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Carbon Intensification and Poverty Reduction in Kenya: Lessons from the Kenya Agricultural Carbon Project

Timm Tennigkeit[1], Katalin Solymosi[2], Matthias Seebauer[3] and Bo Lager[4]

[1]UNIQUE forestry and land use, GmbH, Freiburg, Germany
E-mail: Timm.Tennigkeit@unique-landuse.de

[2]Inter-American Development Bank

[3]UNIQUE forestry and land use, Freiburg, Germany

[4]Concern, Food, Income and Market (FIM) Programme Manager, DPR of Korea
and former Programme Director Vi Agroforestry, Nairobi, Kenya

Abstract. The Kenya Agricultural Carbon Project, implemented by the NGO Vi Agroforestry, is breaking new ground in designing and implementing climate finance projects in the agricultural sector. For the first time, while increasing agricultural productivity and enhancing resilience to climate change, smallholder farmers in Africa will receive benefits for greenhouse gas mitigation based on sustainable agricultural land management. The project has developed an activity monitoring system for sustainable agricultural land management (SALM) practices that enables smallholder famers and extension service provider to track and improve farm production. Based on the development of a carbon accounting methodology this system, in combination with a carbon model, is monitoring soil and biomass carbon sequestration consistent with the Verified Carbon Standard. As a result farmers in Africa for the first time can benefit from international voluntary carbon markets.

The paper describes the Vi Agroforestry extension approach, outlines the project objectives and activities, and explains the carbon accounting methodology. Project achievements and lessons learned, but also the challenges that still lie ahead are presented. The authors conclude that the project model has great potential for scaling up and provide a potential blueprint for widespread adoption and effective monitoring of sustainable agricultural management in smallholder conditions.

Keywords. Kenya, agriculture, carbon, climate change, finance, resilience, mitigation, sequestration, sustainable management, greenhouse gas, emissions

1. Introduction

Western Kenya is a region with a high number and density of poor rural households – many of them female headed – with malnourished children. The region is also important for staple food production, due to relatively favorable site conditions. The medium distance to Nairobi and state of infrastructure may enable the sustainable intensification of smallholder production systems and the successful integration into value chains in the future.

The Kenya Agricultural Carbon Project (KACP) in Western Kenya is the first soil and agricultural carbon finance project in Africa that benefits rural communities and smallholder farmers. KACP is being implanted by the NGO Vi Agroforestry. The project addresses the challenges of growing land pressure, insecure livelihoods and the relative inefficiency of smallholder agricultural production, all of which are exacerbated by negative effects of climate change. Vi's strong extension approach, coupled with a newly developed participatory system for monitoring carbon as well as livelihood benefits, has engaged over 60,000 smallholder farmers on 45,000 ha of land so far.

Advisory services from the project enable farmers to change agricultural practices that in the future will give them increased risk adjusted crop yields and carbon revenues. The carbon revenues hereby provide the "icing on the cake" and the rigorous performance monitoring system will focus management and extension to the real benefits of carbon sequestration which are improved soil fertility and resulting crop yields, increased food security, market access for agricultural produce and increased climate resilience benefits that accrue to farmers and communities. The KACP project is closely integrated into the larger Vi Agroforestry East Africa programme. The main objective of this programme is to improve living conditions for 250,000 farmer households through sustainable use of natural resources within the Lake Victoria Basin. This is accomplished through 300 Vi Agroforestry local field advisers who support farmer groups by meeting their demands for capacity building and advisory services. The supported farmer groups/organisations are mainly small civil society organisations (61% women members) consisting of community based organisations, common interest groups, training groups and financial services associations.

KACP has also applied rigorous international and national social and environmental safeguards. An environmental impact assessment was conducted at an early stage of the project and as a result, among other things, a pest management plan was developed to monitor upcoming pests and diseases and to introduce safe pesticide management protocols. The project has also developed a grievances procedure for farmers and a revenue distribution system for carbon revenues.

2. The extension approach

Vi Agroforestry is a non-governmental, non-profit Swedish organization registered in Kenya, Tanzania, Uganda, Malawi and Rwanda with almost 30 years working experience in community development. Vi offers small-scale farmers advisory services in the areas of farming as a business, financial services, tree planting, agroforestry and sustainable agriculture, sustainable energy, climate change adaptation, mitigation and carbon finance. Vi´s holistic extension approach is centered on the principle of looking at development from a livelihoods perspective. A strong participatory group extension approach that empowers farmers to take charge of development efforts is a crucial success factor in the project. The community groups are expected to clarify their own notions of poverty and prosperity, identify the 'stages of progress' that characterize movements in and out of poverty, identify major livelihood strategies that households employ in the community, and characterize every household according to their livelihood strategies. This provides an opportunity for extension workers to deliberately target the poor, and to identify and promote enterprises that fit their circumstances in the local village context. The field advisers sensitize as many farmers as possible through existing traditional institutional structures such as Barazas and other organized meetings or groups (e.g. schools and local NGOs). The approach used by Vi Agroforestry is demand-driven provision of advisory services, where field advisers meet with groups of farming households and make strategic and action plans together in order to identify the specific demands and how to meet them.

During the intensive support phase (year 1 to year 4), a KACP field adviser will work with and recruit 600 farmers per year in a location and hence be working with 2,400-3,000 households at the end of the fourth year. Altogether, there are 28 field advisers in 28 administrative locations within the project (see Figure 1 below). After four years, the external extension services and staff recruitment will be reduced based on the consideration that communities – with support from Vi Agroforestry – will by then have established their own extension advice network consisting of local research stations, government extension services, input providers and other agricultural knowledge brokers. The main intention of

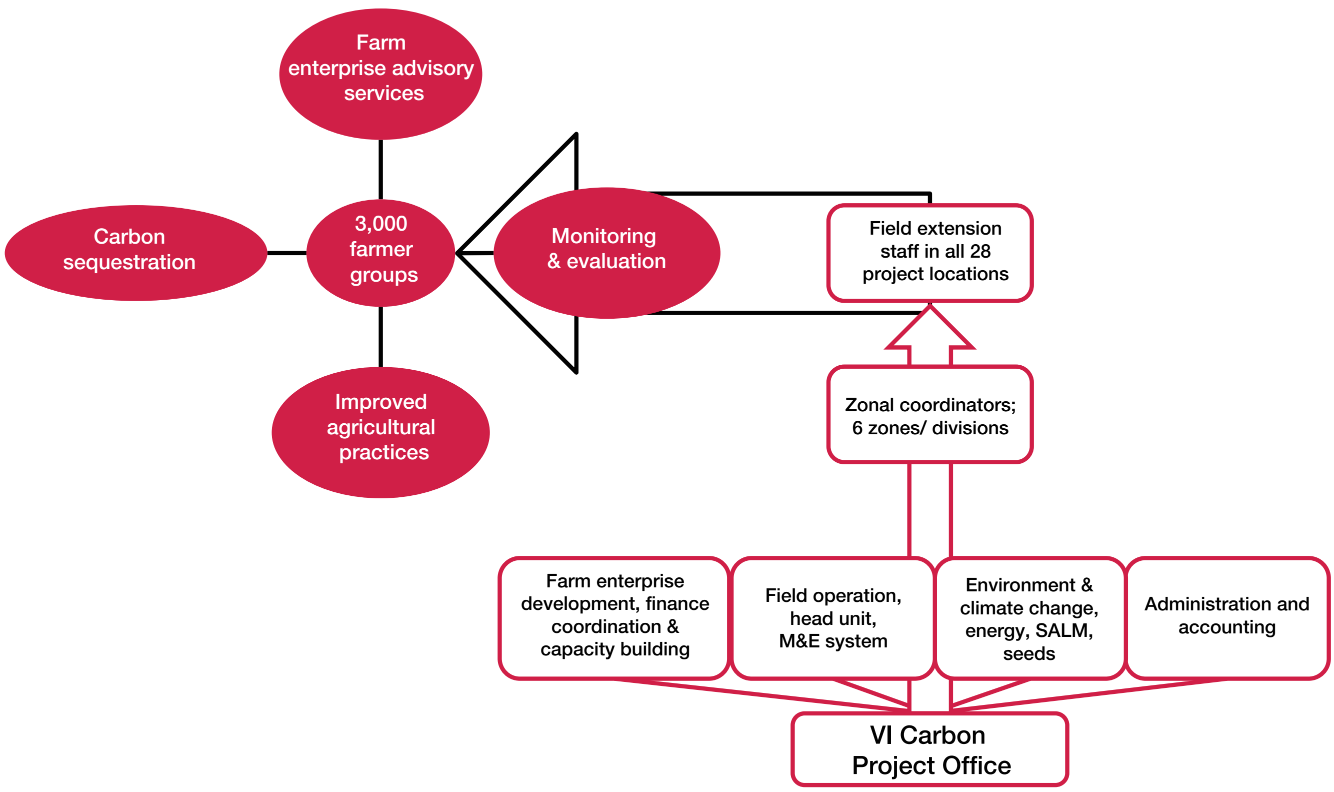

Figure 1. Schematic structure of the institutional set up of the project

the extensive support phase is to strengthen the enabling environment for a farmerled sustainable implementation system under effective guidance from advisory services to make sure that knowledge is established and maintained within the society after the programme phases out in the area. However, in carbon project areas, extensive extension support will continue and the related costs will be covered from part of the carbon revenues.

In each location local community facilitators and farmer trainers are chosen by the groups and trained in a similar way as the Vi Agroforestry field adviser staff. Groups and organisations are also strengthened in order to put higher demand on the existing service providers in the area. Seeing is believing, and Vi Agroforestry therefore works with methods like farmer field schools, demonstration plots, farmer tours and exposure visits. In order to increase the adoption of a practice, it is easier if the practise has a relation to a traditional practice (e.g. improving on a traditional one) or if it has some immediate benefits for the household (i.e. not only longterm benefits). All messages are also better received if they relate directly to the family or household and its needs or challenges. Agroforestry training centres are also used in order to demonstrate the different practices, and to provide a location where farmers can be trained both in theory and practice.

The extension system is set up in a way that a fixed number of field advisors (28) train registered farmer groups in SALM practices as well as performing the necessary assessments, monitoring and evaluation of project activities. The farmer groups are formally contracted by Vi Agroforestry. The roll out phase for the implementation of SALM activities is planned to last nine years until more than 90% of farmers have adopted SALM practices.

The field extension approach consists of five steps:

- Step 1) Stakeholder awareness raising as an entry point in the village and at the regional level to explore existing and complementary extension services;
- Step 2) Sensitization and trust building with farmer groups;
- Step 3) Recruitment of registered farmer groups including contracting;
- Step 4) Strategic planning, training and advisory services for farmers in SALM practices on a group level, including support for village loan and saving associations;
- Step 5) Supporting crop processing, marketing and bulk input purchasing activities to strengthen groups and add value to the crops produced.

Besides the advisory services provided by the project, agricultural productivity is promoted through extension provided by the government and other civil society organizations.

The Vi Agroforestry experience shows that the time horizon is crucial in any development project. There is a time lag of 2-3 years between the adoption of improved Agroforestry practices until net additional benefits accrue. In addition, farmers have to invest labor and inputs such as seeds and small-scale irrigation in order to increase soil fertility and crop yields. Without extension support providing access e.g. to improved seeds and knowledge on the benefits of nitrogen fixing trees and compost making farmers are often not able to improve their farming systems. Furthermore, the increasing population growth rate is resulting in smaller farm sizes per family and therefore without sustainable intensification the threatening food security situation in Western Kenya is not expected to improve. In the project on average an extension worker is serving a farming area of 1,000 ha. The extension intensity is high in the beginning and declines over time. The initial time intensive farmer sensitization process is important to demonstrate the benefits of Agroforestry and to support the establishment of farmer groups that are a precondition to provide any farm enterprise focused extension support. Farmers in general learn best from observing and sharing information with model farmers. Therefore, the extension is supporting the development of farmer field schools and identifies model farmers that have great knowledge, are interested to learn and test new practices and are willing to share their experiences. This extension approach takes time, but ensures sustainability. The project shows that if the time needed for implementation is available and the approaches are participatory and close to the target group, then the adoption of technologies will be high, since the farmers themselves will realize the benefits that actually can change their family from being poor and food and firewood self-insufficient, to instead becoming a supplier of both.

3. Project objectives and activities

Vi Agroforestry through extension aims at increasing the productivity of smallholder farmers and enhancing their resilience to climate change, while carbon sequestration is considered as a co-benefit that will be marketed. Therefore, Vi is promoting farming as a business and the adoption of Sustainable Agricultural Land Management (SALM) practices. The KACP covers 60,000 farmers, organized in 3,000 registered farmer groups. The project rolled out over a 6 year period. The project is located in Nyanza and Western Provinces with the two project locations Kisumu and Kitale, both covering a project area of 22,500 ha. The aggregated project area covers 45,000 ha within a larger project region. The project is financed by the Foundation Vi Planterar träd ("We plant trees"), and the Swedish International Development Agency (Sida). The World Bank administered BioCarbon Fund is buying part of the verified emission reductions upon delivery, which means pre-financing of the project implementation activities is required.

The package of SALM activities promoted by the KACP includes a large number of practices that go beyond the objective of soil carbon sequestration. In the table below only those SALM practices are listed that contribute to carbon stock enhancement.

Table 1. SALM practices promoted in the KACP that contribute to carbon stock enhancement

SALM ACTIVITY	DESCRIPTION
Residue management	Residues from crops such as maize, beans, cow peas, sweet potatoes as well as deciduous tree litter are left on the soil. This organic matter creates favourable microclimatic conditions that optimize decomposition and mineralization of organic matter ("surface composting"), and protect soil from erosion.
Composting	Composting entails controlled biological and chemical decomposition that converts animal and plant wastes to humus. It is an organic fertilizer made from leaves, weeds, manure, household waste and other organic materials from the farm. Proper composting management leads to an increased proportion of humic substances due to high micro-organic activity, and therefore the quantity and quality of humus in the soil increase.
Cover crops	Cover crops are planted on bare or fallow farmland to reduce erosion and mineralization of organic matter. Green manure is a fast growing cover crop sown in a field several weeks or months before the main crop. Before the main crop is planted, the green manure is then ploughed into the soil.
Agroforestry	Agroforestry is a major program activity, which was introduced in the project area by the KACP. Based on the experiences of Vi Agroforestry it proved to be a sustainable economic, social and environmental land management system in smallholder conditions in Western Kenya. Agroforestry increases tree cover which contributes to increased biomass above and belowground, and also improves soil carbon. Several agroforestry practices are part of this project activity: • Agro-silviculture that involves selected species of trees (e.g. Sesbania sesban, Markhamia lutea, Calliandra, Grevilea robusta and others) grown on cropland in a mixed spatial (scattered) system. • Boundary / hedge tree planting involving planting of selected trees along field boundaries, borders and roadsides which can create a micro-climate for crops, and serve as a windbreak, thus stabilizing the soil. • Woodlots serve as woody biomass pools for the farmers. Generally, about 40 trees planted in one distinct piece of land can be considered a woodlot. Woodlots can be established near homesteads and separately from cropland. • Tree shading of perennial crops involves trees grown in combination with other perennial crops such as coffee, sugarcane and tea. These systems potentially increase the productivity of soils through increased litter inputs, enhanced microclimatic conditions and soil nutrient availability. • Silvo-pastoral systems combine trees and pastures to produce green manure and improved fallowing practices. • Fodder banks can provide essential and improved feeds to livestock. This type of crop is an integral part of the whole livestock feeding and management system. Fodder trees usually include Calliandra, Sesbania sesban, Gliricidia sepium, Moringa oleifera and Cajanus cajan.

4. Monitoring the benefits

To quantify carbon offsets, the KACP uses a methodology which is based on an activity baseline and monitoring survey (ABMS) and estimation of soil carbon stock changes using a model. To monitor tree biomass carbon, an existing CDM approved afforestation/reforestation methodology was integrated into the methodology. The methodology is a public good and can be used around the world in various agroecological conditions. The monitoring system takes into account the multiple benefits to smallholders, including increased climate resilience, productivity increases (through the farm enterprise approach) and reduction/removal of greenhouse gases. The methodology for 'Adoption of Sustainable Agricultural Land Management (SALM) practices' was developed by the BioCarbon Fund of the World Bank and approved by the Verified Carbon Standard (VCS) in December 2011, after a number of global expert consultations and a double validation process. The main features of the methodology are presented in Figure 2.

According to the methodology, carbon stock changes in different carbon pools (soil, biomass) are determined by combining information on the project area and management practices adopted (activity data) with coefficients (emission factors) that quantify the emissions or removals per unit of activity. The approach follows the overall 'Good Practice Guidance' of the Intergovernmental Panel on Climate Change (IPCC).

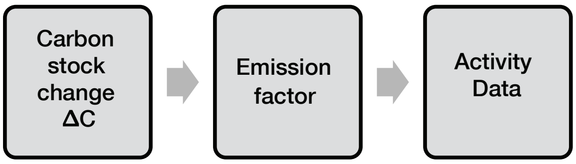

Figure 2. Key features of the VCS approved SALM methodology

For example, if you want to determine the carbon stock change of a mulching activity, the area on which residue mulching is adopted in the project is required (activity data) as well as the emission factor which indicates how much soil carbon is sequestered per unit area as a direct result of the mulching activity. Normally this factor is expressed in t CO2 per ha per year which can then be easily multiplied by the total area (in hectares) where the activity has been adopted.

To collect the activity data, the methodology proposes the use of an activity baseline and monitoring survey (ABMS). The basic idea is that agricultural activities in the baseline will be assessed, and adoption of SALM practices will be monitored, and activity-based models used to estimate the resulting carbon stock changes. The ABMS was designed in line with the requirements of the methodology and is applied in the KACP. Figure 3 summarizes the ABMS design.

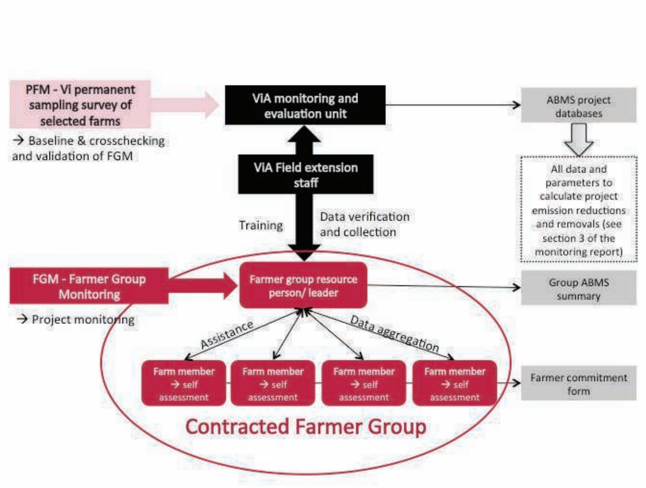

Figure 3. Structure of the ABMS monitoring system

The ABMS monitoring system (1) collects field data using two different monitoring approaches: Permanent Farm Monitoring (PFM) (2) and Farmer Group Monitoring (FGM) (3). The basic distinction between the two monitoring components is that the PFM is entirely implemented by the field officers of Vi Agroforestry on permanent sample farms (socalled ABMS farms) and is a representative survey for the whole KACP project area. It is used to establish the total KACP baseline conditions and to estimate the exante actual GHG emissions and removals for the whole project area. Further it monitors the overall project performance in terms of project implementation (SALM adoption, crop yield monitoring) and is used to verify the results of the FGM.

The FGM, on the other hand, is based on self-reporting by all farmers and farmer groups. Farmers and farmer group resource persons are trained in data collection and record keeping by the project extension staff to ensure the accuracy of the system. In this system, farmers annually record all relevant data themselves and report data to the field officers via a strong system of verification and data aggregation. The soil model input data (4) combined with the data from the ABMS (5) and additional existing data sets (6), such as climate and soil data, are used to parameterize Roth-C to model the actual (ex-post) GHG emissions and removals from SOC and tree biomass of those farmers that have adopted SALM activities. The results of the group monitoring also serve as a basis to distribute carbon benefits to farmer groups.

In the table below the model outputs, i.e. local SOC emission factors, are presented.

Table 2. Roth-C modeled local emission factors

SALM PRACTICES	KISUMU – SOC EMISSION FACTORS IN TCO_2/HA/YEAR	KITALE - SOC EMISSION FACTORS IN TCO_2/HA/YEAR
Residue management Maize		
1st season	0.31	0.58
2nd season	0.22	0.64
Residue management Beans		
1st season	0.20	0.35
2nd season	0.14	0.50
Residue management Sorghum		
1st season	0.22	0.30
2nd season	0.16	0.42
Composted manure		
1st season	0.19	0.20
2nd season	0.21	0.21
Agroforestry (soil fertility trees)		
1st season	0.05	0.19
2nd season	0.02	0.10

The result of this whole system is the total project net GHG removals (8), consisting of the carbon stock change in the soil organic carbon pool and the biomass carbon pool, while also considering carbon emissions due to implementation of project activities.

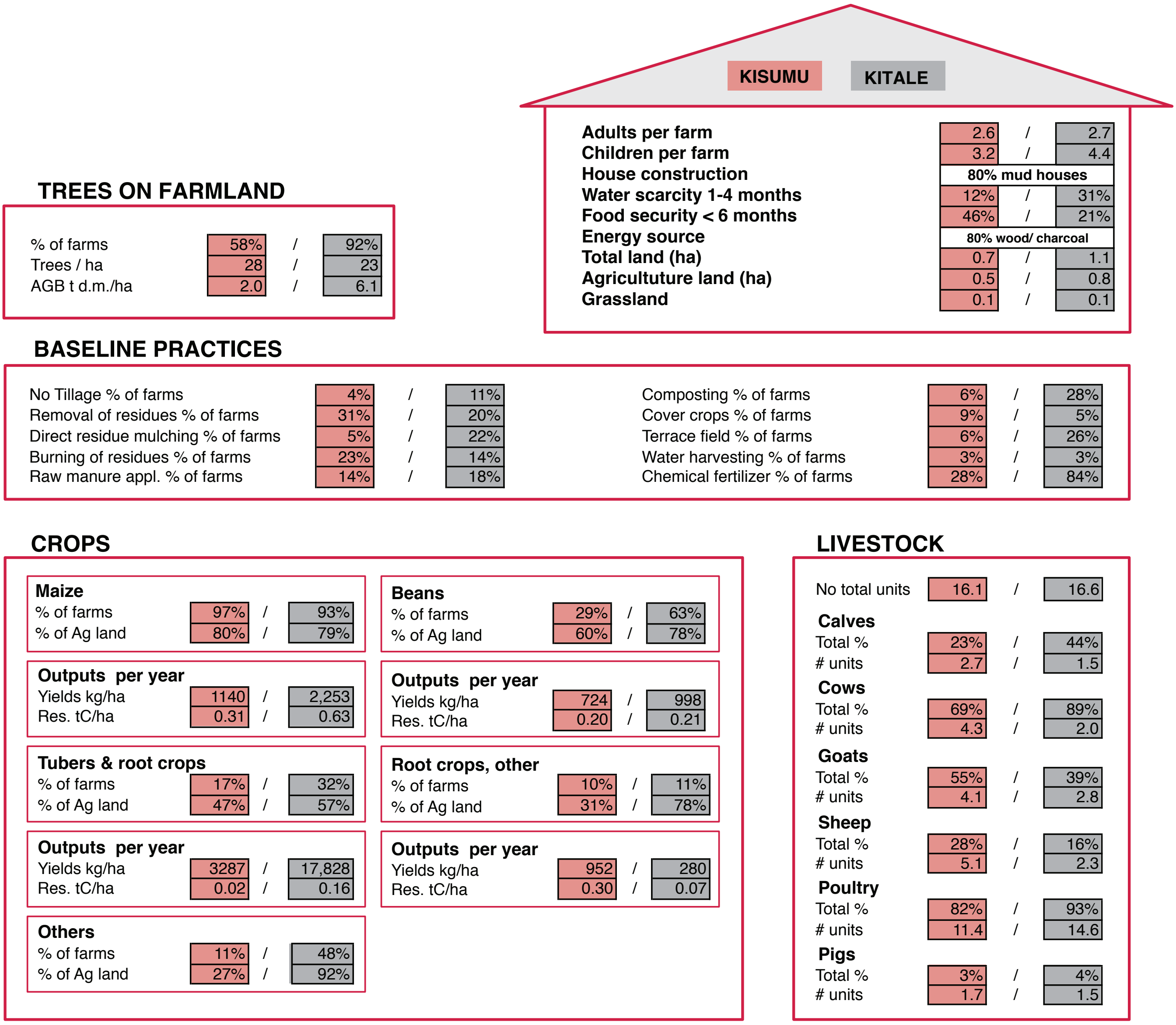

Figure 4. The average farm based on results from the ABMS

Figure 4 illustrates the data collected for an average household in Kisumu and Kitale. It highlights, for example, that in Kitale farmers' grains crop yields are higher per hectare (2,253kg/ha/yr compared to 1,140kg/ha/yr), which is because more farmers use chemical fertilizer. With regard to livestock, there is a trend that in Kisumu farmers have more livestock (except poultry) and more land.

Management of project additionality, leakage and non permanence

A requirement of carbon projects is that they are additional, do not result in leakage outside the project area and ensure that emission reductions are permanent.

Additionality means that the carbon would not be sequestered in the absence of carbon finance. For the KACP, implementation barriers without carbon finance are that the extension services are partly financed from the carbon revenues and that there is a technology barrier to design and implement a climate performance and benefit monitoring system. The monitoring system is important to ensure intense and focused project implementation.

All possible sources of leakage are mitigated in the methodology. For example, if due to the project more chemical fertilizer is used, then the embodied emissions in the chemical fertilizer are captured in the monitoring system and deducted from the soil and biomass carbon sequestered. Similarly, if due to the project non-renewable biomass from outside the project area is used inside the project area for cooking, then the related emissions are considered. Finally, the project is expected to increase yields, residues and tree biomass. Farmers may use this to feed additional livestock, resulting in increased livestock emissions. The project will mitigate these emissions by introducing fodder trees and zero grazing systems that will reduce livestock related emissions per product unit. However, since the project activities do not directly promote an increase in livestock numbers, the related emissions will not be accounted for.

Finally, the project applies a non-permanence risk tool from the VCS to anticipate the risk of non-permanence. The risk assessment of the KACP was rated relatively low, and subsequently 10% of the credits will be placed in the VCS risk buffer account as an insurance against any non-permanence risks.

5. Lessons learned

5.1. Focus on smallholder farmers' interests

From the farmers' point of view, the success of an agricultural carbon finance project is related to increased risk adjusted crop yields and food security, with carbon revenues as a co-benefit. Farmers frequently mentioned that due to the project they gained the skills to increase soil fertility e.g. through simply not burning crop residues and compost making and as a result crop yields and their income have increased For the KACP, the amount of carbon revenues at current carbon prices is expected to be approximately smaller than the value of the 20% increase in revenues from crop yields. The carbon revenues are partly used to cover the extension cost. The largest share will be disbursed to the farmer groups and within the groups the benefits will be distributed according to farm performance indicator and equity consideration. Each farmer group can subsequently decide how to invest the carbon money. Furthermore, carbon revenues will expire when carbon pools are saturated, while farmers will receive continuous incomes from healthy and productive soils and diversified products. Project developers should be careful not to raise false expectations and clearly communicate the amount of carbon revenues that a project may generate. Vi Agroforestry communicated these messages right at the project inception, hence there are no false expectations.

5.2. A strong extension service with decades of focused extension experience

One of the main difficulties of smallholder projects is the coordination of a large number of farmers. Vi Agroforestry is among the strongest farmer extension organizations in East Africa, with a strong team on the ground and indepth experience. Based on this foundation, the organization is working with and strengthening local institutional structures, such as traditional barazas (community information meetings), schools and local NGOs. The project uses participatory planning, monitoring and evaluation of a farmerled implementation system and takes community-based stakeholders on board to ensure the permanence of the project after an intensive development phase.

5.3. The monitoring system used should be cost-effective, demand driven and user friendly

Designing a soil carbon monitoring system that meets the level of accuracy required by international carbon offset standards is a challenge for any smallholder agricultural carbon project. The chosen approach proved to be efficient in terms of data collection and can be easily integrated into existing project extension support systems.

Carbon accounting and monitoring must adhere to the principles of relevance, completeness, consistency, transparency, accuracy and conservativeness to ensure true and fair accounting. Conservativeness is important for projects where accuracy may not be fully attained, and may serve as a moderator to accuracy to maintain the credibility of project emission quantification. Monitoring systems in smallholder land-use carbon projects should be designed to achieve multiple benefits apart from carbon accounting. Above all, they need to be transparent for the farmers who actively reduce emissions in the project area in order to ensure ownership of the sequestered carbon and to create a fair distribution of revenues. Furthermore, carbon monitoring should support project implementation, extension and impact monitoring. Monitoring can be used to identify specific training needs and priority interventions for extension, particularly during the early stages of a project. General livelihood and socio-economic impact monitoring is also important.

6. The way forward

The project has been successfully validated in May 2012, and the first carbon payments have been received. Farmers have already adopted SALM practices on nearly 50% of the total project area and according to the rollout plan, the total project area of 45,000 ha will be covered by 2017. The figure below illustrates the key steps of the project.

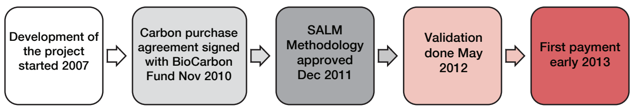

Figure 5. Kenya Agricultural Carbon Project's steps

Scaling up is the way forward, and Vi Agroforestry together with partners has conducted feasibility assessments in Uganda and Malawi to start similar projects based on their ongoing experience. Meanwhile the KACP serves as a model for Nationally Appropriate Mitigation Actions (NAMAs) in the agricultural sector and a number of government and development partner initiatives are underway to explore possible modalities based on the Durban Action Plan of the United Nations Framework Convention on Climate Change.

Public awareness raising and consultations are an important element of further scaling-up for sustainable agricultural management in Africa and other regions. The lessons learned indicate that this model can be used on a large scale and would benefit from modifications and lessons learned from implementation in other geographic locations, social and environmental settings.

7. Acknowledgements

The development of this project started in 2007. Because of the complexity and consensus building required to develop the first soil carbon accounting methodology, several institutions have been involved. Besides Vi Agroforestry as the

project developer, Joanneum Research (Austria), University of Aberdeen and UNIQUE forestry and land use (Germany) have been instrumental in the development of the new methodology. The World Bank BioCarbon Fund, the Agriculture and Rural Development Unit in the Africa region of the World Bank and the Swedish International Development Cooperation Agency (Sida) have provided crucial initial financial support before revenues from the carbon credits are realised.

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