Report of the Joint FAO-CCAFS-CGIAR-workshop:

Towards a Framework for Smallholder Agricultural Mitigation:
Terrestrial Carbon and other GHG Measurement and Simulation Models

FAO Headquarters, Rome, July 13th 2010

I: Background

On July 13th 2010, a workshop was held at FAO headquarters in Rome, hosted by FAO and CCAFS, with the following stated purpose:

To identify how to measure carbon and validate carbon simulation models to assist the development of a framework for smallholder-based agricultural mitigation

- Create a shared understanding of respective programme objectives
- Discuss the state-of-the-art of knowledge and issues related to carbon measurement, modelling and tools.
- Work towards a harmonized approach for smallholder agricultural mitigation projects (SAMPs).
- Take steps towards collaboration among smallholder agricultural mitigation projects (e.g. selection of complementary/shared sites)

This report is a summary of the topics discussed.

II: Welcome, introduction & logistics

Constance Neely (Facilitator), Marja-Liisa Tapio-Biström (MICCA) and Lini Wollenberg (CCAFS) welcomed the participants.

As an introduction to the workshop, the participants were asked: "***Based on your experience, what would be the most important results of agricultural mitigation projects***?"

The answers can be divided into three categories:

Contributions to science:

- Give proof of concept on the synergies between mitigation, adaptation, food security, sustainable soil management and others.
- Improve understanding of soil carbon time averaged carbon stocks in different systems, and/or leakage dynamics
- More data for MRV methods and models

Contributions for smallholders:

- Getting smallholders involved in mitigation activities and the provision of other environmental services, and identify ways to acknowledge and compensate them for their contributions

- Increase yields, including improvement of long-term soil fertility and increasing water and fertiliser efficiencies

Utilisation of carbon markets:

- Pave the way for large scale transfer of carbon funds to agriculture
- Build models for fair transfer of benefits to the smallholder

III: Towards a framework for smallholder-based agricultural mitigation

Three projects were presented: MICCA (FAO), Carbon Benefit Project (ICRAF) and the Western Kenya Smallholder Agriculture Carbon Finance Project (SSC Vi-Agroforestry Programme).

Marja-Liisa Tapio-Biström, project coordinator, presented the MICCA project:

- 5 year project, started in Feb 2010.
- Main activities include:
  - Set up of pilot projects across different agricultural systems and climate zones to produce new knowledge on smallholder agricultural mitigation
  - Improve the knowledge base on the emissions and mitigation potential of agriculture through integrating monitoring and assessment of greenhouse gas (GHG) emissions into FAOSTAT.
  - Development of a GHG emissions database and life cycle analysis (LCA) of agricultural commodities
  - Development of database on GHG mitigation potentials and costs
  - Global economic analysis of mitigation policy options
  - Supporting the UNFCCC negotiation process with relevant technical information
- The focus of the project is to support smallholders and integrate them into agricultural mitigation activities, including the assessment of alternative ways for the remuneration of their contributions, apart from the existing carbon markets.
- The aim is to find pragmatic and in-practice solutions for agricultural mitigation.

Henry Neufeldt, Climate Change Research Leader (ICRAF), presented the Carbon Benefits project

- Project started 1 year ago
- Main problem: Accurate measurements of carbon stock in land use sector are very costly, especially in complex tropical settings of many smallholders.
- Proposed solution: Construct an up-scaling method, preferably global, which can replace soil measurements.
- Criteria for this method:
  - Could contain a decision tree, to adjust method for any context
  - Should be applicable to carbon markets
  - Should be possible to use ex-ante
  - Should include both above and below ground carbon
- Method used: Remote sensing from satellites and aircraft.
- Needs to work with existing projects to verify methodology.
- Working on a toolbox to address socio-economic issues in the projects.
- Problem still to be addressed; are there feed-backs of CO_2 or CH_4 that change net emissions?

Amos Wekesa, presented the Vi-Agroforestry sustainable agricultural land management project

- Smallholder agricultural carbon sequestration project in Western Kenya.
- VCS project.

- No carbon measurements are carried out. The project uses carbon stock modelling, and monitors only farmer activity.
- VCS methodology is pending, ERPA being drafted.
- Only 40% of the modelled carbon sequestration is eligible for crediting. 60% is withheld as buffer.
- Carbon price is $4/tCO$_2$e, and expected carbon revenue is approx $2 mill.
- Co-funding with Swedish aid authority to fill the gap, between carbon price and required revenue.
- The carbon revenue just covers investment costs. The benefits to the farmers come through co-benefits, e.g. increase in yields and support system set up for the project.

The discussion revolved mainly around the topic of accuracy of models and measurements. High accuracy measurements are expensive, and there are also issues with permanence/leakage. One solution could be to let the buyer/funder decide how accurate the method/model needs to be? Another could be to simplify, by disregarding soil carbon all together and focussing on above ground carbon?

IV: Presentation of MICCA protocol

Constance Neely (FAO) presented briefly the draft MICCA protocol (attached to report) which has been developed for Agricultural Mitigation Projects and laid out the structure, which includes site identification and review, pilot initiation and implementation. The sections on data requirements and methodologies would benefit from the insights and contributions of the workshop participants.

V: Project introductions by institutions

Christina Seeberg-Elverfeldt (FAO) presented the selection criteria which were used for a pre-selection of 9 pilot projects (see Annex 2, projects 1-9). This list is not final, as more information on the nine projects is being solicited, as well as scoping of further possibilities is still taking place. The pilot projects will be developed in conjunction with existing projects, e.g. with a rural development focus and aim to introduce mitigation activities for smallholders. The following criteria were used:

- Country
- Location
- Ecological/Climatic zone
- Farming system
- Scale
- No of farmers
- Time frame (stage of project)
- Carbon entry point
- Lead organization

Subsequently all participants were invited to briefly present their projects and to map them out on a world map. This allowed everyone to obtain a good overview of what is done where, which ecological zones and farm systems are covered, and at which scale different projects operate. For a complete list of all 30 projects see Annex 2.

VI: Carbon measurement methods, technologies, tools and issues

This discussion focused on the criteria methodologies and models for carbon stocks should be evaluated on. The following list is the result of that discussion.

Methods	Models
Cost/Accuracy	Validity
Human resources	Sensitivity
Capacity needs	Data needs
Scalability	Ease of use
Application across agro-systems	Trust (i.e. from credit buyer)
Stage of development	
Time of measurement	
Depth/interval of measurements	
Laboratory requirements	
Target users (for whom?)	

The discussion was followed by five presentations on state-of-the-art measurement and modelling approaches to GHG emission and carbon stock assessment.

Reiner Wassmann (IRRI) presented chamber-based systems, both manual and automated, for monitoring soil emissions of CH_4 and NO_2 in rice production. Up to this point, chamber systems represent the state-of-the-art approach for recording CH_4 and NO_2 fluxes in spite of inherent complications in extrapolating point measurements to larger scales due to pronounced regional, seasonal and diurnal fluctuation. The strength of the method is in comparing different management practices.

Main points of the following discussion included whether temperature changes from the closed chamber skewed the results, whether the automated system was too expensive (approx $50,000 per unit, excluding analytical device) with a note to the former discussion on the relation between price and consumer/credit buyer.

Wilson Tadeu Lopes da Silva (EMBRAPA) presented two spetroscopical Soil Organic Matter (SOM) analysis systems.
Laser-Induced Fluorescence (LIF) is used to assert humification of the organic matter in a soil sample.
Laser-Induced Breakdown (LIBS) is used to perform elemental analysis in natural samples.
Both systems are portable, and can be used in the field. Price for the equipment is approximately $30,000 for LIF and $50,000 for LIBS, and approximately $0.50 per sample excluding sample preparation.

The main point of the discussion was whether these systems take bulk density of the soil into account, and they do not.

Alonso Gonzales (CIAT) presented an alternative approach to slash and burn farming called Quesungual Slash and Mulch Agroforestry System (QSMAS). It works by pruning natural vegetation and utilising the gathered biomass combined with crop residues, to improve soil cover thereby minimising tillage and improving fertiliser efficiency. Thus it increases yields by 38-82%, reduces N_2O emissions and increases carbon sequestration.
A comparative life cycle study of bio-ethanol fuel production, from three different banana production systems was presented. It showed very clearly that the carbon balance was much better for organic and especially for bananas produced in an agroforestry system, compared to conventionally produced bananas. The carbon balance was mostly improved by reduced emissions from decreased fertiliser and pesticides use.
The system has mostly been tested in drought prone areas, and so far has not analysed carbon sink effects from the increased biomass.

The discussion about open and closed systems for N_2O measurements was revisited. Furthermore the question was raised, whether the intensification of using more fertiliser, could result in a per production unit reduction in emissions.

Timm Tennigkeit (Unique Forestry) presented the model used in the Vi-Agroforestry project presented earlier.
The model is based on the RothC model, and thus requires no direct measurements of carbon stocks. Instead it monitors farmer activities and utilises carbon emission factors for the activity compared with emission factors for the baseline activity.
Modelling is significantly less cost intensive than direct measurements, and in this specific case direct measurements would mean that no carbon revenue was left over to implement the project once the measurement and reporting costs were paid.

The main points of the following discussion were: A note of caution about using models developed for very different circumstances (RothC is developed for UK agriculture). It was also noted that there are many different versions of both RothC and Century around, making it difficult to get comparable results. It was questioned whether the model accounted for changes in fertiliser use related to crop prices. The presenter explained that that was not included in the specific case, but could be added on as a module to the model.

Henry Neufeldt (ICRAF) presented the remote sensing approach, utilised in the Carbon Benefits project. There are many different remote sensing options including infra red and x-ray spectroscopy, satellite imaging and high-res aerial photos. ICRAF is currently working on a complete soil map of Africa, with the aim to scale up from small-scale to landscape level. The price is approximately $30,000 per 1,000 ha.
Developing allometric equations for above ground biomass is very cost intensive and requires a lot of testing. If, however, it can be coupled with remote sensing it can make financial sense. Without that coupling, it will not be viable.
The presenter referred questions the participants could have on the methodologies to Keith Shepherd, as he was more knowledgeable of the specifics.

When asked, the presenter stated that the method was suitable for performance based remuneration but not for national accounting as that, in his opinion, needed a nested approach. He was unsure whether there were any new developments concerning time-averaged carbon stocks.
The final note of the discussion regarded denser forest areas, where the individual trees cannot be singled out and measured. The presenter acknowledged that some of the mentioned methods could not be used in such cases, but stated that e.g. x-ray to identify deforestation and degradation in closed canopies is a possible options. LIDAR is also an interesting option, but still too expensive, as it is plane bound and cannot cover large areas.

VII: Discussion on harmonised methodological and modelling approach for carbon measurements

Several issues were mentioned during the discussion, the main points of arguments are summarised below.

In a ***carbon market context*** the questions stand, whether modelling will be accepted by the buyers, and whether measurements can be done at a reasonable cost, compared to the carbon revenue. One proposed solution for this problem was the possibility of a differentiated carbon market, where credits with higher accuracy would gain a premium on the carbon price.

Regarding inherent market problems, several participants noted that it would be difficult, if not impossible, to get the direct benefits from carbon markets transferred to smallholders. Some argued for focussing on the co-benefits from such projects, especially yield increases, while others suggested avoiding the carbon markets all together and to look for other options for finance.

In a ***general remuneration for environmental services framework*** it was noted that it was not sufficient to measure carbon, but the wider impacts of projects on water, soil etc should be monitored. The sustainability index was suggested as a point of departure for such a monitoring scheme, although that would be costly. It was also noted that carbon on its own was proving very difficult to monitor, and environmental services as a whole might be even harder.

A need for thinking about ***transnational models*** or even global in scale was stated, as impacts of projects might not be in the same region (eg effects of deforestation). However, it was noted that models tend to have difficulty encompassing different agricultural and ecological systems. Furthermore the remuneration framework for a transnational approach needs to be redone completely, as both CDM and VCS are project based.

Lastly it was mentioned that ***tools developed for monitoring*** could be used for LCA carbon labelling and might be counteractive for smallholders, as the extensive farming practices often have higher per unit emissions.

VIII: Financial instruments for smallholders

Nancy McCarthy (FAO) gave a presentation on the potential impact of linking agricultural mitigation with food security.
At a price of \$20/tCO_2e, agriculture has the potential to sequester 1.5 bill tCO_2e while at the same time raising \$30 bill. While that won't fill the gap it will provide much needed funds, for the world to meet the growing demand for food by 2050.
The presenter argued that sequestration projects should be grouped by mitigation and food security, to find the most appropriate source of funding. Projects with high mitigation potential should aim towards carbon markets, while projects with lower mitigation potentials but high food security potentials should be funded by public funds.
Finally it was mentioned that soil sequestration might not be suitable for CDM-style crediting, but rather should be integrated in a NAMA framework.

In the ensuing discussion it was noted that most of the money that goes to REDD at the moment, is targeted to capacity building. Nothing is aimed at buying credits, and thus nothing goes to the project development. Furthermore at COP 15 it was suggested that most of the funding will go to energy projects, and not to REDD or agriculture.
It was also mentioned that agriculture, contrary to REDD, currently has not obtained a major champion, neither among donors nor developing countries.

IX: Next Steps

In this session the discussion turned to the future of the collaboration between the different parties of the workshop. Different suggestions were raised:

Future workshop topics:

- Socio-economic issues related to smallholders engaging in mitigation activities
- Incentives, including carbon payments and bundling of environmental services

- Opportunities in utilising the private sector to drive implementation of certain practices (e.g. food, fertiliser and finance sectors)

Other possible activities for the network:

- Write a paper or source book (maybe along the lines of the REDD source book) on the options for measuring carbon stocks in agriculture
- Harmonize the terms used about mitigation in agriculture
- Act as knowledge link between research and national governments in developing countries (e.g. through web portal)
- Influence UNFCCC negotiations and policies in developed and developing countries
- Catalogue best practices for agricultural carbon sequestration in different systems
- Make the link between agriculture and REDD more visible
- Create or support an organisation that can act as a lobbying entity for agricultural mitigation (like REDD)

Marja-Liisa Tapio-Biström and **Lini Wollenberg** summed up the day:
All the participants agreed, that the main focus is to increase food production in a climate smart and sustainable way. The potential of agriculture as a mitigation tool is not disputed, but more concrete evidence is still needed. The 30 activities mapped out and introduced during the workshop already indicate part of this effort. Different approaches need to be tried out and then compared to produce the evidence cooperatively. It is very important to remember that the solutions need to be viable for the individual farmer.
These agricultural mitigation systems can not be built linearly, but several elements need to be developed simultaneously. Both MICCA and CCAFS try to deliver elements of the system, and both would like to work closely with other partners in FAO and with the CGIAR centres to present a united front on this issue.

Annex 1: Workshop Programme and List of participants

	Agenda Item	**Responsible/Facilitator**	**Teleconference participants**
8.30 – 09.00	Welcome & Objective Introduction & Logistics	Maisa & Lini Constance	Meine van Nordwick Peter Minang
09:00-10:00	Towards a framework for smallholder-based agricultural mitigation • FAO MICCA project • Integrated landscape analysis • Vi Agroforestry: A SAMP in practice	Maisa (MICCA) Meine/Henry (ICRAF) Amos (Western Kenya Project) (5-10 minutes each, 5 slides)	
10.00-10.15	MICCA protocol developed for Agricultural Mitigation Projects	Constance	
10.15-10.45	*Coffee Break*		
10.45-12.00	Project introductions by institutions Mapping of sites selected by different institutions	All participants short intro (no PPT) on project Christina Constance	
12.00-13.00	*Lunch*		
13.00-15.00	Carbon measurement methods, technologies, tools and issues Simulation models and their verification	IRRI, CIP, ICRAF and CIAT - (5 min each) Timm – models and data for AMPs (10 minutes each, 5-8 slides)	Brazil, CIP and USA/Canada
15.00-15.30	*Coffee Break*		
15.30-16.00	Discussion on harmonised methodological and modeling approach for carbon measurements	Constance	
16.00-17.00	Financial instruments for smallholders	Leslie/Timm – brief overview of instruments available to be used in SAMP Constance	
17.00-18.00	Next steps	Constance	

FAO

• Pierre Gerber, AGAL	• Wendy Mann, NRD
• Nancy McCarthy, ESA	• Theo Friedrich, AGP
• Caterina Batello, AGPM	• Henry Mathieu, NRC
• Constance Neely, AGP	• Marja Liisa Tapio Biström, NRC
• Christina Seeberg- Elverfeldt, NRC	• Mathias Varming, NRC

CG

• Alex De Pinto, IFPRI	• Jim Gockowski, IITA
• Alonso Gonzalez, CIAT	• Lini Wollenberg, CCAFS
• Piet Van Asten, IITA	• Wilson Tadeu Lopes da Silva, CIP-EMBRAPA/CNPDIA
• Henry Neufeldt, ICRAF (teleconference)	• Reiner Wassman, IRRI
• Roberto Quiroz, CIP (Teleconference)	• Adolfo Posadas, Embrapa (Teleconference)
• Gerald Nelson, IFPRI (Teleconference)	Aline Segnini . Embrapa (Teleconference)

Others:

• Silvia Donato, IFAD	• Amos Wekesa, SCC-Vi Agroforestry Eastern Africa
• Timm Tennigkeit, Unique Forestry	

Annex 2: Project descriptions

Project descriptions as presented in V. Numbers 1-9 are the projects short-listed for MICCA pilots.

1) Tanzania, Ulguru mountains
Subtropical mountain system
Tree planting & watershed conservation
Watershed scale
100,000 farmers
PES
ICRAF

2) Philippines, Kalahan
Tropical mountain system, humid
Agroforestry system
10,000 farmers
ICRAF

3) Kenya
Livestock systems
ICRAF, Gates foundation.

4) Bolivia, Peru, Ecuador, Paraguay
FAO

5) Tanzania, Karathu dictrict
Subtropical, semi-arid
Arable farming + pastoralism -> Conservation Agriculture
3,500 farmers
FAO/SARI

6) Kenya, Laikipia & Siaya districts
Subtropical, semi-arid
Livestock/subsistence/commercial crops -> low-till
320 farmers
FAO/KARI

7) Zambia
FAO/CIMMYT

8) Tanzania
Agroforestry & sylvo-pastoral
ICRAF/FAO

9) Azerbaijan
Restoration of grasslands
FAO/ICARDA

10) 3 Rivers Sustainable grazing project
China, Quighai province

Pastoral alpine meadows
The project aims for proof of concept for carbon finance with smallholders, as well as developing methodology for VCS.
Advantages of the site are:

- A lot of baseline information available
- Strong institutions
- Clear land rights

The project has been running for about 1 year, and currently more than half way with the preparations.
FAO, ICRAF, CAAS

11) Mali
3 eco-zones
20,000 farmers
Time: 2011-2014
Entry point: through adaptation
Project document is under development.
The project mainly works with adaptation , but could benefit from link with mitigation.
FAO, GEF

12) Morocco, Ghana, Mozambique, Vietnam
Annual/perennial crops
Entry point: measurements, baseline, test new methodologies to make sense to markets, particularly interested in institutions, "some" transaction costs (data is sketchy)
IFAD/IFPRI partnership

13) South Africa
Fort Hare University
Smallholder promotion of conservation agriculture
Lots of large-scale conservation agriculture adoption in the region
FAO

14) Jordan conservation agriculture promotion
In three regions of Jordan
Problem with measurable carbon sequestration in this region.
RE/FAO

15) Kagera project
Kenya Uganda Rwanda Tanzania
Pastoral issues. Could be linked to LADA.
The project is started. Took 4-5 years to come to life.
GEF-FAO

16) Sylvo pastoral projects
Funded by GEF/WB Catie etc.

a)Costa Rica, Columbia & Nicaragua
Payments made for environmental services
Project already completed
b) Columbia
ongoing

17) Vi-agroforestry projects (presented in depth on page 3)
East Africa
Agroforestry

18) Uganda Rwanda Burundi
Humid tropics highlands
Coffee/perennial based systems banana
>3 mill smallholders could be targeted, but the project is focused on research
Time: on farm surveys + on station trails + scaling out ongoing
Entry: mitigation + adaptation AG intensification of forest margins
Coffee is the primary export crop in the region and is traditionally grown as mono-crop.
The project implements banana/coffee intercropping which generates more revenue and sequesters more carbon in the soil as well as more above ground biomass and also provides firewood. The project also aims to investigate, whether intensification of agriculture can reduce deforestation.
Looking at old systems (1-30 or 40 years old)
The project will so far run until 2011
IITA + national partners

19) Mexico
The project focuses on SFM, but also has a mitigation component.
The project is currently being formulated and is expected to start in 2011
GEF/IFAD

20) Venezuela
Afforestation project
The project is currently being formulated and is expected to start in 2011
GEF/IFAD

21) RUPES
Regional project in Asia
The project works with payments for environmental services, and is currently in its 2nd phase
IFAD and others

22) Sudan
Afforestation in the Butana Region
The project is currently being formulated and is expected to start in 2011
IFAD/GEF

23) Quesungal slash and mulch (additional information on page 4)
Honduras -> other LAC countries
12 years
7000 farmers
Bean/Maize/Sorghum
The project works with alternatives to slash and burn, and has had a big influence on food security. Now the aim is to introduce high value crops and more market focus, to further improve livelihoods. The co-benefits of the project include resilience to disaster, and it provides valuable environmental services including improved water resources, biodiversity and food security.

24) Peru and Brazil
The project aims to map SOM content of the soil in different tropical areas. It currently employs 2 researchers from Peru and 1 in Brazil and is finishing in 2010
No smallholders are currently involved.

Embrapa and CIP cooperation

25) Brazil (national programme)
The project works with carbon balances in agricultural systems looking at till vs no-till, cattle, etc.
60 researchers
Ecological zone: Tropical
4 year project (started in 2009)
Financed by Embrapa

26) Several Asian countries
Irrigated rice research
Each site has different initiatives with fertiliser, pest management etc.
Benefits include improved water management by introducing alternating wet/dry systems.
"Consortium"

27) Philippines
Scaling up "alternative wetting and drying" in rice production
Philippines has a large programme to be more self sustaining and could be and entry point.

28) Indo-Gangetic Plain
Conservation agriculture project in cereal systems in India, Bangladesh and to some extent Pakistan, funded with gates among others. The project aims to improve performance (irrigation, fertiliser etc). There seem to be good possibilities of scaling up.
CSISA

29) Sustainable tree crops programme
Cocoa belt in West Africa: Ghana, Cote d'Ivoire, Nigeria, Cameroon and Liberia
Humid tropics guinea forests are a biodiversity hot spot, and currently the farmers utilise slash and burn. The expansion of production increases area by 3% p.a. and yields 4% p.a., resulting in 150,000 ha of cleared forests per year and emissions of 30 mtCO_2e.
The project aims to increase production in 125,000 households. Programme target is to increase yields by 30% through farmer school training. The project started in 2003 and is currently in its second phase until 2011 and discussions are currently going on, whether there should be a third phase.
Entry point: increase output and productivity
Cocoa systems until few years ago were with no fertilizer input, but input and good management can double yields.
There is currently no quantification of deforestation.
IITA

30) Reducing Emissions from All Land Use (REALU)
Duration: Phase I (June 2009 – June 2010); Phase II (June 2010 – June 2012 with yearly approval)
Countries / Sites: Five landscapes in Cameroon, Indonesia, Peru and Vietnam
Main Areas: Development of Methods and tools; demonstration; policy and research
5 different landscapes
It has good potential for scalability
Benchmark approach
15 years of data
Project Implementation / Proponent: ASB Partnership and ICRAF
Other Partners: IITA, CIAT, INIA (Peru), IRAD (Cameroon), ISRI (Indonesia), MARD (Vietnam)
Funding Agency: Government of Norway- Norad