12. How does the jurisdiction plan to clarify customary property rights?

Source: REDDnet Bulletin East Africa. Issue 2 December 2010.
http://www.ugandacoalition.or.ug/uploads/REDD-net%20Bulletin2%20finalx(2).pdf

**Figure 8: From implementation to VER issuance**



### 6.3.4 Development of the crediting methodology

The development of a complete carbon methodology – including costs for an independent validator – may require a budget of approximately US$100,000-150,000. Methodologies necessitate the development of a carbon accounting system—considering the desired mitigation activities and the requirements from the targeted carbon standard. The validation and public review process for methodologies is quite demanding and time consuming. The methodology design and validation process can take 6-12 months. Therefore, it is always advisable to assess first whether existing and approved methodologies can be applied before considering developing a new methodology. There are already a number of approved methodologies, and other methodologies are in the validation pipeline. Adding a component to an existing methodology will also considerably reduce the methodology development-related costs.

Using experts for a pre-validation screening can smooth the validation process, as potential problem areas can be identified and dealt with as the methodology is being developed. It does, however, entail additional costs of up to US$30,000-40,000. For this reason, only in cases where there is some significant doubt about the methodology is this approach warranted. Validators are engaged after methodology submission and the use of two or more validators can provide ample opportunity to refine the methodology through the submission process, without the need for a pre-review.

Methodology developers need to be kept informed about key developments in validated methodologies across different crediting sources, such as the acceptance of an activity-based monitoring system, or the development of a tool for assessing soil carbon. Once these approaches are validated and formally institutionalized in a crediting scheme, they can be adopted and used in new methodologies.

BOX 11:
**Main questions to address when selecting a standard**

- Does the standard have a well-established national and international reputation?
- Does the reputation of the standard match the objectives pursued by the buyer, e.g. compliance with national targets, corporate social responsibility, ER trading?
- Are there any methodologies and projects similar to the one proposed in the standard's portfolio? If so, could they serve as a template for the proposed project?
- What is the position of the standard with regard to key elements of the proposed project and methodology, e.g. leakage accounting, dynamic baseline, modeling versus direct measurement?
- What are the validation and certifying costs associated with the standard?
- What is the typical timeframe for project and methodology validation?

BOX 12:
**Key issues to be addressed in the methodology**

- Applicability conditions
- Project boundary
- Procedure for determining the baseline scenario
- Procedure for demonstrating additionality
- Quantification of GHG ERs and removals
  - Baseline emissions
  - Project emissions
- Leakage (see Box 4 in the case of the Three Rivers Project)
- Summary of GHG ERs and/or removals
- Monitoring procedure

BOX 13:
**Addressing leakage in a traditional grazing system**

Reduced grazing intensity can sequester carbon. But if implementation in the project area leads to increased grazing intensity outside the project boundary, then there may be no real net increase in carbon sequestered. In the Three Rivers Project in Qinghai, China, due to degradation of grasslands in the project area and unequal herd growth since households were allocated grassland in the 1980s, household forage supply does not necessarily meet demand. Thus a large proportion of project households currently rent in grasslands from households in non-project communities, and some project households with few livestock rent out part of their grasslands to other households in the community or to households from other communities. Since livestock grazing systems depend on mobility and flexible adjustment to environmental changes, the grassland plots rented out are not the same each year, and project participants may change the location of grasslands rented in from year to year. The duration of rental may also change from year to year.

The current CDM afforestation/reforestation (A/R) tool for accounting for leakage from grazing displacement[52] requires that the project proponent identifies the area of each parcel to which livestock will be displaced and calculates the leakage resulting from overgrazing based on theoretical carrying capacity of each of these external parcels. The CDM tool may be practical in the context of many forestry projects where the total numbers of livestock displaced are small, so identifying the plots to which they will be displaced and developing a leakage management plan is feasible. In most traditional pastoralist contexts, mobility is a key feature of grazing systems, so it may not be possible to identify in advance the lands to which grazing will be displaced. In the case of the Qinghai project, the baseline survey found that many households graze outside the project boundary for different durations and in different locations each year. Because land plots outside the project boundary cannot be fully specified in advance, and monitoring of displacement to different locations every month of each year by more than a hundred households would be prohibitively expensive if not impractical, an alternative grazing displacement tool was developed to account for emissions due to displacement of grazing.

Instead of being based on an estimate of the impacts of grazing displacement on soil organic carbon (SOC) as with the CDM A/R tool, this proposed tool uses a discount on total project ERs in proportion to the net increase in animal unit-months spent outside the project boundary compared to the baseline. That is, if in the baseline there is a net export of 5% of total animal unit months and in the project scenario there is a net export of 10% of total animal unit months, then 5% of total project ERs would be deducted to account for the leakage effects. This requires only monitoring of the grazing and rental behavior of participating households, not identification and assessment of every land plot to which grazing is displaced. The method is conservative because it assumes that any net increase in grazing outside the project boundary leads to emissions.

52 http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-09-v2.pdf, to be revised after June 2011

# Costs, benefits and risks

7

## 7.1 Project development costs

Project development costs can vary substantially, depending on the level of novelty and complexity of the project. Elements that will lower the development cost include the existence of validated methodologies that can serve as precedent or template, the availability of baseline data, and demonstrated mitigation and sequestration technical packages. The presence of effective institutions among project participants that can support monitoring activities as well as the management of carbon revenues will further lower transaction costs.

Development costs may be anticipated by the buyer after agreement on the PIN. In this case, they are generally withdrawn from carbon payments during project implementation. Alternatively, developers may acquire a loan to finance the project and add interest costs to the price of the carbon credits.

## 7.2 Carbon revenues

Carbon revenues should cover at a minimum the activity (abatement) and transaction costs of the project and remove barriers to the adoption of carbon sequestration and ER activities. In the context of smallholder farmers, carbon revenues may be most useful to strengthen community structures, including group saving and investment schemes and access to markets, or to improve extension services and on -farm research.

Table 7 below presents four options for distributing carbon revenues. The table does not provide a complete list of options, and the different options are not mutually exclusive and can be combined. Options can be offered to payment recipients, as well as how they are invested or spent. Performance -based payments strengthen individual incentives, but they are demanding and expensive with regard to monitoring requirements. They are also most likely to increase payment and income gaps between farmers. For both performance- and group -based revenue systems, carbon payments may not be

**Table 7. Overview of agricultural methodologies**

| Option | Recipient of the revenue | Investment | Issues to be considered |
|---|---|---|---|
| Performance-based payments | Farmer | Farmer's choice | Additionality condition will penalize, e.g. often progressive farmers will not receive any carbon payments since they have adopted best practices already |
| Group payments | Registered farmers' group or association | Group's choice | Directly strengthens group functionality but less effective in providing individual incentives; may be one way of overcoming problems associated with additionality (e.g. if all group members receive payments) |
| Payments for extension services | Extension provider delivering demand-driven services | Agricultural know-how and skills | Assuming that skills and know-how are the main barriers to adopting improved practices |
| Payments for crop insurance | Insurance provider to cover insurance premium | Climate change adaptation | The insurance normally will reimburse a percentage of the input costs in a drought event. An index is used to define a drought event |

necessarily re-invested into agriculture -related activities. However, for long-term sustainability of a project, it is desirable that carbon revenues are at least partly re-invested in agriculture, either directly or indirectly.

When carbon payments are used to cover the costs for demand -driven extension services, this can overcome a key barrier for adopting improved sustainable land management practices, since extension services, for food crops in particular, are often not available. In many countries, crop insurance systems are currently promoted as an effective climate change adaptation strategy. Linked with upfront carbon payments, this could be provided without any additional cash injection required by the farmer.

## 7.3 Reducing risk

Risk management is central to the economic feasibility and distributional implications of land-use carbon finance projects. Project developers have a central role in risk mitigation and in moderating the interaction between the carbon buyer and smallholders. Smallholders in general have low and uncertain incomes. Even farmers that are food secure or above the extreme poverty line of one dollar a day (US$) are exposed quite often to at least one hunger month a year when the income from the last harvest is spent, and extra costs like medical bills or school fees have been raised.

Table 8 below presents four broad categories of risk that will be faced by project developers and farmers in the framework of a carbon finance project.

Carbon finance-related risk management strategies should aim to smooth total income over time, with a particular focus on the hunger month(s), when smallholders are often forced to borrow at great cost, which prevents them from making productive investments to increase their livelihoods.

The biophysical sequestration potential is related to the specific agricultural management practices adopted, but also varies by climate, agro-ecological zone, and historical land use. Therefore, a drought will not only reduce the carbon sequestration rate, but also the expected yield. In addition, farmers affected by a drought may also not continue with the proposed practice or have to reduce agricultural inputs like improved seed or fertilizer. Hence, carbon revenue should be used to buy crop insurance[53] or linked to saving schemes.

**Table 8. Risks and risk bearers in agricultural carbon finance projects**

| | | |
|---|---|---|
| Sequestration rates | Is sequestration lower than expected? | Farmers and project developers |
| Adoption & dis-adoption | Have farmers actually adopted, and do they continue to use, proposed sequestration practices? | Project developers |
| Crop & livestock response | Are productivity changes associated with prescribed practices lower than expected? | Farmers |
| Operational regulatory risks | Is the project developer capable of managing the project as outlined in the PDD over the project period and are carbon assets maintaining their value in the market? | Carbon buyer |

For a carbon buyer, only upfront payments or forward contracts will expose him directly to the first three risk categories mentioned in Table 8 above. Therefore, most commercial carbon buyers will only put a limited amount of equity at risk, since they are mainly interested in performance contracts, i.e. payment upon delivery of the carbon credits. When performance-based payments are agreed, the remaining risks are: (i) that the carbon buyer is investing in project due diligence and in the legal setup and subsequently the project developer fails to implement the project; or (ii) that the regulatory environment for carbon assets will change, and so will the related price of the carbon asset. Respective risks can be mitigated if the carbon buyer is paying due attention that: (a) carbon sequestration potential is conservatively estimated; (b) approved carbon accounting methodologies are eligible in the context of the project; (c) legal risks are assessed and mitigated within respective contractual agreements; and (d) regulatory risks have been considered (discounted from the carbon price).

The public sector (host governments, donors, developed countries interested in investing in agricultural mitigation activities), within the current rudimentary climate change financing framework, has an important role since it is defining the regulatory framework that will determine the engagement of the private sector. Initially public funds, or the commitment to underwrite regulatory risks, are required to attract private-sector investments.

Given that agriculture is susceptible to the impacts of climate variability, as well as input and product price volatility, one can also expect that the institutional arrangements of carbon trade will link with other risk management arrangements (see Box 14 below).

BOX 14:
**Managing risk from price fluctuations**

For smallholder farmers, volatile markets are a high risk, because smallholders have limited options and assets for hedging their risks. Carbon revenue streams that increase the volatility of farm revenues are not desirable from a smallholder perspective. Carbon revenues can be structured and combined with crop insurance in order to buffer crop losses or low harvests. However, in general crop losses also imply reductions in biomass production and soil carbon sequestration. So crop losses may be covariant with carbon revenues. Given the likely correlation between crop and carbon losses, it's imperative that carbon payments are structured to separate volatility in carbon revenue and crop yields.

Estimating carbon sequestration rates on the basis of multi-year averages, and thus smoothing the carbon revenues over time is one option.

The carbon price risk can be best managed in the ERPA by fixing the price for a long period e.g. ten years or by limiting the down-side risks in the contract. Of course, reducing carbon price risks for the farmer or herder means the buyer has to bear them, which results in a price discount for the carbon credits.

53 In a crop insurance scheme currently tested in Kenya, farmers pay 10% extra to insure fertilizer, seed and other inputs. In case of crop failure, the insurance company compensates 80% of the inputs, which enables farmers to invest again in the subsequent season.

# 8 Institutions to link smallholders to mitigation finance

A carbon finance project requires a robust and transparent institutional and legal set-up to generate, aggregate and trade carbon assets. This arrangement should ensure that performance is met because payments are made for measured ERs over long-term periods of 20 to 30 years.

## 8.1 Institutional and legal set-up for enabling carbon finance trade

At the most general level, a carbon finance project requires a set of suppliers (e.g. the farmers), a project developer that generates the carbon assets, a standard recognized by the public or private buyer of the carbon assets, and a third party certifier that is accredited by the relevant standard.

Carbon finance projects in the framework of the Kyoto Protocol are also required to contribute to sustainable development of the host country. The Designated National Authority (DNA) – usually part of the Ministry of Environment – has to approve CDM projects against the national sustainable development criteria, considering social, environmental and economic benefits and potential negative impacts. DNAs will most often be required to confirm the legal status of the carbon assets created, and are responsible for approving carbon finance projects under the UNFCCC (i.e. projects submitted to the CDM standard).

For the VCS, legally binding requirements to meet sustainability requirements do not exist, but it is clearly advisable to inform the host government about the project and to ask for a letter of approval for the project. Without engagement of the host government, carbon asset purchasers cannot be sure that rights over the assets will not be revoked by subsequent national initiatives.

BOX 15:
**The Panda Standard**

China has hosted the largest number of CDM projects of any developing country. China's government has also announced a voluntary goal of reducing carbon intensity by 40-45% by the year 2020 compared with 2005. The Panda Standard (PS) is a private-sector initiative to bring voluntary offsetting into play in the pursuit of this objective. The PS is a voluntary standard for certifying ERs originating within China. Panda Standard v1.0 was issued at Copenhagen in 2010, and the AFOLU guidelines were announced at Cancun in 2011. The PS focuses on sectors which have been underrepresented in the CDM. The first sector guidelines are being issued for the AFOLU sector, with plans to issue guidelines for the rural energy and transport sectors. By targeting these sectors, the PS intends to provide a platform for investment by industrial investors in agriculture, by urban funding in the rural sector, and by China's wealthier eastern regions in poorer western China. The PS requires that projects implemented in poor areas of China must monitor and report on poverty impacts. Impacts of PS projects on the environment and local communities – both on-site and offsite – must be assessed, mitigated and monitored. Thus, in addition to facilitating ERs, the standard aims to contribute to China's wider social and environmental sustainability goals. Aiming to develop a high quality voluntary standard, the PS is a joint initiative of China Beijing Environment Exchange, the China Forestry Exchange, Blue Next and Winrock International. More about the Panda Standard can be found at www.pandastandard.org.

In most countries the DNA is also the first contact point for carbon funds and project developers, and the lead agency in providing capacity building in carbon market engagement. However, in practice DNAs with limited resources are mainly involved in the international climate change negotiations and disseminating decisions from those negotiations. For sectoral expertise, the DNA relies on the relevant line agencies and therefore often has only limited interaction with civil society.

DNAs are responsible for overseeing the development of national and sectoral GHG inventories which provide robust and transparent documentation of the baseline emissions scenario. A common approach to developing carbon finance projects for a given sector is to first complete a GHG inventory, as this enables one to identify the major sources of emissions, from which one can then identify mitigating actions and calculate the costs of emissions abatement for the sector. Pilot projects can then be initiated within the overall national framework established. Early mitigation action may start before the national system is in place. Such a system will be based on national sovereignty rights, but also consider ongoing decentralization processes in rural areas.

Commercial carbon buyers will conduct legal and project due diligence before they engage in an ERPA. The legal due diligence serves to identify the legal ownership of the carbon and the contractual requirements to gain legal access to land. In most circumstances the land owner or user will also own the carbon rights. The carbon buyer will sign a contract with the aggregator and establish additional contracts – e.g. between the smallholder and the smallholder group, and between the smallholder group and the aggregator are required. The carbon buyer, usually not based in the project host country, will always aim to pass on the delivery risk to the project aggregator or will only pay upon delivery since he has no means to enforce the project on the ground. The project aggregator[54] in general has no interest to legally enforce a contract with a smallholder. Therefore, he has to protect himself from any liability to deliver ERs. Since carbon transactions engaging smallholder farmers are relatively new, there is only limited experience on how to prevent asymmetric power structures, and professional advice is required to structure legal contracts. Carbon funds are investment vehicles that seek to deliver either carbon credits or a return on investment.

## 8.2 Institutions to support smallholder participation in carbon crediting

Smallholder rangeland carbon projects by nature are often in large contiguous areas, while cropland projects cover often thousands of small-scale farms, each covering not more than one hectare. These project characteristics have to be considered in the design of institutions for aggregating smallholders' carbon assets in order to meet a minimum scale required for carbon finance projects, and so that projects generate sufficient income streams to provide benefits at the household level.

Carbon finance projects generally have an organization (aggregator) to aggregate individual households' carbon assets within the project area. In Brazil, farmers do not get credits from banks if they do not apply defined soil conservation measures. Smallholders themselves cannot access directly the carbon market. Important intermediaries are often registered groups of smallholders and institutions aggregating large number of smallholder groups, providing targeted advisory services related to agriculture, record

54 Aggregators provide the link between land users (producers of carbon assets) and the verification and trading institutions that link smallholders to the purchasers of those assets. The role of an aggregator includes signing contracts with land users, monitoring contract compliance and managing the funds generated from sale of carbon assets.

keeping, microfinance and all other skills that a group of smallholders requires to access the market for their produce and to invest in income generating activities. Carbon trade from multiple farmers will only be possible if there is an institutional arrangement that facilitates the implementation, monitoring and trade at relatively low cost. Individuals and organizations potentially involved in the project should be involved in the design of the project from the start.

Implementation of C sequestering practices will often require an extension service provider to provide land users with access to the materials, information and training required to implement improved management practices. Extension agencies, which may be research organizations, government technical extension agencies or NGOs with a relevant track record, will be contracted by the implementing organization to provide the required services. The costs of extension services will either be covered by fee-for-service charges to land users recovered from project revenues or paid for by third party project funding. The arrangements adopted would depend on the results of financial analysis in the project feasibility study stage.

BOX 16:
**The Kenya Agriculture Carbon project approach**

**Step 1: Sensitization and understanding existing farmer groups in the project region**
In this step, representatives from local government agencies, NGOs and the private sector will be invited to gain an overview on existing agricultural support services and farmer group related activities.

**Step 2: Identification and sensitization of existing farmer groups**
The extension team of the NGO VI Agroforestry with complementary skills on agronomy, health, microfinance and social counseling will support farmer group members to identify options how to improve their livelihood using a farm enterprise development approach. The project developer has to decide at what stage he wants to introduce the concept of carbon finance. Considering that it may take a few years before the first carbon payment arrives, raising un-filled expectations at an early stage might not be useful. In any case it should be clearly communicated that carbon payments are relatively small, i.e. between 10-30%, compared to the additional income that can be generated from the adoption of sustainable land management practices and the related yield increase.

**Step 3: Supporting farm planning and adoption of SALM**
After farmer groups have expressed their interest to participate in the agricultural support programme, farm planning will be the first step considering the specific circumstances of the farm and the farming family. Labor availability, food security status and land quality are important considerations to optimize the farming system. Usually the first step in Western Kenya is that farmers build terraces to prevent soil erosion, raise tree seedlings and plant hedges for Sesbania or Caliandra for mulch and fodder production. At a later stage, record keeping skills are built in order to start a small dairy or a bee keeping business. Throughout the extension support it is important that farmers learn to secure and improve their diet and to make savings that enables them to bridge hunger months or to pay for health services and school fees.

**Step 4: Annual survey to monitor adoption of carbon sequestration activities**
The Adoption of Sustainable Agricultural Land Management methodology[55] which was submitted to the VCS is based on activity monitoring and model derived default values to estimate the carbon stock changes based on the adoption of specific sustainable agricultural land management practices. The activity carbon monitoring exercise is conducted on permanent sampled farms and a number of additional temporary sampled farms to control that the permanent farms are representative for all farms over time. Carbon revenue distribution can only be linked to the activity carbon monitoring if all farms are surveyed. However, detailed monitoring of all farms is unrealistic therefore, at group level farm records will be used to distribute carbon revenues.

55 http://www.v-c-s.org/methodologies/adoptionsustainable-agricultural-land-management-salm

Box 16 above outlines the process for involving community organizations involved in implementing one of the first agricultural carbon projects in Africa; the Kenya Agricultural Carbon Project.

Another useful example of the institutional team support to existing carbon finance projects comes from Plan Vivo. Plan Vivo is a framework for developing community-based carbon benefits, developed in 2004 as part of a UK Department for International Development (DFID)-funded research project in Southern Mexico and led by the Edinburgh Centre for Carbon Management (ECCM), in partnership with El Colegio de la Frontera Sur (ECOSUR). Participants are small-scale producers and communities in developing countries who start the process by creating sustainable land-management plans ('plan vivos') by combining existing land-uses with additional eligible project activities, including (i) Afforestation and reforestation (not commercial plantations), (ii) Agroforestry, (iii) Forest restoration and (iv) Avoided deforestation and forest conservation. Plan Vivo projects are independently assessed and generate Plan Vivo Certificates, representing long-term carbon benefits (VERs) (Plan Vivo, undated). Currently the Plan Vivo Foundation has 13 projects, four of which have issued VERs already and the others at different stages of development (http://planvivo.org.34spreview.com/?page_id=42).

Table 9 below lists roles and responsibilities for a support team.

**Table 9. Plan Vivo Institutional support team required and their functions**

| | |
|---|---|
| Administrative (and coordination) | Recording individual land use plans<br>Identifying project supporters and selling Plan Vivo Certificates<br>Recording service agreements with producers<br>Administering and recording payments to producers<br>Coordinating project reviews i.e. validation, annual reporting, verification |
| Technical | Developing and updating technical specifications<br>Assisting development of individual land use plans by producers<br>Evaluating individual land use plans<br>Monitoring individual land use plans & providing extension support & training<br>Collecting other data as required by the project (e.g. tree growth data) |
| Social | Advising on the engagement of communities, assessing organisational capacity, stability of the area, identifying local conflicts or issues<br>Assessing the security of land-tenure rights<br>Conducting discussions and workshops with groups, dispute resolution<br>Building local organizational capacity |

Source: Plan Vivo, undated

# 9 Conclusions and lessons from experience with project-based offsets

This guidebook has made the case that there are numerous mitigation options in smallholder agriculture for soil carbon and LULUCF in developing countries. At present, methodologies and established approaches for developing offset projects based on these options do not exist. This means that realizing this potential will first require that project and programmatic approaches are demonstrated and experiences are shared so that subsequent project and methodology developers can benefit from real experiences. The preceding sections of this guidebook have presented generic principles and procedures relevant to the development of smallholder carbon finance projects. Beyond these guidelines, experience from FAO and partners' support to the development of the Three Rivers Grassland Carbon Sequestration Project in Qinghai, China, provides the following reflections, which will most likely be relevant to the development of other new classes and types of smallholder agricultural carbon finance projects:

- Prepare for a long lead-time to allow for an iterative process of project and methodology development: For new types of projects where neither project development procedures nor methodologies exist, it should be expected that the project and the methodology are developed through an iterative process. Where no previous experience provides guidance, the values of key parameters affecting the calculation of ERs and the livelihood impacts of the project will have to be discovered through a process of iteration between activity design and progressively accurate estimation of ERs. For example, initial design of the Qinghai project's activities was based on literature values for sequestration rates of different management practices. The methodology that was developed at the same time required that ex ante emissions reduction estimates were made through application of a biogeochemical process model. Results of modelling validated for the project region were only available after more than a year, and results of the estimation had to be reflected in adjustments to the design of procedures for monitoring project activities. Sufficient lead-time has to be allowed for the iteration between project activity design, emissions reduction estimation and methodology development. Organizations or technical consultants engaged in developing the project should also expect to collaborate across disciplines and engage in an iterative process of project design. Regionally specific features, such as short growing seasons or other seasonal factors, should be taken into account in developing a realistic timeline for project preparation. In our experience, a minimum of two years should be expected. The number of qualified and accredited validators for project methodologies and PDDs is still limited, and this may also contribute to a longer lead-time.

- Allow for piloting and a phased roll-out of implementation: Implementation of new project types may require several simultaneous innovations. For example, in addition to adopting new agricultural management practices, smallholders and the organizations aggregating their carbon assets will have to adopt new procedures for monitoring production activities— most likely more stringent procedures than those they are used to. A commercially viable carbon finance project will require enrolment of a relatively vast area and a large number of smallholders, so it is important to identify a strong partner that can serve as aggregator in early phases of planning. For activities that have no established methodology for crediting, it may also be worthwhile to consider initial piloting on a smaller scale of both the adoption of mitigation activities and the operation of management, monitoring and reporting systems. An initial small-scale pilot or a phased roll-out plan would provide a chance to test the project plan and allow time to adapt technical and management protocols before their wide-spread application.

- Clarify the national policy and institutional set-up when planning the project development phase: Innovative carbon finance projects will require support not only from the local project proponent and institutions such as NGOs which will act as aggregators of smallholders' carbon assets, but also from relevant ministries responsible for the agricultural sector and other agencies responsible for climate change mitigation. For example, agricultural agencies may be concerned to ensure that mitigation projects do not compromise other policy goals such as food security, and the support of the Designated National Authority or other responsible agencies may be required in order to receive country recognition of the legality of the eventual sale of carbon rights. Depending on the national agriculture and climate change policies, it may be advisable to involve other agencies – such as those designated by ministries – to provide technical support to national inventory and other scientific work. This policy and institutional set-up should be assessed prior to initiating project development activities so as to ensure that national authorities and other stakeholders are appropriately involved.

- Consultants cannot replace champions within the local institutions: In many countries, interested project proponents and other agencies related to the project may have only a general understanding of agricultural carbon finance and the voluntary market. Ensuring their support for development and later implementation of the project requires that these agencies are also enabled to deepen their understanding during the project development process. Expert consultants can play a role in not only completing technical aspects of project design, but also in increasing the understanding of these secondary stakeholders in the project. They cannot, however, replace the role of champions within the local institutions who will play the primary role in linking the project developer with these other agencies whose support is required. Considering also the sometimes long lead-time required to develop new project types, the role of these champions is particularly important in maintaining interest and momentum among these stakeholders and in engaging their active support when required. The project development process and structure of stakeholder engagement should support champions to play these roles that outsiders and consultants cannot play.

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# Annex 1

# Verified Carbon Standard (VCS) Agricultural Land Management (ALM)

Eligible cropland and grassland activities that can increase carbon stocks (in soils and woody biomass) and/or decrease $CO_2$, $N_2O$ and/or $CH_4$ emissions from soils include:

A. improved cropland management, including the adoption of practices that demonstrably reduce net GHG emissions from a defined land area by increasing soil carbon stocks, reducing soil $N_2O$ emissions, and/or reducing $CH_4$ emissions;

B. improved grassland management, including the adoption of practices that increase soil carbon stocks and/or reduce $N_2O$ and $CH_4$ emissions; and

C. cropland and grassland land-use conversions.

Land conversions of cropland or grassland to forest vegetation are considered Afforestation, Reforestation and Revegetation activities (see Section C of this table below).

(see IPCC 2006 GL for AFOLU: www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm – excluding manure management, which is covered under the CDM)

### A. Improved cropland management activities

ICM activities include the adoption of practices that demonstrably reduce net GHG emissions from a defined land area by increasing soil C stocks, reducing soil $N_2O$ emissions, and/or reducing $CH_4$ emissions.

- Soil C stocks can be increased by practices that increase residue inputs to soils and/or reduce soil C mineralization rates. Such practices include, but are not limited to the: adoption of no till; elimination of bare fallows; use of cover crops; creation of field buffers (e.g. windbreaks, riparian buffers); use of improved vegetated fallows; conversion from annual to perennial crops; and introduction of agroforestry practices on cropland. Where perennial woody species are introduced as part of cropland management (e.g. field buffers, agroforestry), C storage in perennial woody biomass may be included as part of emission reduction credits.
- Reducing soil $N_2O$ emissions generally involves enhancing the N use efficiency of targeted crops to reduce the amount of N added as fertilizer or manure. Examples of specific practices that improve efficiency while reducing total N additions include: improved timing of application (e.g., split application), improved formulations (e.g., slow release fertilizers, nitrification inhibitors) and improved placement of N.
- Reducing soil $CH_4$ emissions is an applicable practice primarily in flooded rice cultivation. Practices that reduce $CH_4$ emissions include: improved water management; and the use of rice cultivars with reduced capacity for $CH_4$ production and transport.

### B. Improved grassland management activities

IGM activities include the adoption of practices that increase soil C stocks and/or reduce $N_2O$ and $CH_4$ emissions.

- Soil C stocks can be enhanced by practices that increase belowground inputs or slow decomposition. Such practices include: increasing forage productivity (e.g. through improved fertility and water management); introducing species with deeper roots and/or more root growth; and reducing degradation from overgrazing.
- Reducing $N_2O$ emissions involves N fertilizer management practices similar to those outlined above for cropland management.
- Reducing fire frequency and/or intensity can reduce $N_2O$ and $CH_4$ emissions from burning.
- Reducing emissions of $CH_4$ and $N_2O$ from grazing animals can be achieved, inter alia, by improved livestock genetics, improving the feed quality (e.g. by introducing new forage species, or by feed supplementation); and/or by reducing stocking rates. If these practices involve displacement of animals to outside the project area, leakage should be accounted for, particularly if displaced animals cause a reduction in carbon stocks outside the project area.

### C. Cropland and grassland land-use conversions

Cropland conversion to perennial grass vegetation is likely to be the dominant land-use conversion for ALM projects. Some grassland conversions to cropland production, however, e.g. introducing orchard crops or agroforestry practices on degraded pastures, could increase soil and biomass C stocks (thereby reducing net GHG emissions). Under such conditions, these conversion practices would also be considered eligible for project certification. Projects converting grasslands, however, must demonstrate that they do not harm local ecosystems as outlined in the general AFOLU. The conversion of cropland to perennial grasses can increase soil carbon by increasing belowground C inputs and eliminating/reducing soil disturbance. Reductions in N fertilizer and/or manure additions associated with conversion to grassland may also reduce $N_2O$ emissions. Special attention, however, should be given to accounting for leakage associated with conversion of cropland (particularly to conservation set-asides), associated with both the displacement of crop production to previously uncropped lands (causing soil C losses) as well as the displacement of N fertilizer and/or manure additions to existing or new croplands (causing increases in $N_2O$ emissions) to compensate for the loss of agricultural production.

- Conversion of drained, farmed organic (e.g. peat) soils to perennial non-woody vegetation, along with reductions or elimination of drainage, can reduce emissions of $CO_2$ and $N_2O$ from organic soils. Potential increases in $CH_4$ emissions, however, would need to be accounted for. Biofuel crop production activities are eligible for crediting under VCS AFOLU only to the extent that they generate measurable increases in carbon stocks (aboveground, belowground and/or soil).
- Afforestation, reforestation and revegetation: establishing, increasing or restoring vegetative cover through the planting, sowing or human-assisted natural regeneration of woody vegetation to increase carbon stocks in woody biomass and, in certain cases, soils.
- Improved forest management: forest lands managed for wood products such as sawtimber, pulpwood and fuelwood:

(i) conversion from conventional logging to reduced impact logging (RIL).

(ii) conversion of logged to protected forests (LtPF) including:
   a) protecting currently logged or degraded forests from further logging; and
   b) protecting unlogged forests that would be logged in the absence of carbon finance.

(iii) extending the rotation age (ERA) of evenly-aged managed forests; and

(iv) conversion of low- to high-productive forests (LtHP).

**Reduced Emissions from Deforestation and Forest Degradation (REDD)**

1. Avoiding planned deforestation (APD): reduces GHG emissions by stopping deforestation on forest lands that are legally authorized and documented to be converted to non-forest land.
2. Avoiding unplanned frontier deforestation and degradation (AUFDD): reduces GHG emissions by stopping deforestation/degradation of degraded to mature forests at the frontier that has been expanding historically, or will expand in the future, as a result of improved forest access.
3. Avoiding unplanned mosaic deforestation and degradation (AUMDD): reduces GHG emissions by stopping deforestation/degradation of degraded to mature forests occurring under the mosaic configuration.

# Annex 2
# BioCarbon Fund Projects

| Project | Mention "soil carbon" or "below ground sequestration" |
|---|---|
| Albania | no<br>a) protection of areas for natural regeneration or re-growth by fencing; (b) supplemental planting at 200-500 seedlings per ha to enrich species diversity and to stabilize highly eroded areas; and (c) basic silvicultural works (vegetative cutting to promote growth such as coppicing, cleaning and thinning). |
| China:<br>Pearl River Watershed Management | no<br>reforestation only although they also foresee benefits from reduced soil erosion |
| Colombia<br>San Nicolás Agroforestry- REDD | no<br>a) afforestation and reforestation, of about 1,400 hectares of abandoned pastures, and b) avoided deforestation and induced regeneration on about 5,000 hectares of remaining forest in the valley of San Nicolas. |
| Colombia:<br>Caribbean Savannah | yes<br>Total carbon accumulation of 23 t $CO_2$ equivalents per hectare per year could be obtained in the reforestation sites given the high tree number per unit area used for the reforestation (tree cover will reach 60% in the fourth year and 90% in Year 10). The improved management will increase the storage of carbon both above- and below-ground.<br>Silvopastorial systems to reduce soil compactation reforestation of most degraded land<br>"Grasses will also be established in the soils most devoid of vegetation, to favor rapid land cover, minimize erosion, and accelerate the rebuild of soil organic matter. Priority in reforestation will be given to areas surrounding water streams and undulating terrain where soil erosion is a major problem." |
| Costa Rica:<br>Coopeagri Forestry | no<br>Through FONAFIFO's PSA system, but on a particular area of the country<br>Of the total project area of 4,140 ha primarily used for cattle raising, 450 ha will be allocated to agroforestry, 1,200 ha will be dedicated to reforestation through natural regeneration, and 2,490 ha to commercial reforestation, 50% with native species, (...) and 50% with non-native species such as Melina (Gmelina arborea) and Teak (Tectona grandis). |
| Ethiopia:<br>Humbo Assisted Regeneration | no<br>Restoration of 2,728 hectares of natural forest, farmer-managed natural regeneration (FMNR).<br>Seven forest cooperatives have been established with legal ownership of the community land.<br>The seven cooperatives are responsible for managing the land and for conducting income generating activities for the local population. |
| Honduras:<br>Pico Bonito Forest Restoration REDD | no<br>Agroforestry and reforestation in park buffer zone |

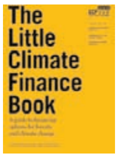
| Project | Mention “soil carbon” or “below ground sequestration” |
|---|---|
| India: Improving Rural livelihoods | no<br>Development of 3,500 ha of tree plantations<br>Farmers will be organized into a cooperative to increase their representation and negotiation power, and will individually sign buy back contracts with an industrial partner from the paper industry.<br>The partner will help arrange short term credit to farmers for up-front investment costs and provide subsidized planting material, as well as committing to purchase the timber at market prices. Long term credit to small and marginal farmers will also be arranged to meet the cost of plantation and maintenance. |
| Kenya:<br>Green Belt Movement | no<br>Reforestation to: “reforestation will therefore bring important environmental benefits by reducing the erosion process, protecting the water sources, and regulating water flows.” |
| Madagascar:<br>Andasibe-Mantadia Biodiversity Corridor | no<br>First priority is at restoring forest corridors linking fragmented habitats. The project will also establish sustainable forest and fruit gardens that will provide alternative livelihoods to local communities and a buffer around the corridor |
| Mali:<br>Acacia Senegal Plantation Project | no<br>Planting of around 6,000 ha of Acacia Senegal, establish cost-effective modern nurseries, contribute to farmers' training and assistance for planting trees, maintaining plantations, and Arabic gum harvesting.<br>Re-introduce agricultural activities through intercropping with groundnuts and cowpeas. |
| Moldova:<br>Soil Conservation (BioCF) | yes<br>Restoration of degraded lands through improvement in the vegetative cover<br>Project activities will regenerate the soil profile and improve soil organic accumulation, mitigate the landslide occurrence and impacts, reduce run off and increase the moisture holding capacity of plots<br>The Moldova Soil Conservation Project aims to conserve soils on 14,494 ha of degraded pasturelands through afforestation. Social assessment confirmed that only degraded and overgrazed land areas with very limited forage value are targeted. Because afforestation plots are dispersed and small, pasture access is not disrupted. Afforestation plots account for only a small proportion of grazing lands in each village, and sufficient communal grazing lands remain to avoid increased livestock density in non-afforested grasslands and to prevent adverse effects on shepherds’ livelihoods.<br>Source: World Bank (2003)<br>World Bank 2003 Moldova Soil Conservation Project Environmental Analysis And Environmental Management Plan available at http://www-wds.worldbank.org/servlet/main?menuPK=64187510&pagePK=64193027&piPK=64187937&theSitePK=523679&entityID=000094946_03080504003021 |
| Nicaragua:<br>Precious Woods | no<br>Reforestation of ex-ranching lands with teak |
| Niger:<br>Acacia Community Plantations | unclear<br>Reforestation with gum trees (acacia senegalensis) and re-introduction of agricultural activities through intercropping with groundnuts and cowpeas.<br>“Acacia's rooting system is very powerful (subterranean biomass is twice the aerial part), which makes it efficient for dune-fixing as well as wind and water erosion control.” |

| Project | Mention “soil carbon” or “below ground sequestration” |
|---|---|
| Philippines: Watershed Rehabilitation | no (no longer in the list in 2010)<br>(i) stream bank rehabilitation that will increase the riparian forest cover of the rivers in the watershed; (2) reforestation in upland areas that will reforest denuded and grassland areas near the headwaters of key rivers; and (3) agroforestry that will provide income for people in upland areas. |
| Uganda: Nile Basin Reforestation | no<br>The project will establish a plantation of pine and mixed native species in grassland areas within Rwoho Central Forest Reserve. |
| Brazil: Reforestation Around Hydro Reservoirs | no<br>Recuperation of native vegetation cover of approximately 5,576 hectares, located around four reservoirs created by hydroelectric plants in the State of Sao Paulo, and their establishment as a conservation area. |
| Nicaragua: Futuro Forestal Nicateca | no<br>Reforestation of previously degraded and/or underutilized land over a 5-year period of 12,000 hectares of land on Nicaragua’s Pacific coastal plains, all of which had been previously deforested for use as pastoral grazing land or low intensity cropping. The project should plant about 10,000 hectares of productive forest for commercial harvest, mainly with teak and other tropical hardwoods, and reserve about 2,000 hectares of protective forest not for harvest. |
| China: Reforestation on Degraded Land in Northwest Guangxi | yes<br>Reforestation of around 9,000 ha of multiple purpose forests which will be established on degraded lands in Longlin, Tianlin and Linyun counties. |
| DR Congo: Ibi Bateke Carbon Sink Plantation | yes<br>Afforestation and clean energy project:<br>Convert a natural grassy savanna, disturbed by man-initiated fires, into an abundant and sustainable fuelwood supply for charcoal production. |
| Moldova: Community Forestry Development | yes<br>New community forests on an area of 7,619 ha through the afforestation of eroded and unproductive agricultural lands, creating forest protection belts.<br>A mix of native and naturalized species will be planted, including fruit trees. The proportion of native species will range between 25-75%, depending on the severity of land degradation. |
| Trinidad and Tobago: Nariva Wetland Restoration | yes<br>Reforesting parts of the wetland with native arboreal, simplified baseline and monitoring methodology for small scale afforestation and reforestation activities implemented on wetlands (AR-AMS0003). The reforestation of roughly 1200ha will deliver fully Kyoto-compliant tCERs. |

Source: adapted from project information available through http://wbcarbonfinance.org

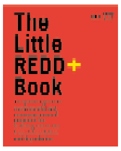
## Annex 3
# Project development materials

### Resources




A guide to ongoing discussions on Financing Mechanisms for CC Mitigation, including generation, allocation, delivery and institutional arrangements

http://www.globalcanopy.org/main.php?m=117&sm=224&t=1




A list of proposals made by countries and organizations, analysed as to how they compare in terms of scope, reference level, distribution and financing

http://www.globalcanopy.org/main.php?m=117&sm=176&t=1

Methodologies under development

http://www.v-c-s.org/public_comment.html

Guidelines to assist in the development of VCS-compliant AFOLU projects and methodologies

http://www.v-c-s.org/afl.html

VCS project list (only one from AFOLU currently registered and is on A/R

http://www.vcsprojectdatabase.org/resources/AccessReports.asp

Plan Vivo Tools and Resources

Introductory materials

Eligibility checklist

Use the Plan Vivo eligibility checklist to quickly check if the Plan Vivo System and Standard is applicable to your project or project concept

Project Registration Process: step-by-step guide

This document describes each stage in the project registration process and provides costs associated with registration

Introductory powerpoint with guidance for project developers

Plan Vivo Guidance Manual

Use the Plan Vivo Manual for guidance on developing activities with communities, developing technical specifications, setting up administrative and governance structures and other aspects of project development.

Templates

Project Idea Note Template and Guidance

Project Design Document Template

http://www.planvivo.org/?page_id=53

## Resources

| | |
|---|---|
| Biocarbon Fund | http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTCARBONFINANCE/0,,contentMDK:21844884~menuPK:5221277~pagePK:64168445~piPK:64168309~theSitePK:4125853,00.html<br>Monitoring part:<br>http://wbcarbonfinance.org/docs/LULUCF_Sourcebook_compressed.pdf<br>TARAM (V1.4)- Tool for Afforestation and Reforestation Approved Methodologies, Developed by BioCF and CATIE<br>http://wbcarbonfinance.org/Router.cfm?Page=DocLib&CatalogID=49187 |
| Rainforest Alliance | Providing guidance on how to prepare a PDD, assess risk, validation and verification, and guidance on how to apply the AR-AMS0004 – Simplified baseline and monitoring methodology for small-scale agroforestry – afforestation and reforestation project activities under the CDM.<br>This guidance was developed and tested by the Rainforest Alliance, whose effort was made possible by the support of the Innovation Fund of the International Finance Corporation (IFC) – a member of the World Bank Group – and in collaboration with ProNatura Sur of Mexico.<br>http://www.rainforest-alliance.org/climate/documents/coffee_carbon_guidance.pdf<br>Guidance on coffee carbon project development using the simplified agroforestry methodology<br>Rainforest Alliance in collaboration with the IFC Innovation Fund |
| Joanneum Research | ENCOFOR: bringing together existing manuals and providing guidance to project developers on which questions to ask themselves, along each stage of project development (tool to screen proposals; 2.4 USM project for 4 years)<br>http://www.joanneum.at/encofor/tools/tool_demonstration/download_tools.htm |

## Annex 4
# Land-use NAMAs submitted by country

Armenia
- Restoration of degraded forests
- Afforestation
- Reducing the volumes of deforestation
- Sustaining soil $CO_2$ content and ensuring its increase

Benin
- Sustainable management of natural forests and development of plantation forestry to increase carbon sinks

Brazil
- Reduction in Amazon deforestation
- Reduction in Cerrado (tropical savannah) deforestation
- Restoration of grazing land
- No-till farming
- Biological nitrogen fixation

China
- Increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic metres by 2020 (from the 2005 levels)

Republic of the Congo
- Development of REDD-related activities
- Development of silviculture in degraded forests and silviculture activities in rainforests
- Development of a national land-use strategy
- Promotion of sustainable management of forests
- Promotion of silviculture to enhance village, community and private plantations
- Promotion and enhancement of non-timber forest products
- Reforestation of eroded areas
- Promotion of youth employment in the regeneration and sustainable management of forest ecosystems
- Education and awareness raising on forest conservation practices
- Awareness raising of adaptation actions in the agricultural sector
- Promotion of plant species that fix nitrogen

Costa Rica
- Forestry

Cote d'Ivoire
- Reorganize and sustainably manage rural and state forests
- Develop and implement a national plan to combat land degradation
- Manage waste in an integrated and sustainable manner
- Develop sustainable farming

Ethiopia
- Enhanced district-level reforestation actions for the increment of vegetation cover of 214,440 square kilometres of degraded lands, lands affected by gullies and slopes, including through the management of community areas closed off to grazing

- 28,736.70 square kilometres of natural high forest area sustainably managed in order to reduce GHG emissions from deforestation and forest degradation
- 4,390.96 square kilometres of deciduous forest land sustainably managed in order to reduce GHG emissions from deforestation and forest degradation
- 60,360 square kilometres of national parks sustainably managed to reduce GHG emissions from deforestation and forest degradation
- 198,175 square kilometres of existing forests that are providing non-timber forest product maintained as buffer area for mitigating desertification
- 52,695 square kilometres of forest in exhaustion or production forests established and sustainably managed for the purpose of sequestrating carbon
- 51,496 square kilometres of wetlands wisely managed and sustainably used
- Application of compost on 80,000 square kilometres of agricultural land of rural local communities for increased carbon retention in the soil
- Implementation of agroforestry practices and systems on 261,840 square kilometres of agricultural land for livelihood improvement and carbon sequestration

Ghana

- Promote sustainable forest management
- Implement REDD++ mechanism
- Implement various forest governance initiatives
- Rehabilitate degraded wetland
- Develop and enforce land-use plans
- Promote spot and zero burning practices
- Promote minimum tillage
- Incentivize use of bio-fuels for mechanized agriculture
- Promote the use of organic fertilizer
- Promote integrated use of plant nutrients
- Promote the cultivation of high-yielding upland rice cultivation
- Promote the recycling of crop residues

Indonesia

- Sustainable peat-land management
- Reduction in date of deforestation and land degradation
- Development of carbon sequestration projects in forestry and agriculture

Jordan

- Control and stop deforestation
- Expand forest areas and tree-covered areas
- Rehabilitation and protection of the green cover and the grazing areas in the Badia region
- Grow nature reserve areas by including new reserves with the existing ones
- Growing perennial forages in the Badia region
- Best management practices in irrigated farming fertilization applications

Madagascar

- Implement widespread reforestation in 22 regions
- Restore the Torotorofotsy wetlands that cover approximately 9,000 hectares including its watersheds
- Improve the management of protected zones through the implementation of a management plan and management of biodiversity activities

- REDD+
- Improve pasture land and forage
- Increase agricultural production through improved seeds
- Increase use of compost and organic fertilizer in agricultural investment zones

Mongolia

- Reduce emissions from deforestation and forest degradation, improve sustainable management of forest and enhance forest carbon stocks in the Mongolian forest sector, including implementation of a REDD project
- Improve forest management, with major mitigation options identified as natural regeneration, plantation forestry, agro-foresty, shelter belts and bioelectricity

Morocco

- Reforest 50,000 hectares per year up to 2012 and one million hectares by 2030, in line with the reforestation master plan, which was adopted in 1994
- Improve forest fire protection through implementation of the master plan to prevent and combat fires, which was adopted in 2003
- Improve the yields of agricultural land

Papua New Guinea

- High-level policy objectives include forestry and agriculture as appropriate mitigation actions

Sierra Leone

- Increase conservation efforts in Sierra Leone through: establishing a network of twelve Protected Areas by 2015; sustainable management; and protection of forest reserves and catchment areas in Sierra Leone, including mangroves, coastal and inland wetlands
- Delineation and restoration of vulnerable habitats and ecosystems in the western area of Sierra Leone
- Provide support for a national assessment on forest resources
- Improve forest governance to maintain the proportion of land area covered by forests to at least 3.4 million hectares by 2015. To be achieved through the development of legislation, regulations and by-laws for environmental protection, including control of deforestation, firewood collection and charcoal production, and through capacity building, training and support to law enforcement services, and through the Ministry of Agriculture (Forestry Department).
- Introducing conservation farming and promoting the use of other sustainable agricultural practices (e.g., agroforestry, etc.)
- Development of an Integrated Natural Resources and Environmental Management programme for Sierra Leone, including sustainable land management programmes, particularly in relation to ecosystems.

Macedonia

- Enabling favourable pre-conditions for GHG ERs in the agriculture and forestry sectors
- Introducing and developing greenhouse gas mitigation technologies in agriculture
- Strengthening local capacity for carbon financing
- Educating experts, farmers and decision-makers on the agricultural mitigation measures and technologies
- Implementing the national strategy in the forestry sector

Togo

- Increase national forest cover from 7% in 2005 to 30% in 2050 through reforestation

Source: Minang, P.A. and Murphy, D. 2010

# Annex 5
# Measurement, reporting and verification (MRV) resources

List of datasets and tools of potential interest for terrestrial assessment, developed at:
Expert Consultation on GHG emissions and mitigation potential in the agriculture, forestry and fisheries sectors, held in Rome 2-4 December 2009, Final Report
http://www.fao.org/climatechange/20847-01b0979a43a063c907066694fe6ff63a4.doc

- IPCC 2006 IPCC Guidelines AFOLU and 2003 GPG LULUCF www.ipcc-nggip.iges.or.jp/. They provide methods which are designed for estimating, measuring, monitoring and reporting on carbon stock changes and GHG inventories and can be adapted for a global assessment.
- FAO Datasets on agriculture, forestry and other land use, together with the IPCC Guidelines document, is in preparation and can be requested from FAO at climate-change@fao.org
- IPCC emission factor database www.ipcc-nggip.iges.or.jp/EFDB/main.php
- FAO Forest Resource Assessment (FRA) www.fao.org/forestry/fra and National Forest and Monitoring Assessment (NFMA) www.fao.org/forestry/nfma/en/ both provide good forestry data.
- FAO World Reference Base for Soil Resources (WRB): Map of world soil resources www.fao.org/AG/agL/agll/wrb/soilres.stm and Harmonized World Soil Database www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html
- FAO Global climate maps www.fao.org/nr/climpag/climate/index_en.asp
- GIS-based scenarios of SOC annual change on croplands at sub-national level: case studies of Burkina Faso and Uzbekistan www.fao.org/fileadmin/templates/agphome/documents/climate/IPCC_croplands_20-10-2009.ppt.
  See also notes on presentation
  www.fao.org/fileadmin/templates/agphome/documents/climate/Accompanying_ document_to_FAO-IFAD-IPCC_Meeting.pdf
- The genetic improvement of forage grasses and legumes: to reduce greenhouse gas emissions www.fao.org/ag/AGP/agpc/doc/climatechange/papers/abberton_%20geneticimprovement.pdf and the genetic
  www-data.fao.org/ag/AGP/agpc/doc/climatechange/papers/Adaptationpaper.pdf
- See FAO AGP division climate change
  www.fao.org/agriculture/crops/core-themes/theme/climatechange0/en/
- CarboAfrica
  www.carboafrica.net/index_en.asp
- Global agroecological zones
  www.iiasa.ac.at/Research/LUC/GAEZ/index.htm
  www.iiasa.ac.at/Research/LUC/SAEZ/index.html
  www.fao.org/landandwater/default.stm
- Yasso07 soil carbon model
  www.environment.fi/default.asp?node=21605&lan=en
  www.ymparisto.fi/default.asp?node=21613&lan=en

# Annex 6
# CDM-approved methodologies of relevance for agriculture

**Number of CDM-approved carbon accounting methodologies by sector**

| Sectoral scope | | Methodologies | Small-scale methodologies | Consolidated methodologies |
|---|---|---|---|---|
| 1 | Energy industries (non-/renewable sources) | 33 | 15 | 9 |
| 2 | Energy distribution | 1 | 2 | 0 |
| 3 | Energy demand | 8 | 9 | 0 |
| 4 | Manufacturing industries | 11 | 11 | 5 |
| 5 | Chemical industries | 13 | 5 | 1 |
| 6 | Construction | 0 | 0 | 0 |
| 7 | Transport | 2 | 8 | 1 |
| 8 | Mining/mineral production | 0 | 0 | 1 |
| 9 | Metal production | 7 | 0 | 0 |
| 10 | Fugitive emissions from fuels (solid, oil & gas) | 6 | 1 | 1 |
| 11 | Fugitive emissions from production & consumption of halocarbons & sulphur hexafluoride | 6 | 2 | 0 |
| 12 | Solvent use | 0 | 0 | 0 |
| 13 | Waste handling and disposal | 8 | 10 | 3 |
| 14 | Afforestation and reforestation | 10 | 7 | 2 |
| 15 | Agriculture | 2 | 3 | 1 |

### Relevant to agriculture

| Sectoral scope | Methodologies |
|---|---|
| 1-Energy industries<br>(non-/renewable sources) | AM0042<br>Grid-connected electricity generation using biomass from newly developed dedicated plantations |
| 13-Waste handling & disposal | AM0073<br>GHG ERs through multi-site manure collection and treatment in a central plant |
| 14-Afforestation & reforestation | AR-AM0002<br>Restoration of degraded lands through afforestation/reforestation<br>AR-AM0003<br>Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing<br>AR-AM0004<br>Reforestation or afforestation of land currently under agricultural use<br>AR-AM0005<br>Afforestation and reforestation project activities implemented for industrial and/or commercial uses<br>AR-AM0006<br>Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land<br>AR-AM0007<br>Afforestation and Reforestation of Land Currently Under Agricultural or Pastoral Use<br>AR-AM0008<br>Afforestation or reforestation on degraded land for sustainable wood production<br>AR-AM0009<br>Afforestation or reforestation on degraded land allowing for silvopastoral activities<br>AR-AM0010<br>Afforestation and reforestation project activities implemented on unmanaged grassland in reserve/protected areas<br>AR-AM0011<br>Afforestation and reforestation of land subject to polyculture farming<br>AR-AM0012: Afforestation or reforestation of degraded or abandoned agricultural lands |
| 15-Agriculture | AM0016: Greenhouse gas mitigation from improved animal waste management systems in confined animal feeding operations<br>AM0073: GHG ERs through multi-site manure collection and treatment in a central plant |

| Small-scale methodologies | Consolidated methodologies |
|---|---|
| | |
| AMS-III.D<br>Methane recovery in animal manure management systems --- Version 16<br>AMS-III.R<br>Methane recovery in agricultural activities at household/small farm level | ACM0010<br>Consolidated methodology for GHG ERs from manure management systems --- Version 5 |
| AMS0001<br>Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands<br>AR-AMS0002<br>Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the CDM implemented on settlements<br>AR-AMS0003<br>Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on wetlands<br>AR-AMS0004<br>Simplified baseline and monitoring methodology for small-scale agroforestry - afforestation and reforestation project activities under the clean development mechanism<br>AR-AMS0005<br>Simplified baseline and monitoring methodology for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on lands having low inherent potential to support living biomass<br>AR-AMS0006<br>Simplified baseline and monitoring methodology for small-scale silvopastoral - afforestation and reforestation project activities under the clean development mechanism<br>AR-AMS0007: Simplified baseline and monitoring methodology for small-scale A/R CDM project activities implemented on grasslands or croplands | AR-ACM0001<br>Afforestation and reforestation of degraded land<br>AR-ACM0002<br>Afforestation or reforestation of degraded land without displacement of pre-project activities |
| AMS-III.A.<br>Urea offset by inoculant application in soybean-corn rotations on acidic soils on existing cropland<br>AMS-III.D.: Methane recovery in animal manure management systems<br>AMS-III.R.: Methane recovery in agricultural activities at household/small farm level | ACM0010: Consolidated baseline methodology for GHG ERs from manure management systems |

Source: UNFCCC CDM website http://cdm.unfccc.int/DOE/scopes.html

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