The EX Ante Carbon-balance Tool

EASYPol Resources for policy making

ISSUE PAPERS **EASYPol Module 099**

Mainstreaming Carbon Balance Appraisal in Agriculture

EX-ACT: A Tool to Measure the Carbon-Balance

About EX-ACT: The *Ex Ante* Appraisal Carbon-balance Tool aims at providing *ex-ante* estimations of the impact of agriculture and forestry development projects on GHG emissions and carbon sequestration, indicating its effects on the carbon balance.

See EX-ACT website: ***www.fao.org/tc/exact***

Related resources

- EX-ANTE Carbon-Balance Tool (EX-ACT): (i) Technical Guidelines; (ii) Tool; (iii) Brochure
- See all EX-ACT resources in EASYPol under the Resource package, Investment Planning for Rural Development, EX-Ante Carbon-Balance Appraisal of Investment Projects

EASYPol

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Mainstreaming Carbon Balance Appraisal in Agriculture

A Tool to Measure the Carbon-Balance

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About EASYPol

EASYPol is a multilingual repository of freely downloadable resources for policy making in agriculture, rural development and food security. The EASYPol home page is available at: *www.fao.org/easypol*. These resources focus on policy findings, methodological tools and capacity development. The site is maintained by FAO's Policy Assistance Support Service.

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Abbreviations

AfDB	African Development Bank Group
AGF	African Green Fund
CAADP	Comprehensive Africa Agricultural Development Programme
CDM	Clean Development Mechanism
EX-ACT	Ex-Ante Carbon-balance Tool
GHG	Green House Gas
ICRAF	World Agroforestry Centre
IPCC	Intergovernmental Panel on Climate Change
MRV	Monitoring, Verifying and Reporting
NGO	Non Governmental Organization
PES	Payments for Environmental Services
REDD	Reducing Emissions from Deforestation and forest Degradation
SOM	Soil Organic Matter
VCS	Voluntary Carbon Standards

1. SUMMARY

Agricultural systems can contribute significantly to an overall mitigation that will help to reduce the extent of adaptation required and catastrophic impacts on systems and sectors, on which lives and livelihoods depend. Many agricultural mitigation options, particularly those that involve soil C sequestration also generate co-benefits for adaptation, food security and rural development.

This paper analyses the current context in which carbon balance and greenhouse gass (GHG) indicators face growing interest in agriculture development. It highlights the multi-objective significance of carbon balance and multi benefits of improved carbon soil in term of mitigation, adaptation, cropping systems and local community resilience building. It proposes that Soil Organic Carbon (SOC) be used as the Agri-Environmental indicator in agriculture policy monitoring for developing countries and carbon balance as performance indicator in policy analysis.

Tools that are currently available to calculate GHG emissions in agriculture sector at farm level or at project level are listed. EX-ACT[1] is presented as the specific tool to allow for a quick appraisal of the potential mitigation impacts of agricultural investment projects, available to donors and planning officers, project designers and decision makers within agriculture and forestry sectors in developing countries.

Lastely, this paper develops a way in which carbon balance can be used in project and policy analysis, highlighting synergies with existing donors' approaches. It also analyses the different ways to upscale the use of carbon balance methods within agriculture sector in developing countries.

2. INTRODUCTION

Objectives: This paper analyses different ways to upscale the use of carbon balance methods within agriculture sector in less industrialised countries, questioning its relevance in agriculture planning, in project formulation, policy impact analysis, its potential use for resource mobilization and the institutional strengthening and capacity development implications it generates.

Target audience: The national agriculture sector, forestry and food security policy makers, institution-based, agency and donor decision-makers.

Required background: To fully understand the content of this module the user must be familiar with:

- Concepts of climate change mitigation and adaptation
- Concepts of land use planning and management

[1] See FAO's Ex-Act Website: *www.fao.org/tc/exact*

- Elements of project economic analysis

Readers can download the EX-ACT Tool and related brochure[2]. Links are included in the text to other EASYPol modules or references[3]. See also the list of EASYPol links included at the end of this module.

3. Conceptual Background

Changes in climate – particularly extreme events such as droughts, heat waves, flooding and storms – will impose significant stresses on rural livelihoods, threatening existing food production and income systems and limiting options in the future.

Agriculture is a major source of GHG, contributing directly 14% of total global emissions. When combined with related changes in land use including deforestation (for which agriculture is a major driver), agriculture's contribution rises to more than one-third of total GHG emissions. Globally, agricultural production (crops and livestock) is responsible for the majority of methane emissions (cattle, rice plantations, and wetlands) and nitrous oxide (application of fertilizer). The potential for technical mitigation in the sector is high and 74% of it is in developing countries.

The mitigation potential of the agriculture, forestry and other land uses (AFOLU) sector is high. Many of the technical options are readily available and could be deployed immediately: reducing emissions of carbon dioxide (CO_2) through the reduction of the rate of deforestation and forest degradation, adoption of improved cropland management practices (reduced tillage, integrated nutrient and water management, conservation agriculture); reducing emissions of methane and nitrous oxide through improved animal production, improved management of livestock waste (manure, biogas), more efficient management of irrigation water on rice paddies, improved nutrient management; and, sequestering carbon (C) through conservation farming practices, improved forest management practices, afforestation and reforestation, agroforestry, improved grasslands management and restoration of degraded land.

The Intergovernmental Panel on Climate Change (IPCC) and global financial indicators highlight that the magnitude of the challenges to stabilize GHG concentrations will require

[2] See also *EX-ACT website*

[3] EASYPol hyperlinks are shown in blue, as follows:
a) Resource packages are shown in **underlined bold font**
b) other EASYPol modules or complementary EASYPol materials are in ***bold underlined italics***;
c) links to the glossary are in **bold**; and
d) external links are in *italics*.

using AFOLU-related emission reductions to the fullest sustainable extent possible, until new energies and technologies are affordable.[4]

Such a strategic decision will require a wide mobilisation of voluntary countries, of national public institutions and partners. It will also need a set of capacity building and training to appraise, compare, promote high mitigation impact actions and technologies within the agriculture sector.

Definition of carbon balance: The carbon balance, for a specific project (or scenario of action) in comparison with a reference, should be considered as the net balance of all GHG expressed in CO_2 equivalent computing all emissions (sources and sinks) with the atmosphere interface and the net change in C stocks (biomass, soil…). It can be realized at different scales, locally for an investment, an institution, or globally for a region, a value chain, a country, the planet. Within a dynamic process, it is also possible to appraise the global carbon balance effect of a new action, a project / programme, a strategy or a policy.

Carbon balance appraisal may help to build new strategies to adapt and prevent climate change consequences especially in developing the agriculture sector. In this perspective, FAO has just developed EX-ACT, a tool aimed at providing ex-ante estimations of the impact of agriculture and forestry development projects on GHG emissions and C sequestration, indicating its effects on the Carbon-balance[5].

4. A PROMISING CONTEXT: CARBON BALANCE AS AN EMERGING CRITERIA IN BOTH PUBLIC AND PRIVATE POLICIES AND INVESTMENTS

4.1. Use of GHG indicators in trade and business

Environmental sustainability is becoming a driver of business strategy for companies. Sustainability trends affect competitiveness, costs, regulatory risk, consumer perceptions and market position. Private sector companies are pro-active in carbon footprint impact. It generates a demand for new accounting tools to measure the GHG impacts of a company's supply chain and of the products that are sold to customers. Several tools were developed to support the efforts from private companies to assess their footprint. The *GHG Protocol* is an international accounting standard used by businesses to identify, calculate and report their emissions. It was developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) in 1998.

[4] FAO, 2009. Anchoring Agriculture within a Copenhagen Agreement, A Policy brief for UNFCCC parties by FAO, Rome, Italy. http://www.fao.org/climatechange/media/17790/0/0/

[5] Bernoux et al., 2010

The current Walmart project[6] with WRI is very significative to show this new carbon footprint trend. Support from Walmart will also go towards developing a "Green Standards Guide" to help companies navigate through the "green" claims of different environmental certifications or labels. It will help companies decide which eco-labels their organizations will recognize through a standard set of eco-label evaluation criteria.

Resorting carbon balance could be a way in private sector to cope with energetic challenge (energy savings, low carbon activities and footprint), to reshape strategic objectives (insourcing carbon costs in institutional decisions), to anticipate regulatory duties and to improve external communication.

4.2. Use of GHG in public policies

Among public sector initiatives, there are mostly support policies towards private sector. For example, The Ministry of Economy, Trade and Industry (METI) has been working to establish a carbon footprint system for Japan, a system aimed at promoting joint efforts by businesses and consumers to prevent global warming by estimating greenhouse gas emissions throughout a product's or a service's life cycle in terms of the amount of equivalent-CO_2, and displaying them clearly with a mark[7].

With the Grenelle de l'Environnement, launched in 2007, France has drawn a consensus between stakeholders and with civil society to further green its economy. As a result, laws have been adopted and will soon be enforced with a specific emphasis on reducing carbon emissions. The policies[8] adopted include (i) Green buildings: to generalize low energy consumption buildings, (ii) Emissions from cars, (iii) Renewable energy objective: (to reach its 23% objective set in the European Renewable Energy objective), (iv) Public transportation: massive public investments in urban public transportation (US$37 billion by 2020), (v) Carbon tax: in order to achieve France's domestic emission reduction objective by 2020.

The "Grenelle 2 plan" (bill on the French national commitment to the environment) aims to adopt sustainable methods of production and consumption, and increase consumers' awareness of the environmental impact of products, which would include for example the amount of GHG emitted during a product's manufacture, packaging, and transport. The proposed bill would make environmental labels mandatory on all products sold in France, including agricultural/food products, by January 2011.

The 20,20,20 : At the level of European Union, Energy- Climate on which 27 member states agreed, is the first real agreement on climate change. It is a framework which should evolve through negotiation. The negotiation on Energy- Climate package occurred in Bruxelles from 9 to 11 of December 2009, beside Poznan Conference. The package plans to reduce by 2020 the GHG by 20% in European countries, to improve energy efficiency by 20% and to reach

[6] see Green Supply Chain Initiative of the World Resources Institute (WRI)
[7] METI, 2009. *http://www.meti.go.jp/english/press/data/20090303_01.html*
[8] source: *http://www.ambafrance-us.org/climate/france-and-greenhouse-gas-emissions-facts-and-rationale/*

20% of renewable energies in energy consumption. In the framework of World GHG reduction agreement of Copenhagen, EU engaged to 30% of reduction by 2020.

In New Zealand, the Government took the initiative of a sector-based policy in primary production sector. In particular, the government has initiated a public strategy on GHG footprinting for the land-based primary sectors. A key part of this strategy[9] is development of sector-specific approaches to GHG footprinting and management which has a number of advantages, including: (i) being more cost-effective than undertaking individual life cycle carbon footprints for each enterprise (for example, different growers), (ii) allowing calculation of a carbon footprint at sector level, (iii) easy monitoring. In the agricultural sector, New Zealand is among the first countries to have developed the use of GHG as agri-environmental indicator for policy analysis with Canada (2005).

5. USE OF GHG AND CARBON BALANCE IN AGRICULTURE SECTOR

5.1. Carbon balance and sustainable agriculture

Among development partners, a consensus is being progressively built around the "development and operationalization of a new paradigm for agricultural intensification—more food and fiber but with less land, more efficient water use, less fossil fuel inputs, significantly reduced land and water pollution, and reduced greenhouse gas emissions"[10]

Non climate benefits of improved carbon balance in soil are known and valued in agriculture development. They are linked with many environment objectives targeting agriculture and natural resources (watershed management, water management, drought management, sustainability of cropping systems, erosion control, flood risk management, water quality management, eco-tourism...). It could thus be considered that soil carbon sequestration provides a triple win as a public good.

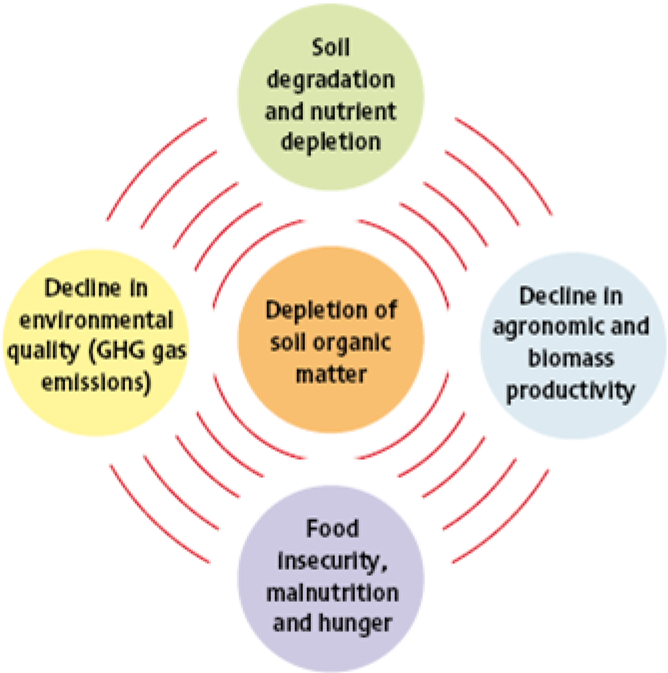
- **Value to farmer** : C sequestration improves agriculture performances (yield increase, input saving, water saving) and incomes (additional production and Payment of Environmental Services (PES[11])
- **Value to community**: C sequestration increases cropping systems and watershed climate shocks resilience (adaptation, PES)
- **Value to society:** Large mitigation potential of agriculture arises from C sequestration (local and global carbon value)

9 World Bank, 2009. http://www.lcm2009.org/ABSTRACTS/OR_23_McLaren.pdf

10 http://siteresources.worldbank.org/INTARD/Resources/WB_ARD_ClimateChange_v3.pdf

11 See FAO's Payment for Environmental Services website: http://www.fao.org/es/esa/pesal/index.html

Figure 1: The vicious cycle of depletion of soil organic matter



Source: Lal, 2004, a.

However, most of these benefits are currently non marketable benefits, considered as externalities with no monetary value for farmers. Such market failure and the gap between upstream actors and downstream beneficiaries did limit any large scale expansion of such win-win practises through farmers' mobilisation.

Payments for Environmental Services (PES) are one type of economic incentive for those that manage ecosystems to improve the flow of environmental services that they provide. Generally these incentives are provided by all those who benefit from environmental services, which include local, regional and global beneficiaries (FAO, 2008[12]). Within this perspective the PES allows to promote actions which benefit simultaneously at the three levels.

As a good example, NGOs initiated a project in Tanzania in 2008 to bring watershed services payments to farmers. Now in its implementation phase, the Equitable Payments for Watershed Services programme has enrolled 450 farmers to implement land use projects including reforestation and soil conservation (improved carbon balance). The Dar es Salaam Water and Sewage Corporation (DAWASCO) and Coca Cola Kwanza Limited will pay between US$30 and $280 per hectare per year to the farmers, depending on project type, rewarding them for improving their land use practices and ensuring a cleaner water supply[13].

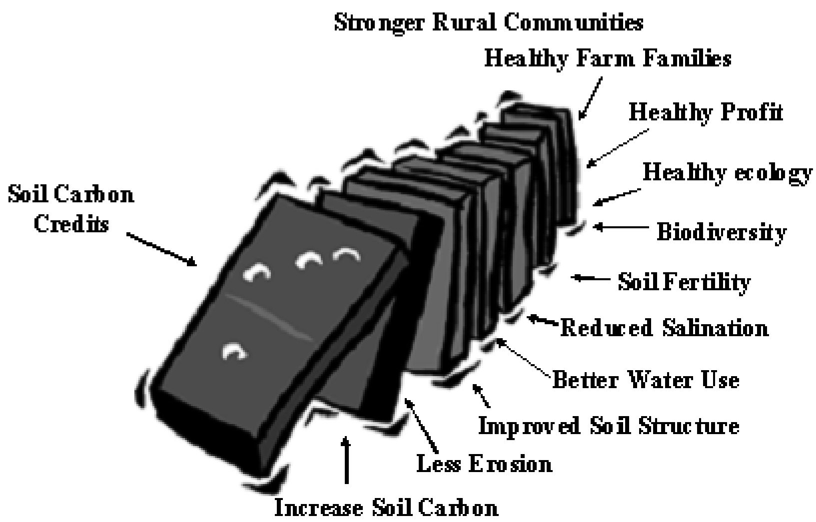
[12] http://www.fao.org/ES/esa/pesal/index.html
[13] Branca G, Lipper L, Neves B, Lopa L Mwanyoka I, "New Tools for Old Problems: Can Payments for Watershed Services Support Sustainable Agricultural Development in Africa?", FAO, 2009, ftp://ftp.fao.org/docrep/fao/012/ak597e/ak597e00.pdf

Carbon in soil consolidates the resilience of cropping systems against both excess of water and lack of water, as well as biodiversity increases resilience to changing environmental conditions and stresses. Therefore it strengthens the capacity to face climate shocks (climate adaptation).

Conservation agriculture and organic agriculture that combine zero or low tillage and permanent soil cover allow increasing soil organic carbon while reducing mineral fertilizers use and on-farm energy costs.

So to some extent, as illustrated below, an agriculture improved carbon balance which derives from improved soil carbon content ensures widely cumulative benefits at producers' level, at community level. Therefore it could be considered as a quite relevant indicator of natural capital building, of adaptation resilience in addition of being of critical interest for Climate mitigation.

Figure 2: The widely cumulative benefits of soil carbon



Source: Australian farmers carbon group

5.2. Assessing soil organic carbon (SOC) changes in agricultural systems

Although both organic and inorganic forms of C are found in soils, land use and management typically has a larger impact on organic C stocks. Consequently, the methods usually provided focus mostly on soil organic C. The influence of land use and management on soil organic C is dramatically different in according to the soil type. Using soil classification and mapping allows for the development of SOC change assessment for the different land use categories. Various models were developed to estimate the soil organic carbon change in time and the relation with nitrogen or water cycle allows for crop yield predictions. Soil organic carbon is one of the main indicators of soil fertility and assessment of soil carbon sequestration allows for the identification of win-win agricultural policies. It is possible to estimate the current soil organic carbon at different points in time and under different land uses in order to assess the carbon sequestration and livelihood benefits. Soil organic carbon can be used as an indicator to identify the soil fertility, suitability for agricultural activities, soil degradation and guide agricultural policies and mitigate climate change. We therefore have the opportunity in the future to adopt land use and land management strategies that lead to greater C storage in the soil, thereby mitigating GHG effects and improving soil fertility. Maximising this opportunity will require the formulation of policies at the national and sub national levels.

Several projects were developed to report the soil organic carbon balance at national scale in developing and developed countries. In developing countries, the Global Environment Facility Soil Organic Carbon (GEFSOC) projects supported the countries in improving national assessment methodologies relating to the UNFCCC for carbon emissions and sinks and analyse the impact of a range of land management scenarios for sustainability and conservation of biodiversity vis à vis carbon sequestration, soil fertility and soil quality assessment. The AFRICA –NUANCES project developed models and tools to to describe and explain current practices and to explore scenarios for future sustainable development of the farming systems.

Using SOC as an indicator of soil fertility it is possible to investigate the win–win options to address poverty alleviation, food security and sustainable management of natural resources by enhancing land productivity through diversification of agricultural systems, soil fertility management and carbon sequestration in rural areas, thereby creating synergies among the Convention to Combat Desertification (UNCCD), the Convention on Climate Change (CCC) and the Convention on Biodiversity (CBD).

SOC is the result of farming management and could be used as an indicator to support agricultural development, the sustainable use of natural resources and enhanced food security. It can be integrated into the **Monitoring African Food and Agricultural Policies (MAFAP)**[14] project and assist African policy-makers and other stakeholders. The MAFAP project is a joint FAO/OECD initiative to support decision-making in the agricultural sector in Africa, by developing a system for monitoring food and agricultural policies. Quantification of SOC and the SOC sequestration potential can facilitate the recognition of agricultural services as a mitigation option to climate change and the link with carbon markets

5.3. Carbon balance as agri-environmental indicator in agriculture policy analysis

While varying GHG emissions under different policy scenarios have been modelled for all OECD countries in a number of studies, only a few have done so within the context of examining the impact of agri-environmental policies on GHG emissions. Policy makers face a number of knowledge gaps, in particular: incomplete scientific knowledge and data on the effects and timing of policies and agricultural practices on the environment; partial knowledge of the impact of the environment on agriculture. Given the evidence of the growing

[14] See MAFAP website: *http://www.fao.org/mafap/en/*

importance of agri-environmental policies across OECD countries, there is value in developing robust agri-environmental indicators and modelling efforts to improve policy decision making (OECD using agro-environmental indicators in policy analysis).

Canada uses an integrated modelling capacity linking its Canadian Regional Agricultural Model (CRAM), an economic model used for policy analysis, to science based agri-environmental indicators in order to understand how changes to agricultural policies and programmes affect the sector's economic and environmental outcomes, and evaluate future plans. This multidisciplinary approach has recently been directed towards the assessment of possible GHG mitigation strategies for agriculture[15] and to support the selection of quantitative provincial environmental outcome targets under the Agricultural Policy Framework (APF). The APF analysis assessed the impacts of adopting a suite of beneficial management practices for agricultural production on a number of environmental indicators including GHG emissions, soil erosion from wind and water, residual nitrogen and the risk of water contamination from nitrogen, change in soil organic carbon, and wildlife habitat[16] . MacGregor *et al.* (2001), outlined the data needs to support this integrated economic and environmental modelling system which is being used for policy assessment and development.

The climate mitigation dimension of a public policy could be first evaluated through the incremental carbon balance fixed and through the cost generated by ton of equivalent CO_2 fixed or emission-reduced. This cost can then be compared to a carbon cost reference. However the scaling up of economic strategies and investments to mitigate climate change will need appropriate analysis of the economic and social impact and particularly of income redistributive effects. These will depend upon use modalities of added carbon value generated.

5.4. Carbon balance tools and methods

In the agriculture and food-chain sector, a set of carbon-foot-printing methodologies and decision support tools are being developed since 2008. It links with the willingness of institutions[17] to be prepared to implement carbon marketing and carbon funding facilities. Among the tools identified, there are the following:

- **Holos Software[18] is** a whole-farm modelling software program to help Canadian farmers estimate their greenhouse gas (GHG) emissions. It was developed by Agriculture Department in Canada since 2001. It could be soon transferred to Norwegian agriculture
- The C**arb**O**n** M**anagement** E**valuation** T**ool -** V**oluntary** R**eporting[19] (COMET-VR**) is an online management tool that provides a simple and reliable method for estimating changes in soil carbon sequestration, fuel, and fertilizer use resulting from changes in land

[15] Junkins, 2005.
[16] Heigh et al., 2005.
[17] For instance USDA ensures to be prepared to implement carbon soil marketing when the congress decision will be made.
[18] *http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1226606460726&lang=eng*
[19] *http://www.cometvr.colostate.edu/faq/*

management. COMET-VR calculates in real time the annual carbon flux using a dynamic Century model simulation. This tool is limited to US situations.

- The **Dairy Greenhouse Gas Model**[20] **(DairyGHG)** is a software tool for estimating the greenhouse gas emissions and carbon footprint of dairy production systems. DairyGHG uses process-based relationships and emission factors to predict the primary GHG emissions from the production system. Emissions are predicted through a daily simulation of feed use and manure handling. Daily emission values of each gas are summed to obtain annual values.
- **DNDC** [21](i.e., DeNitrification –DeComposition) is a computer simulation model of carbon and nitrogen biogeochemistry in agro-ecosystems. The model can be used for predicting crop growth, soil temperature and moisture regimes, soil carbon dynamics, nitrogen leaching, and emissions of trace gases including nitrous oxide (N_2O), nitric oxide (NO), dinitrogen (N_2), ammonia (NH_3), methane (CH_4) and carbon dioxide (CO_2).

EX-ACT[22] (EX-Ante Carbon-balance Tool) is a FAO tool which provides ex-ante measurements of the mitigation impact of agriculture and forestry development projects, estimating net carbon (C) balance from GHG emissions and C sequestration. It is a land-based accounting system, measuring C stocks, stock changes per unit of land, and CH4 and N2O emissions expressed in t CO_2-eq per hectare and year[23]. The main output of the tool is an estimation of the C-balance associated with the adoption of improved land management options, as compared with a “business as usual” scenario. Thus, EX-ACT allows for the carbon–balance appraisal of new investment programmes by ensuring an appropriate method available for donors and planning officers, project designers, and decision makers within agriculture and forestry sectors in developing countries.

Such tools and facilities should drive to an extended use of carbon balance as an operational criteria to benchmark and compare sector projects, strategies and policies.

5.5. Carbon Balance and project analysis, monitoring and funding

Currently the design and formulation of projects and programmes is an opportunity for technical experts within the government, donors and international organisations. They are the ones to negotiate the introduction of innovative ways of working and promoting technology transfers. Country policy reviews will later be influenced by country success stories from projects, public pilot actions or from NGO initiatives. In other words, what appears successful at the project or programme level could later be scaled up to the policy level[24] (let the risks be taken by the projects, as we can capitalise on their success or learn from their failure).

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[20] *http://www.ars.usda.gov/Main/docs.htm?docid=17354*
[21] *http://www.dndc.sr.unh.edu/Pubs.html*
[22] *EX-ACT Brochure*:
[23] EX-ACT has been developed using primarily the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, complemented by other existing methodologies and reviews of default coefficients. Default values for mitigation options in the agriculture sector are mostly from the 4th Assessment Report of IPCC (2007).
[24] Bockel L, Barry S, Climate Change and Agriculture Policies. How to Mainstream Climate Change Adaptation and Mitigation into Agriculture Policies?, Policy Guidelines, FAO, 2011.

Within the cycle of donor-funded projects and programmes including identification, formulation, analysis and monitoring, it is very usual to proceed with financial and economic project analysis and to integrate a more qualitative project evaluation. However in line with the need to integrate climate change issues within public decision making, climate mitigation and adaptation issues are given more importance by most partners. Furthermore the increasing concern on climate mitigation drives to multiply funding facilities. Therefore insertion of carbon balance appraisal in agriculture project formulation could facilitate climate mitigation funds mobilisation.

Such carbon balance appraisal could become a key factor in the preparation of "Agriculture's entry into the carbon market, which is an essential and economically viable way to reduce existing concentrations of GHG and help stabilize the changing climate[25]".

It also links within the perspective to better monitor and quantify the potential of agriculture sector in climate mitigation and for measuring possible impact of agriculture and food security programmes and projects on mitigation. That is why FAO has developed carbon balance methods.

Mitigation financing for agriculture is one potentially significant source which can play two important roles: providing increased investment flows to the agricultural sector of developing countries, and/or providing increased incomes to farmers in the form of C payments.

This will require a systematic use of both carbon balance appraisal and monitoring to identify before investing or before project, what mitigation impact can be expected.

Mitigation finance could be either public or market-based and integrated with existing official development assistance (ODA). Rural development projects involving the implementation of sustainable land management practices could therefore obtain funds from C finance related to mitigation benefits. In this perspective environment analysis within project formulation needs to switch from qualitative to quantitative appraisal with a focus on the effective carbon-fixing and GHG reduction capacity of the future project.

6. DOES CARBON BALANCE APPRAISAL FIT WITH DONOR EXPECTATIONS AND APPROACHES IN DEVELOPING COUNTRIES?

6.1. GTZ experience of climate proofing

GTZ has initiated an approach[26] for all new projects, that requires that an assessment be implemented for climate risk and its impact on climate (mitigation).

GTZ climate check objective are (i) the Climate Proofing through systematic climate risk reduction & increase of adaptive capacity, (ii) the Emission Saving, through systematic

[25] Sustainable Food Laboratory, available at www.sustainablefoodlab.org/filemanager/download/14489/
[26] Petersen L, GTZ, 2009 integrating climate change into development cooperation, www.gtz.de/climate

maximisation of contributions to GHG reductions and (iii) broad awareness rising on climate challenges.

Thus, project activities that offer multiple benefits (satisfying the development needs of developing countries at the same time as addressing climate change) give countries the incentive to take greater initiative and to more proactively tackle climate change. At the same time, for developed countries that provide support to developing countries, these are also worthwhile approaches that have the potential to broaden and promote the effectiveness of the assistance they provide for sustainable development.

6.2. **Link with REDD Initiative**

Reducing Emissions from Deforestation and Forest Degradation (REDD) is a set of steps designed to use market/financial incentives in order to reduce the emissions of GHG from deforestation and forest degradation. Its original objective is to reduce green house gases but it can deliver "co-benefits" such as biodiversity conservation and poverty alleviation. REDD credits offer the opportunity to utilize funding from developed countries to reduce deforestation in developing countries.

A REDD-plus mechanism should provide scope for a wide range of measures that reduce emissions from deforestation and forest degradation, stabilize and safeguard existing forest carbon stocks through conservation and the sustainable management of forests, and expand forest carbon sinks through the enhancement of carbon stocks. Having a tool which allows to appraise a wider scope of combined actions which target both agriculture, forestry, watershed or landscape management, will facilitate the formulation and carbon balance appraisal of wider land use approaches ensuring a continuum between forests, woodlands, rangelands and crop land, as far as people are concerned.

6.3. **World Bank position and priorities[27] on agriculture mitigation**

The World Bank is committed to scaling up investment in agriculture and rural development, as part of the sustainable development and agenda. Its agricultural action plan includes five closely inter-related pillars:

i. enhanced agricultural productivity,
ii. reducing risk and vulnerability,
iii. linking farmers to markets and strengthening value chains,
iv. facilitating agricultural entry and exit and increasing rural non-farm income, and
v. enhancing environmental services and sustainable land, water and forest management.

[27] *http://siteresources.worldbank.org/INTARD/Resources/WB_ARD_ClimateChange_v3.pdf*

Carbon footprint management is closely related to the first, second and fifth of these pillars, and WB work emphasises the triple benefit from improved landscape management to climate resilience, to climate mitigation and to longer term productivity increases.

Climate resilience and forestry and agricultural land use practices which store or emit less carbon need to be part of core development programmes. But a priority for the WB is to help developing countries take advantage of the range of new climate funds which are becoming available, to help the poorer countries with resilience and adaptation, and to help all countries with lower carbon development paths.

For agriculture and forestry these include the new pilot Climate Investment Funds. Specifically the Pilot Programme for Climate resilience (US$ 660 m) is piloting climate resilience in key sectors; agriculture, forestry and water management are priority sectors in most of the nine pilot countries. And the Forest investment programme (US$ 350 m) is addressing deforestation, forest degradation and improved forest and woodland management in five pilot countries.

The WB also supports the inclusion of agricultural soil carbon in future carbon markets, both because of the benefits this brings to developing countries, and because the goal of climate stabilization cannot be achieved without this. Within this framework, WB supports piloting and development of a mix of market and non-market mechanisms to encourage agricultural carbon sequestration and reduce carbon emissions, such as:

1. Payments for ecosystem services that can be accessed by communities for actions that enhance agricultural biomass and soil carbon, above- and below-ground biodiversity, and hydrological (environmental) flows.
2. Public support for agroecological and hydrological modelling, alongside land-use planning approaches to optimize synergies and tradeoffs of land-and-water management options for improved productivity and agricultural carbon sequestration from local to sub-national and even national scales.
3. Voluntary funds from developed countries, philanthropic organizations, and the private sector to encourage desirable land-and-water management approaches that protect and enhance agricultural carbon sequestration.
4. Piloting of a range of approaches to estimate the carbon footprint of its operations. These include (a) a simple list of activities which contribute to mitigation or adaptation; (b) testing and rolling out more robust estimation tools such as the ex-ante carbon measurement tool, and project-based tools already in use by the IFC adapted from the Agence Francaise de Developpement approach; and (c) project-based carbon measurements for access to the voluntary carbon market, (d) sharing knowledge between and within countries. (Partnerships with other organizations are key in this respect, since they are often well suited to this function).

These measures will require substantial investment support. They will also require enhancing the capacity of national institutions and professionals to ensure their effective participation in:

- Creating and managing national agricultural carbon inventories and the monitoring and verification of project and national-level outcomes.

- Developing appropriate national mechanisms and overseeing the distribution of agricultural carbon payments to the rural communities engaged in protecting and sequestering agricultural carbon.

6.4. Advantage / disadvantage of carbon balance analysis

This analysis drives to develop multi objective approaches where mitigation could be either a main objective or a co-benefit. The co-benefits approach to climate change countermeasures involves initiatives that make it possible to fulfill the needs of a developing country at the same time as implementing climate change countermeasures and CDM projects. Socioeconomic development and environmental problems are key issues—at both national and local levels—for many developing countries.

Thus, by implementing projects in the form of climate change countermeasures designed to address these issues, it is possible to promote sustainable development in those countries at the same time as promoting proactive and highly effective initiatives to address climate change.

Sectoral approaches have been put forward as a way to broaden participation of developing countries in emission reduction. They could lower overall mitigation costs, facilitate international technology transfers, and are likely to require less institutional capacity than nation-wide targets[28] .

The main disadvantages and limits of Carbon balance appraisal are mostly the high transaction costs required to sensibilize the national planners and technical partners in order to mainstream the method and the uninsured permanence of some carbon fixing in soils.

7. Lessons from ex-ante appraisal experiences with EX-ACT

The EX-ACT challenge was to provide a tool that is as simple as possible, as well as cost effective, but at the same time capable of covering the wide range of projects relevant for the AFOLU sector. To be recognized at the international level this tool must be compliant with international standards and best recognized practices. Moreover the tool should be readily understandable and usable by project developers. Finally, the tool must be upgradable over time, enabling the possibility of incorporating new information and policies, for instance, new approaches for REDD accounting that are currently being debated. Such requirements are preconditions to ensure quick scaling up towards the application of C–balance appraisal on new investment programmes.

EX-ACT has been tested on several projects ranging from intensive crop and livestock production to sustainable agriculture, reforestation and rural development including (i) the “Accelerated Food Security Project” in Tanzania, (ii) the “Rio Rural Project” in Brazil, (iii), the Eritrea National Agriculture Programme IFAD, (iv) the Irrigation and Watershed project (WorldBank funded) in Madagascar and (v) the Grassland Restoration project in Qinghai

[28] OECD, 2009.

Province, China (ICRAF). The experiences developed within pre-testing phase have allowed for a completion revision of the the Ex-ACT software. They also permitted to work out following lessons.

Firstly, carbon balance computing is only the first step of a process which drives users through a critical path of options to: review the project proposal; consider carbon as an externality or switching towards a co-benefit approach; complete the project funding with carbon funds; and integrate payment of environment services for project beneficiaries.

Secondly, the utility of the carbon balance compared to technical options tested in Tanzania and Brazil, confirms its high relevance to propose improved project options, to elaborate or upgrade specific climate mitigation project components (watershed component in Madagascar). Within such an exercise, the EX-ACT tool ensures easy option building simulation work.

Thirdly, it is necessary to distinguish between projects for which carbon balance is just an externality and projects for which it is among initial targets. In this perspective, we distinguish three types of project:

- Type 1: Agriculture development projects
- Type 2: Multi-objective agricultural projects
- Type 3: Agriculture mitigation projects

Case studies	Country	Project type	Geographic area	Test
Accelerated Food Security Project	Tanzania	Type 1	Africa	Desk
National Agricultural Program	Eritrea	Type 2	Africa	Field
Irrigation and Watershed Management	Madagascar	Type 1	Africa	Desk
The Santa Catarina Rural project	Brazil	Type 1	Latin America	Field
The Rio Rural project	Brazil	Type 1	Latin America	Field
Grassland Restoration and Conservation	China	Type 3	Asia	Field

Main goal of **Type 1** projects (*Agriculture development projects*) is the enhancement of food security through agricultural productivity increase and improvement of the net returns to agricultural production. These projects are formulated without specific mitigation targets as their main objective is to support agriculture development. In this project framework any positive impact on climate change mitigation is to be considered as a positive externality[29].

[29] An externality is a cost or benefit resulting from an economic transaction that is borne or received by parties not directly involved in the transaction. An externality occurs when the consumption or production of a good

Box 1: An example from the "Accelerated Food Security Project" in Tanzania

The case of the FAO/World Bank "Accelerated Food Security Project" (ASFP) in Tanzania represents an interesting example of the potential use of Ex-Act in estimating the impact of agricultural development projects on GHG emissions and C sequestration. The ASFP seeks to increase maize and rice production and productivity in targeted areas mainly by improving farmer's access to critical agricultural inputs like fertilizers and improved seeds.

Maize and rice production accounts respectively to 25 and 14% of agricultural GDP. Thus, improvements in food crop productivity will greatly contribute to the overall economic growth and poverty reduction in Tanzania. Current productivity of maize and rice farmers in Tanzania is very low (e.g. in 2007/08 average maize yield was only 1.3 t ha^{-1}, much lower than in most neighbouring countries). The limited use of improved seeds and fertilizers has been the major reason of these low yields. In 2005/06, for example, the rate of fertilizer application in the country was reported at 8 kg ha–1 N while the depletion of soil nutrients was found to be about 61 kg ha^{-1} N (IFPRI, 2008). The use of improved seeds is also extremely low (only 24% of farmers, ranging from 15% in the South to 45% in the North), and the seeds planted are mainly self-produced and recycled (IFPRI, 2008).

Farmers participating in the project obtain, for an average of 0.5 hectare of maize/rice cropped area, an input package through the National Agricultural Input Voucher Scheme (NAIVS), consisting of one voucher for Nitrogen fertilizer (1 bag of Urea), one voucher for Phosphorus fertilizer (1 bag of diammonium phosphate – DAP – which is the most commonly used basal fertilizer in Tanzania) and one seed voucher (10 kg of open-pollinated varieties or hybrid maize and rice seeds). Participating farmers are also requested to abandon the practice of burning crop residues.

At full implementation, the project is expected to benefit 2.5 million smallholders in several districts of Tanzania. The aim of NAIVS is to intensify food production in areas with high agro-ecological potential for producing staple crops in the southern and northern highlands as well as western regions:

Results show that annual crops with project compared to without project result in a net sink of 11.25 Mt CO_2-eq, although expanded fertilizer use and changes in rice management are net sources of respectively 4.4 Mt CO_2-eq and 2.6 Mt CO_2-eq. The adoption of improved land and integrated nutrient management practices will contribute to soil C sequestration so that the net project effect will be the creation of a C sink, with positive effects in terms of mitigation. In maize, avoiding burning is the most significant practice applied in terms of emissions reduction impact, which contributes to 65% of the mitigation potential.

The overall C balance of the ASFP of Tanzania is computed as a difference between C sinks and sources and it has been estimated at 5.6 Mt CO_2-eq over 20 years, corresponding to 280,000 t yr–1 of CO_2-eq Given the area of 1.06 Mha, this corresponds to a sequestration rate of 0.26 t ha–1 yr–1 of CO_2-eq. As expected, the most significant source of potential mitigation comes from the implementation of improved cropland management in maize production.

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impacts on people other than the producers or consumers that are participating in the market for that good. Externalities can be either negative (e.g. water pollution caused by industrial production) or positive (e.g. the role of agriculture in maintaining the countryside and rural communities).

Type 2 projects (*Multi-objective agricultural projects*) are designed with explicit multiple objectives, as in the case of many integrated rural development projects. For the purposes of this note, we take the case of a project with agricultural development and mitigation joint objectives, looking for agricultural productivity increase and promoting agricultural practices which increase productivity but also contribute to increase soil organic C (mitigation). In this case, mitigation should be considered as a co-benefit. In the future, with mitigation becoming part of public sector global development objectives, it is plausible that the importance of these agriculture multipurpose projects will increase.

Type 3 projects (*Agriculture mitigation projects*) are those where agricultural mitigation is the primary objective and C credits are their desired output. This is the case, for example, of projects aimed at producing C credits from agriculture in developed countries to be sold on the (voluntary or mandatory) C markets.

EX-ACT could also be used to drive project formulation in order to increase the mitigation impact of project components: this may be relevant for types 2 and 3 projects, or for type 1 projects which could potentially move to type 2 because of their significant mitigation potential. The tool can in fact easily be adopted in the phase of project formulation and design, for example simulating different scenarios by modifying existing components or adding new components with higher mitigation impact and estimating the corresponding mitigation impact[30].

Specifically Type 1 projects are expected to have lower mitigation benefits per ha. However there is no or insignificant MRV costs since no carbon financing is mobilised. Cost of public implementation dedicated to mitigation is marginal since the project is mostly targeted to agriculture development. ODA public funds remain the main financing source for this category of projects.

Type 2 projects may have higher mitigation potential than type 1 ones. Part of the project budget is clearly allocated to pursuing low-C agricultural and forestry. In such projects MRV facilities are to be considered. In this case, public funding may be a possible financing source which could integrate ODA funds.

For type 3 projects, mitigation benefits (value of C sequestered) need to be greater than the costs of adopting and meeting C crediting MRV requirements. C crediting mechanisms are a suitable source of financing for this category of projects.

However within carbon funding, there is a quick evolution of funding modalities and future perspectives drive towards a mix of markets and multifunding.

It is important to notice that both mitigation potential of project activities, transaction costs of contracting and verification are key-elements to determine the potential source of financing,

30 It is worth specifying that the data needed to run EX-ACT are basic data usually collected during project appraisal (e.g. land use and management, cropping patterns, input use, livestock breeding, investments) and that results can be obtained in a relatively short amount of time.

and that these costs vary depending on the socio-institutional context where the project is developed.

For example, payments for carbon sequestration from sustainable rangelands management practices (e.g. reducing or avoiding land degradation, rehabilitating degraded lands and increasing native carbon stocks by increasing above ground and below ground biomass) in West Africa may need to be based on public funding because of the relatively lower amount of carbon that can be sequestered per hectare - which is true of most dry lands. On the other hand, the adoption of grassland restoration and conservation practices foreseen by an FAO-ICRAF mitigation project in China is expected to result in high sequestration rates per hectare and to generate a sufficient amount of credits to make the project financially viable. Therefore the project will be entirely funded by carbon finance from offsets. This would also be possible thanks to the suitable institutional environment.

8. CONCLUSIONS

Going towards sustained internalization of agriculture mitigation practices in farming systems in all agro-ecological zones will require a wide effort of communication of technology transfer and a wide set of incentive policies.

In term of policy planning, to accelerate the integration of climate mitigation and adaptation in agriculture, food security policies, and programmes through expanded country mobilisation and appropriate country support will require extensive policy support and capacity building in planning and policy units of Agriculture and rural development ministries of developing and intermediary countries.

It will also require strengthening inter-ministry capacity to coordinate and pilot agriculture and rural sector mitigation actions within a multi-objective framework in line with watershed management, disaster management, climate mitigation and food security policies.

Mitigation policy and programme implementation will also require to :

- strengthen capacities of public services and institutions to control and protect forest and rural areas from slash and burn and pasture and to promote sustainable watershed management;
- strengthen local community and municipality capacity to improve local behaviours (local funding, training, legislation);

Carbon balance tools and GHG calculator updating and promotion will also be a top priority mobilizing research and operational partners. It would make sence to promote and encourage public and private partner initiatives towards the progressive integration of carbon balance management and monitoring at value chain and at farm level[31] .

[31] USDA, Unilever, Universities. 2010

In terms of agriculture practices, it will be a key issue to update and improve the access to appropriate technical packages that improve carbon fixing and reduce GHG emissions (land use, zero-ploughing, reduced tillage, residue management, cropping systems, irrigation management, agroforestry, grassland renovation...) through web, networking with other technology transfer channels (training institutes, extension services, universities).

9. READERS' NOTES

This module belongs to a set of EASYPol modules and other related documents:

- ***EX-ante Carbon-Balance Tool : Software***
- ***EX-ante Carbon-Balance Tool : Technical Guidelines***
- ***EX-ante Carbon-Balance Tool : Brochure***

See all EX-ACT resources in EASYPol under the Resource package, Investment Planning for Rural Development - EX-Ante Carbon-Balance Appraisal of Investment Projects

Related policy briefs

- ***Climate Change Financing: What are the Challenges and the Opportunities for Financing Agriculture in Africa?*** EASYPol Module 100
- ***Climate Change and Agriculture Policies. How Far Should We Look for Synergy Building Between Agriculture Development and Climate Mitigation?*** EASYPol Module 098

10. FURTHER READINGS

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