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CHAPTER V

Towards a standardized system for the reporting of carbon benefits in sustainable land management projects

Abstract

Given the fact that human activities currently emit greenhouse gases (GHG) equivalent to over 50 billion tonnes of CO_2/year and that approximately 30 percent come from land use and land-use change, natural resource management (NRM) and sustainable land management (SLM) activities could have a large role to play in climate change mitigation. The types of land management activities covered by such projects vary widely. These activities have different carbon (C) and GHG impacts. Reports of changes in C and GHG emissions for land management projects are required for a variety of reasons and vary depending on the purpose of the project. Land management projects can be divided into two categories: (i) those that are carried out specifically for climate change mitigation; and (ii) those that are not, but still have some impact on GHG flux and require some level of C reporting. Mitigation projects are usually required to use inventory methods accepted by a certification scheme or other regulating body. As the interest in climate change mitigation has grown, so has the interest in reporting C changes and GHG mitigation for projects that are primarily SLM projects rather than C mitigation projects. For these types of projects, C reporting will be different, depending on the resources available and the motivation for doing the report.

The Global Environment Facility (GEF) provides incremental financing to a wide range of SLM activities to ensure they can deliver global environmental benefits. These activities take place in developing countries and range from reforestation and agroforestry projects, to projects that protect wetlands

or foster sustainable farming methods. The C benefits of these and other non-GEF SLM projects are likely to be considerable. The Carbon Benefits Project (CBP) is aimed at producing a standardized suite of tools for GEF projects (in all of its focal areas) and other SLM and NRM projects to measure, monitor, model and forecast C stock changes and greenhouse gas (GHG) emissions and emission reductions. The system which is being developed will be end-to-end (applicable at all stages of a project cycle), cost-effective and user friendly. The project consists of two components: A – led by Colorado State University (CSU), with greater emphasis on cropland and grazing land; and B – led by the World Wildlife Fund (WWF), with special attention to forestry and agroforestry. In this chapter, we refer only to the activities of component A. The CBP system is being developed and tested, in close collaboration with five existing SLM projects in Brazil, China, Kenya, the Niger and Nigeria.

INTRODUCTION

Most sustainable land management (SLM) and natural resource management (NRM) projects do not have climate change mitigation as their main objective focusing instead on long-term improvements in livelihoods and productivity, and reductions in environmental degradation. However, SLM projects have the potential not only to reduce greenhouse gas (GHG) emissions, by reducing emissions from biomass burning, biomass decomposition and the decomposition of soil organic matter (SOM), but also to sequester carbon (C) through practices that increase biomass production and promote the build-up of SOM. Given the fact that human activities currently emit GHGs equivalent to over 50 billion tonnes of CO_2/year and that approximately 30 percent come from land use and land-use change, SLM activities could have a large role to play in climate change mitigation. In this chapter we discuss the potential C benefits of SLM activities before considering how the C reporting needs of SLM projects vary from those of C mitigation projects. Finally, we outline a current initiative co-funded by the Global Environment Facility (GEF) to produce a standardized system for GEF and other SLM projects to report changes in C stocks and GHG emissions.

SUSTAINABLE LAND MANAGEMENT, NATURAL RESOURCE MANAGEMENT AND CARBON BENEFITS

There are different definitions of SLM. According to the World Overview of Conservation Approaches and Technologies (WOCAT):

"Sustainable Land Management refers to the use of renewable land resources (soils, water, plants and animals) for the production of goods – to meet changing human needs – while at the same time protecting the long-term productive potential of these resources." (WOCAT, 2008)

The types of land management activities covered by SLM and NRM projects vary widely from large-scale reforestation to changes in stocking densities on grassland. These activities have different potential C and GHG impacts, examples of which are considered here.

Grasslands

Much of the world's population depends on grasslands, especially in arid and semi-arid regions and in many instances they are overused and degraded (Oldeman, 1994). Grasslands are therefore the subject of many SLM projects. According to Ravindranath and Ostwald (2008), the improvement of grasslands offers a global GHG mitigation potential of 810 Mt CO_2, almost all of which is in the soil. Activities that improve grasslands are generally aimed at improving productivity. SLM projects also take into account the long-term viability of the activity, and soil organic carbon (SOC) can give a good indication of this. In general, grassland improvement activities can include the following.

- The addition of fertilizers and manures. This can have a direct impact on SOC levels through the organic material they add, and an indirect impact by increasing productivity. For chemical nitrogen (N) fertilizers, any increase in SOC has to be set against emissions of nitrous oxide (N_2O) resulting from the fertilizer use and the GHG cost of fertilizer production. The GHG emissions associated with the transport of any type of fertilizer is also an issue for consideration.
- Improved grassland management. Overstocking can lead to the degradation of grasslands and depletion of SOC. High stocking rates are also associated with high methane emissions (through enteric fermentation), another potent GHG. Many SLM projects therefore aim to reduce stocking rates to an optimal level.
- Improved pasture species and the inclusion of legumes can improve productivity both above and below ground and lead to SOC accumulation.
- Irrigation, which again can improve productivity and the production of SOM. It does, however, have to be set against any GHG emissions associated with energy used to implement the irrigation.

- Introduction of earthworms. Earthworms mix up different soil layers and lead to better soil aeration. They can also facilitate the movement of particles of undecomposed organic matter from the soil surface into the soil profile where they add to SOM.

Conant, Paustian and Elliott (2001) looked at 115 studies of improved grassland management activities and found that C increased in 74 percent of them as a result of the grassland management interventions.

Some SLM projects may involve the establishment of pasture on degraded land and these have the potential to reintroduce large amounts of organic matter (and therefore C) into the soils (Guo and Gifford, 2002).

Forests

Many SLM projects include forestry activities. The benefits of such activities in terms of biodiversity, livelihoods and climate regulation are numerous. In addition, forests have considerable GHG mitigation potential, storing large stocks of C both above and below ground. IPCC estimates the mitigation potential of forests at 2.7 to 13.8 Gt of CO_2 annually (IPCC, 2007). SLM projects with forestry components may include the following.

- Protection of existing forests will preserve existing C stocks and avoid GHG emissions associated with the burning of forests and emissions from accelerated decomposition from soils following clearing. FAO (2006) estimated that 9.39 million ha of forest were lost annually between 2000 and 2005.
- Increasing tree density in degraded forests increases biomass density and therefore C density.
- Establishment of new forests. When croplands, grasslands or degraded lands are returned to forests, there will be an eventual increase in total ecosystem C because of the much greater above-ground biomass. C stocks in soils may also be increased due to the greater input of biomass for decomposition, especially in the case of degraded lands being reforested. Schroth *et al.* (2002) found C accumulation rates of 4 Mg/ha/year when an infertile upland soil in the Amazon was returned to forest.
- Many SLM projects introduce fruit trees – agroforestry, orchards and woodlots – or into cropland to increase income, diversify production and optimize use of water resources. Trees in croplands and orchards can store C above and below ground and even reduce fuel emissions if they are grown as a renewable source of firewood.

Cropland

Managing land to meet the food demands of a rapidly increasing population without degrading finite resources is one of the major problems faced by SLM projects. Some 52 percent of global agricultural land is now classified as degraded (Gabathuler *et al*., 2009). Many cropping practices used in SLM projects will be aimed at reducing soil erosion and therefore have a positive C sequestration potential. The majority (~ 90 percent) of the GHG mitigation potential of the agricultural sector relates to increasing soil C (Ravindranath and Ostwald, 2008). A few cropland management techniques that might be used in SLM projects are the following.

- Mulching, which is usually carried out to improve soil moisture conditions and prevent erosion. It also adds organic matter to the soil if mulches are later incorporated into the soil. If crop residues are used, mulching also prevents C losses from the system.
- Reduced or no tillage. This reduces the accelerated decomposition of organic matter that occurs with intensive tillage (ploughing) and causes loss of C from the soil.
- Addition of manures and fertilizers. Organic manures increase SOC. Chemical fertilizers can increase productivity and therefore increase SOC. However, GHG emissions associated with the use and production of chemical fertilizers have to be taken into account.
- Planting of cover crops and use of green manures increases biomass returned to the soil and therefore increases soil C stocks.
- The use of improved crop varieties. Measures to increase productivity above ground can also lead to productivity increases below ground as well as increases in crop residues, thereby enhancing soil C.

PROJECT SCALE CARBON REPORTING FOR LAND MANAGEMENT ACTIVITIES

Reports of changes in C and GHG emissions for land management projects are required for a variety of reasons and vary depending on the purpose of the project. Broadly speaking, land management projects can be divided into two categories: (i) those that are carried out specifically for climate change mitigation; and (ii) those that are not, but still have some impact on GHG flux and require some level of C reporting.

Mitigation projects

The mitigation potential of the land management sector is well recognized.

There are now many examples of projects involving reforestation, agroforestry and grassland management that have the specific aim of mitigating climate change. Grassland management projects can involve either a change in grazing pressure or amendment of grasslands with manure, chemical fertilizer or liming. Mitigation projects need to show a verifiable change in C over a given period, either through the conservation of existing C stocks or the expansion of C sinks. In addition, they need to assess the C costs associated with the activities that led to these changes. For example, grassland improvement through fertilization needs to take into account emissions associated with fertilizer use, machinery and even fertilizer transport and manufacture, depending on how far the user needs to go with a lifecycle analysis. The methods used to prove the changes in land-use C mitigation projects vary, depending on the type of mitigation activity, the length of the project and the scale of the project (Ravindranath and Ostwald, 2008).

Mitigation projects are usually required to use inventory methods accepted by a certification scheme or regulating body. The best known of these is probably the clean development mechanism (CDM), the Kyoto Protocol's scheme that allows developed countries to offset part of their GHG emissions by funding C mitigation activities in developing countries (United Nations, 1998). The CDM guidelines give broad guidance on sampling methods for biomass and the frequency with which samples should be taken. Currently, only afforestation and reforestation projects can be considered under the CDM. However, it is likely that grassland projects will be eligible in the future (after 2012). The CDM guidelines are also used as a standard for other projects entering into C trading, for example, those financed by the World Bank Biocarbon Fund (World Bank, 2009).

Other mitigation programmes and schemes linked to the voluntary C markets rather than national emissions reductions have their own regulations and guidelines and many cover those sectors not eligible for CDM, such as grassland and cropland, as well as forestry. The Voluntary Carbon Standards provide standards and guidelines for voluntary offset projects including those involving improvements to grasslands and croplands that increase soil C and reduce GHG emissions (VCS, 2008). There are also certification schemes that provide guidelines for how land management projects should measure and monitor changes in C stocks and GHG fluxes. These provide their own approval certificates. Examples include the Climate Community and Biodiversity Alliance (CCBA), the Scientific Certifications Systems Carbon Offset Verification scheme for forests and several others related to biofuels.

Guidelines for mitigation projects generally involve rigorous sampling for areas both under the project activities and in baseline areas that are not under project activities. Methods for field and laboratory measurements are set out in the guidelines and a minimum number of samples have to be taken in a given period. At present, the different sources of guidelines for mitigation projects involving land management are not standardized. Most, however, are based to a greater or lesser extent on the 2006 IPCC Guidelines for AFOLU (IPCC, 2006).

Non-mitigation projects

As the interest in climate change mitigation has grown, so has the general interest in reporting C changes and GHG mitigation for projects that are primarily SLM and NRM projects rather than C mitigation projects. This is mainly driven by funding agencies and has arisen as many of them realize that projects involving agroforestry, improved cropland and grassland management and the restoration of degraded land will be accompanied by increases in C stocks or the maintenance of existing stocks. There are several reasons why funding agencies and project managers may want to estimate C changes in these projects.

- The funding agency may require the project to make some estimate of C stock change and GHG emissions. This may be motivated by a need for the funding body to assess the C impact of all the SLM projects it is funding. For funding agencies associated with the United Nations (such as FAO and GEF), this is increasingly the case.
- Changes in C over the lifetime of a project act as a good indicator of the status of an area under an SLM intervention. For example, increases in SOC are generally accompanied by an increase in soil fertility and water-holding capacity (van Keulen, 2001). An assessment of C under the baseline and project conditions can therefore give an indication of the success of the SLM intervention.
- With the emerging interest in ecosystem services, projects may wish to track C changes to show changes in regulating, supporting and provisioning services.
- The project may be looking to change focus in the future and seek C certification or enter a C market. A basic understanding of the steps involved in C reporting and baseline information will help with this transition.

For these types of projects, C reporting will be different, depending on the resources available to the project and the motivation for doing the report. In the same way as a C mitigation project, they will need to identify the project area and those SLM activities that might impact C stocks or GHG emissions. Beyond that, the methods used and resources allocated to monitoring and reporting will depend on the land-use system, the objective of the project and the costs involved. However, projects should be encouraged to use the most accurate methods possible given the resources available (Pearson, Brown and Ravindranath, 2005). At the moment, no standardized guidelines for C reporting exist for these types of projects within most funding bodies, let alone between them.

TOWARDS STANDARDIZED REPORTING OF CARBON BENEFITS IN SLM PROJECTS: THE GEF CARBON BENEFITS PROJECT (CBP)

The GEF provides incremental financing to a wide range of SLM activities to ensure they can deliver global environmental benefits. These activities take place in developing countries and range from reforestation and agroforestry projects, to projects that protect wetlands or foster sustainable farming methods. The C benefits of these and other non-GEF SLM and NRM projects are likely to be considerable, as outlined in the previous section on SLM, NRM and C benefits. However, at the moment it is difficult for GEF to compare the C benefits of different land management interventions, as a wide range of different methods are being used to measure and monitor them in these projects, if monitoring occurs at all.

The aim of the CBP is to produce a standardized suite of tools for GEF and other SLM and NRM projects to measure, monitor, model and forecast C stock changes and GHG emissions and emission reductions. The system which is being developed will be end-to-end (applicable at all stages of an SLM project cycle), cost-effective and user friendly. The project consists of two components: A – led by Colorado State University (CSU), with greater emphasis on cropland and grazing land and B – led by the World Wildlife Fund (WWF), with special attention to forestry and agroforestry. Here, we outline the activities of component A.

Methodology

Premises

GEF and other SLM/NRM projects need to know if project interventions affect C stocks or GHG emissions and this involves measurement, modelling and verification for: a baseline scenario (the stocks and fluxes that would have occurred in the absence of the intervention); a project scenario (stocks and fluxes that occur with the intervention); and the incremental change between the two. A protocol is therefore needed that guides the user through all stages of delivering a land management intervention in terms of proving net C benefits, from forecasting at the planning stage, and monitoring and verification at the implementation stage, to long-term projection of future impacts.

The CBP is developing a modular Web-based system (see Figure 8) that allows the user to collate, store, analyse, project and report C stock changes and GHG emissions for baseline and project scenarios in SLM and NRM interventions in a standardized and comprehensive way. Decision trees will guide the user to different options of varying complexity, depending on the stage of the project and the level of detail required in terms of reporting net C benefits.

Modelling approaches

Carbon inventory assessments involve estimation of stocks and net fluxes of GHGs from different land-use systems in a given area over a given period and under a given management system. Ultimately, the scale of a project, the objective (whether a C mitigation project or a land management project with an interest in C) and the time and resources available for monitoring will determine the methods and data to be used for the C assessment.

CBP builds on more than 15 years of experience at CSU of producing project- and national-scale C inventory tools for the agriculture, forestry and land-use sector that represent IPCC Tier I (empirical), II and III (process model) approaches. CBP is adapting and building on three tools in particular:

- the agriculture and land-use tool (ALU), a national GHG inventory tool based on a Tier I/II approach (www.nrel.colostate.edu/projects/ghgtool/);
- COMET-VR, a Web-based decision support tool for the assessment of C stock changes at the field scale (Paustian *et al.*, 2009; www.cometvr.colostate.edu/);
- the GEFSOC system (Milne *et al.*, 2007; Easter *et al.*, 2007), a Tier III tool for estimating national and subnational scale soil C stock changes in developing countries.

Socio-economic dimensions of land management interventions are also being considered in the project to ensure that land management activities with a positive impact on C and GHG mitigation do not have detrimental effects on society or livelihoods. Socio-economic considerations are often key determinants of possible success in terms of improved livelihoods – for example through payment for environmental services.

Measurement approaches

The CBP system is being designed to include measurement protocols that suit the project objective (how much focus there is on C or GHG mitigation), the type of land use, the resources available to the project (both human and financial) and the length of the project. Consequently, there is no single protocol to fit all projects using the system, rather a range of options involving varying levels of effort and associated trade-offs in certainty. The measurement protocol module is being developed around a decision-tree approach, guiding the user to appropriate sampling designs and field and laboratory procedures.

Methods and protocols being drawn on include the Winrock Guidelines for Integrating C Benefits in GEF Projects (Winrock International, 2005) and the IPCC Good Practice Guidance for LULUCF (Land use, land-use change and forestry) (Namburs *et al*., 2004), among others. The IPCC guidelines are important for Component A of the CBP system as they form the basis of two of the assessment options available in the system an IPCC Simple Assessment (ISA) option, using default information supplied by IPCC, and a second option that allows users to create their own project-specific emission factors. The second option is suited to projects with a reasonable amount of time available to collect biomass or soil samples and some access to laboratory facilities. Users will be given guidance on the most important measurements to take to improve specific emission factors recommended in the measurement protocol module.

The system also includes standardized data templates for the user to record and store repeated field measurements in a format that can be fed into the three calculation options of the system.

Test case areas

The CBP system is being developed and tested in close collaboration with five test case partners. These are helping to develop the system by providing feedback on the C reporting needs of GEF SLM/NRM projects and testing parts of the system. The test cases include four GEF SLM projects and one non-GEF project.

- The Ningxia Integrated Ecosystem Management (IEM) and the Gansu IEM projects, both part of GEF China. These projects are located in the arid northwest of China and are implementing a number of measures to address land degradation, such as shelterbelt establishment, conservation tillage and revegetation with drought-resistant shrub species.

- The Kenya Agricultural Productivity and Sustainable Land Management (KAPSLM) project, which will promote sustainable land management in three watersheds in Kenya that cover humid to semi-arid areas of the country.
- The Niger-Nigeria IEM project, which is implementing a number of measures such as orchard establishment and rehabilitation of degraded rangelands to address land degradation in the transboundary area between the Niger and Nigeria.
- Also, one non-GEF project, the Environmental Impact of Agricultural Expansion in Southwest Amazonia project, which is providing detailed data sets for the verification and testing of modelling components in the CBP system.

The test case areas vary in size, from landscape-scale projects at 80 000 km^2 to plot-scale at 12 km^2. They cover a range of SLM interventions, including conservation agriculture, agroforestry, wetland protection and grassland management. The projects are partners in CBP to help develop a system that meets their C stock and GHG reporting needs; these range from very detailed (where GHGs are the main focus of the project) to very broad-based (where GHGs and C stocks are a minor part of the project). The SLM project partners will be implementing the CBP system by the end of Phase I of the project (May 2011). Phase II of the project will involve a series of workshops to roll out use of the CBP system to other GEF networks of projects and non-GEF SLM projects.

CONCLUSIONS

Land management projects in developing countries are becoming increasingly interested in reporting GHG emissions and C stock changes mainly as a result of the changing interests of funding bodies. The reporting needs of such projects are different from C mitigation projects since the resources available, capacity for monitoring and level of detail required are very different. By providing a standardized C benefits protocol, CBP will allow a consistent comparison of different SLM projects by GEF and other donors. It would also bring developing countries and project managers closer to being able to gain reward for land management activities that sequester C and reduce GHG emissions.

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