KENYA AGRICULTURAL CARBON PROJECT

Document Prepared By Vi Agroforestry

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Table of Contents

1 PROJECT DETAILS

1.1 Summary Description of the Project

The Kenya Agricultural Carbon Project (hereafter named KACP) represents one of the first pilot projects in this context. Supported by the BioCarbon Fund of the World Bank, it promotes and implements a package of Sustainable Agricultural Land Management (SALM) practices within smallholder farming systems and generates GHG removals through soil and tree carbon sequestration. The project is achieving its goal using a holistic and focused farm enterprise extension approach and by supporting farmer groups to establish village savings and loan associations Carbon credits will be generated and claimed using the approve VCS methodology VM0017: Adoption of Sustainable Agricultural Land Management. The methodology is specifically addressing the need for a robust but cost efficient monitoring system and to assist smallholder farmer to reach their objectives (productivity, food security and climate resilience).

The project proponent – the NGO Vi Agroforestry – is promoting the adoption of SALM practices on approximately 45,000 ha in Nyanza and Western Provinces such as use of residues for mulching and composting, cover crops, water harvesting, terracing and agroforestry to restore soil fertility, improve resilience and sequester carbon.

Vi Agroforestry aims at increasing productivity of smallholder farmers and enhancing their resilience to climate change, while carbon sequestration is considered as a co-benefit that will be marketed. The following document serves the purpose to inform the carbon validation process, hence the focus on carbon in this document. The project is undertaken by 3,000 registered farmer groups with about 60,000 small-scale subsistence farmers who carry out mixed-cropping systems on 45,000 ha. The project area is divided into two project locations Kisumu and Kitale, both with around 22,500 ha of potential project area.

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

In accordance with the VCS terminology, a group of farms in the project adopting a set of SALM activities is considered a project activity instance. Based on the assumption that within a period of nine years an increasing number of farms are adopting SALM practices, this means that this project will include further project activity instances (farms) subsequent to initial validation of the project. Therefore, it follows the definition of grouped projects as outlined under the VCS:

Grouped projects are projects structured to allow the expansion of a project activity subsequent to project validation. Validation is based upon the initial project activity instances identified in the project description. The project description sets out the *geographic areas within which new project activity instances may be developed and the eligibility criteria for their inclusion (VCS Standard 3.0 2011).*

It is further defined for Grouped projects that they shall include one or more sets of eligibility criteria for the inclusion of new project activity instances. The KACP meets the following eligibility criteria sets:

- The applicability conditions set out in the methodology (SALM Methodology, Version 1) apply to all project instances

- The technologies or measures (SALM practices) are used within the whole project area and are applied in the same manner as specified in the project description.

- The whole geographic project area within which the project instances shall be located is subject to the baseline scenario determined in the project description.

- The characteristics with respect to additionality are consistent for the initial instances as well as for the total geographic project area.

In addition this grouped project and the present project description refers to the following general requirements for Grouped projects as specified in the VCS Standard 3.0 (2011, page 9):

- The geographic areas within which project activity instances (farms adopting SALM) are developed are clearly defined. The exact geodetic polygons of the farms which are included in the project description at validation (initial project activity instance) have been done by means of GPS Tracking and are available as shape files.

- The initial project instances are those farms that are included in this project description at validation representing all farms where SALM practices are currently implemented on the issue date of the project description.

- The project is promoting a set of SALM practices among which each farmer can adopt his preferred practice. Based on the monitoring approach, the project description designates the areas of adoption of a specific SALM activity.

- The baseline scenario and the demonstration of additionality are determined for the entirety of the geographic project area within which project activity instances are developed. The project monitoring system ensures that the baseline scenario and the additionality are representative for all potential farms in the project (approx. 60,000) as well as the initial project activity instances (farms currently adopting SALM)

The table below summarizes the initial project instances of the project. The total area of more than 10,000 farmers is 12 174 ha of which 8,332 ha is agricultural land.

Table 1 Initial project activity instances of the KACP

1st KACP project instances	No of farmer groups	Total No of farmers	Total farm area (ha)
Total 1st instances	660	10,873	12,174

1.2 Sectoral Scope and Project Type

Based on the AFOLU Requirements of the VCS (VCS 2011, Version 3) the project activities fall under the category "Agricultural Land Management (ALM). Eligible ALM activities are those that reduce net GHG emissions on cropland and grassland by increasing carbon stocks in soils and woody biomass and/or decreasing CO2, N2O and/or CH4 emissions from soils. The project area shall not be cleared of native ecosystems within the 10 year period prior to the project start date.

In the ALM category, this project falls under the following activity group:

Improved Cropland Management (ICM): This category includes practices that demonstrably reduce net GHG emissions of cropland systems by increasing soil carbon stocks, reducing soil N2O emissions, and/or reducing CH4 emissions. Among these groups, this project focuses on:

a) Practices that increase soil carbon stocks by increasing residue inputs to soils and/or reducing soil carbon mineralization rates and introduction of agroforestry practices.

As mentioned in section 1.1 this project follows the definition of grouped projects as outlined under the VCS.

1.3 Project Proponent

The project will be implemented by the Vi Agroforestry Program, a non-governmental, non-profit organization with 25 years of working experience with agroforestry advisory services to farmers in East Africa. Further, the project is financed by the Foundation Vi Planterar träd ("We plant trees"), and the Swedish International Development Agency (Sida).

Role	Company	Contact
Project proponent	Vi Agroforestry Programme	Bo Lager, Programme Director P.O. Box 3160, 40100 Kisumu, Kenya Ph.: Tel +254 57 2020386 Email: bo.lager@viafp.org

1.4 Other Entities Involved in the Project

Project development support including the development of the SALM Methodology has been provided by UNIQUE and JOANNEUM RESEARCH. All carbon project related development activities have been financed by the World Bank.

Role	Company	Contact
Project development support	UNIQUE forestry and land use Schnewlinstrasse 10 D-79098 Freiburg Germany	Timm Tennigkeit, Matthias Seebauer Ph.: +49 (761) 208534-0 Email: timm.tennigkeit@unique-landuse.de
Technical advisors	JOANNEUM RESEARCH Elisabethstrasse 5, A-8010, Graz, Austria	David Neil Bird Ph.: +43 316 876 1423 Email: neil.bird@joanneum.at
Investor	World Bank 1818 H Street, NW Washington, D.C. 20433, USA	Neeta Hooda Ph:1-202-4585182 Email:nhooda@worldbank.org Johannes Woelcke Ph.: +1 (202) 473-6054 Email: jwoelcke@worldbank.org

1.5 Project Start Date

Project start date: 01.07.2009.

1.6 Project Crediting Period

Project start date	01.07.2009
Project end date	30.06.2030
Total No of crediting years	20 years

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project	X
Mega-project	

Years	Net anthropogenic GHG emissions and removals (tCO2e)
Year 2010	10,320
Year 2011	28,943
Year 2012	55,867
Year 2013	88,536
Year 2014	117,055
Year 2015	137,271
Year 2016	149,185
Year 2017	156,949
Year 2018	164,712
Year 2019	165,026
Year 2020	157,040
Year 2021	132,134
Year 2022	107,226
Year 2023	86,471
Year 2024	74,018
Year 2025	69,867
Year 2026	69,867
Year 2027	69,867
Year 2028	69,867
Year 2029	69,867
Total estimated ERs	**1,980,088**
Total number of crediting years	**20**
Average annual ERs	**99,004**

1.8 Description of the Project Activity

The purpose of KACP is to promote Sustainable Agriculture Land use Management (SALM) practices for mitigation of degraded lands and greenhouse gas emission and build adaptive capacity of farmers to be able to cope with impacts of climate change. Vi Agroforestry's field officers are sensitizing, mobilizing and training farmers on sustainable agricultural practices through participatory group and organization development approaches. Farmers changing agricultural practices to SALM will generate carbon stocks in agricultural systems, increase staple food production and access carbon market to generate annual revenues until 2029.

The project area is characterized by cropland or grassland, constant or increasing agricultural pressure on lands, decreasing use of agricultural inputs such as fertilizers and decreasing forest land. Smallholder farmers participating in the project are practicing mixed agriculture dominated by maize, beans and livestock keeping, but the majority of farmers live in poverty and suffer from food insecurity. Beside the advisory services provided by the project, agriculture productivity is promoted through extension advisory systems provided by government and other civil society organizations.

The project is using participatory planning, monitoring and evaluation of farmer led implementation system. Altogether, there are 28 field advisers in 28 administrative locations within the project. Average land holding that potentially can be under SALM per household is assumed to be approximately 0.5 ha 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 field adviser will contract farmer groups and the contract is signed between the farmer groups and Vi Agroforestry.

Generally the field extension approach consists of the following five steps:

Step 1) Stakeholder awareness raising as an entry point in the village, region and to explore existing and complementary extension services to engage in partnerships (farmer, NGOs and Government agencies are invited);

Step 2) Sensitization and trust building of farmer groups;

Step 3) Recruitment of registered farmer groups including contracting;

Step 4) Strategic planning, training and advisory services for farmers on farm-specific 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.

Practical things promoted through advisory services within these strategies are e.g.: on-farm diversification; capacity building on appropriate SALM practices like contour planting, composting, terracing and residue management; tree planting promotion and off-farm business engagement.

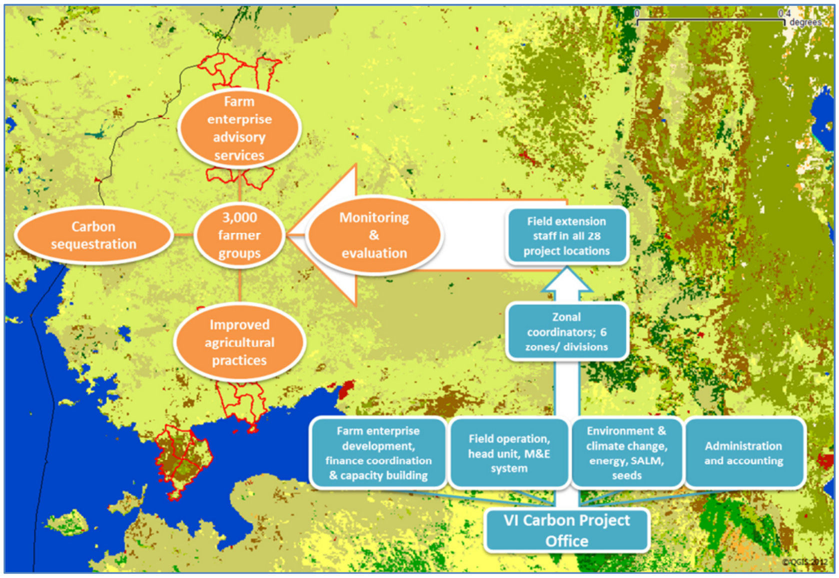


Figure 1 Schematic structure of the institutional set up of the project

The package of SALM activities promoted by the KACP includes a large number of practices which go beyond the objective of soil carbon sequestration. A full list of SALM practices is provided in the supporting documentation. In the table below only those SALM practices are listed which are accounted in terms of emission reductions and carbon sequestration.

Table 2 SALM practices promoted in the KACP and accounted for carbon

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 has proved to be a more sustainable economic, social and environmental land management system in smallholder conditions. Agroforestry increases tree cover which contributes to increased biomass above- and belowground including 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 the cropland in a mixed spatial (scattered) system. • Boundary / hedge tree planting involves planting of selected trees along field boundaries, borders and roadsides which can create micro-climate for crops, serves as windbreaks thus stabilizing the soil. • Woodlots serve as woody biomass pools for the farmers. Generally, about 40 trees planted at one distinct piece of land can be considered as a woodlot. Woodlot 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 productivity of the soils through increased litter inputs, enhanced microclimatic conditions and soil nutrient availability. • Trees and pastures is a silvo-pasture system. This practice can contribute to the production of green manuring and improved fallowing practice. • 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.

1.9 Project Location

The KACP is located in Western Kenya in the Nyanza and Western provinces within two project locations in Kisumu and Kitale:

- Kisumu: 0° 7'45.53"N; 34°23'38.56"E and 0°23'34.29"S; 34°17'58.55"E
- Kitale: 0°27'0.12"N; 34°31'14.87"E and 0°48'18.13"N; 34°24'54.61"E

The map below displays the geographic project area divided into the two project areas in Kisumu (southern part) and in Kitale (northern part) and further subdivided into the administrative locations.

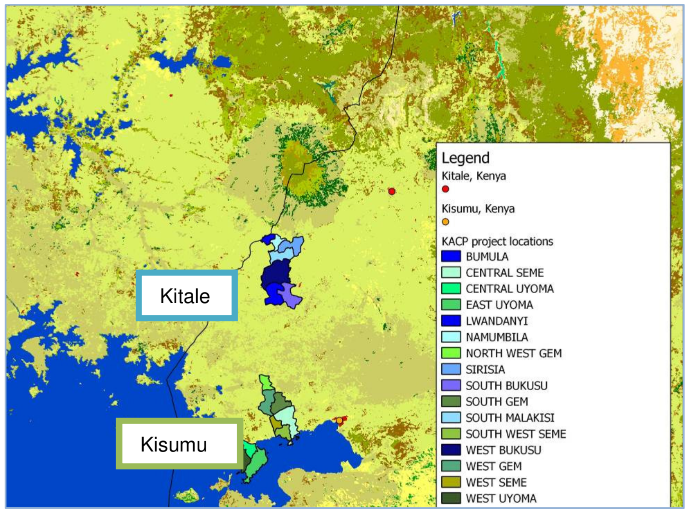


Figure 2 The KACP project locations in Kitale and Kisumu, Western Kenya

Biophysical conditions

The project area is dominated by Lower and Upper Midlands Agro-Ecological Zones (AEZ) supporting mainly maize, sorghum, millet, beans, potatoes, cassava and sugarcane among other types of crops. Due to this range of agro ecological zones climatic factors such as temperature and rainfall varies and a great diversity of farming systems exist although maize and bean arethe most dominating crops within the subsitence farms.

Table 3: Biophysical conditions of the project locations

Project Region	Altitude	Mean temperature range	Mean precipitation	Major crops
Kisumu	1200 – 1500 m	17.4 °C - 29.8 °C	1,326 mm	Maize & sorghum
Kitale	1200 – 1850 m	14 °C – 27.6 °C	1,884 mm	Maize & sugarcane

Dominant soil types: To identify major soil types in the proejct area the assessment of soil classes used the results of the study done by Batjes (2010)[1] which derived the IPCC soil classes from the Harmonized World Soils Database (HWSD)

[1] http://www.isric.org/isric/webdocs/Docs/ISRIC_Report_2009_02.pdf

(FAO/IIASA/ISRIC/ISS-CAS/JRC, 2009)[2] which is the most recent, highest resolution global soils dataset available. Accordingly, most of the soils in the project area are classified as high activity clay soils (HAC) and low activity clay soil (LAC). The map below shows the clay content in % of the soils in the project. The clay content in Kisumu is significantly higher than in Kitale which is important for the modeling of soil carbon sequestration.

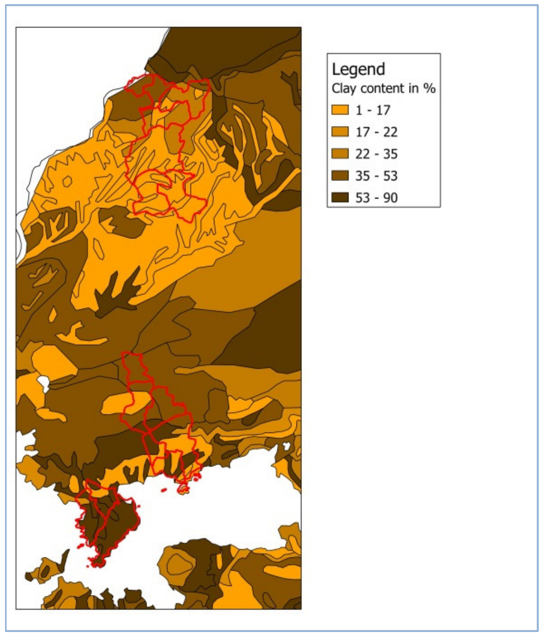


Figure 3 Clay content in % of the soils in the total project area

1.10 Conditions Prior to Project Initiation

Generally, the region in western Kenya is characterized by high agricultural potential that attracted large human settlement in the past, resulting in extensive land fragmentation and degradation (Crowley and Carter, 2000). The Western Province is one of the most densely populated regions in Kenya. Following the 1999 household census, average population density stood at 406 persons/ km^2. According to the government projections using logistical regression functions, population will still significantly increase in Western province. Therefore land degradation and fragmentation will continue and lead to extreme poverty (Jaetzold et al. 2005).

Generally, under humid conditions, the permanent leaching of the soils is a serious problem aggravated by the high population densities and therefore overuse of the land for food production over the years. Except for the volcanic deposits around Mt. Elgon and an old volcanic layer near Kakamega Town, soils in Western Province have mainly developed on basement rocks, which are normally not rich in nutrients. The heavy rains of the humid and semi humid climates there have leached the soils considerably for millions of years. Today dense population is a driver of agriculture

[2] *FAO/IIASA/ISRIC/ISSCAS/JRC, 2009. Harmonized World Soil Database (version 1.1). FAO, Rome, Italy and IIASA, Laxenburg, Austria. http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/*

intensification that dramatically reduce the nutrient content of the soils and therefore compromise food supply. Fallow years or even forest periods for the partial restoration of the nutrients are normally not possible due to the high population pressure (Jaetzold et al. 2005). A goal of the project is to increase the agricultural yields through improved nutrient management.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

There are no laws in the Republic of Kenya related to the use of manure, cover crops, and trees in agricultural systems.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

The land for implementing the proposed project is owned by individual farmers/family members. The ownership of the land in the project area was adjudicated and legally assigned after consolidation and demarcation in the mid 1950's. This legal position bestows upon registered members of the society, the powers to make the necessary decisions with respect to this project. The legal title of the land is evidenced through legally registered land certificates (available upon request), issued by the Government Registrar of Land Titles. The land tenure system in the project site is" free hold" which does not have expiry date and is only transferable through sale or inheritance. Land ownership in project region is private (freehold) and the family has both access and control. Land is owned in two major categories among most farmers. Based on the household monitoring in the project, land under full ownership is about 48 % and full ownership within the family is 52 %. For the latter land ownership among family members is clear, but land titles have not been processed since this is expensive. Farmer only register the title when they want to sell their land or use it as collateral.

1.12.2 Emissions Trading Programs and Other Binding Limits

Agricultural projects in non-Annex I countries are not eligible under the Kyoto Protocol.

1.12.3 Participation under Other GHG Programs

The project has not been registered, or is seeking registration under any other GHG programs.

1.12.4 Other Forms of Environmental Credit

The project is not being used to create other environmental credits.

1.12.5 Projects Rejected by Other GHG Programs

n.a.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The initial project activity instances (farms) included in this project description is spread in most administrative locations of the entire project area. Consequently all eligibility criteria which apply for the whole project area in regard to the application of the methodology equally apply to the first project activity instances as well as all activity instances which are included at later stages of the project. Further, the technologies or measures applied in the project and described in this project description as well as the baseline scenario and the characteristics of additionality are determined for the whole project area and are consistent for all project instances. See the monitoring plan described in the section 4 for further details on monitoring of the total project area and project activity instances.

Leakage Management

This project aims at increasing the organic inputs from plants and manure to the agricultural land. The project intervention is focusing on the whole farm as the basic unit where biomass is produced to provide organic inputs to the crop fields as well as to provide feedstock to livestock. Consequently biomass and organic material is only shifted within a single farm system.

The one potential source of leakage is an increase in the use of fuel wood and/or fossil fuels from non-renewable sources for cooking and heating purposes due to the decrease in the use of manure and/or residuals as an energy source. Leakage due to the increase in the use of fuel wood from non-renewable sources for cooking and heating purposes may be a significant source of leakage if manure or other agricultural residuals used for cooking and heating are transferred to the fields as part of the project. In the project, the traditional cooking method is cooking on open fires or three-stone fires. Based on the Vi Permanent Farm Monitoring data 2009 none of the farmers used manure or residues as fuel source while more than 80% and 97% use firewood or charcoal in Kisumu and Kitale respectively. This is in line with the national data for Kenya where a survey conducted in February 2006 in Kenya showed that: 96.8 % of the population use firewood for cooking and 87.5 % of the population uses traditional three-stones cooking. The average firewood consumption is 1.5 kg per person per day (ppd) (Austin et al. 2009)[3].

Vi agroforestry, through its whole farm approach, is promoting the shift from the traditional three-stone stove to an improved and wood-saving stove. It is expected that the firewood consumption per farm is reduced by half through this intervention. Further, as part of the project, firewood trees (e.g. Markhamia lutea) are planted to ensure sustainable source of energy.

Commercially Sensitive Information

None

Further Information

[3] *http://www.compete-bioafrica.net/improved_land/Annex2-2-2-COMPETE-032448-2ndReport-D2-2-D2-3-Final-Final.pdf*

See supporting information, chapter 7 and additional documents which are available on request

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

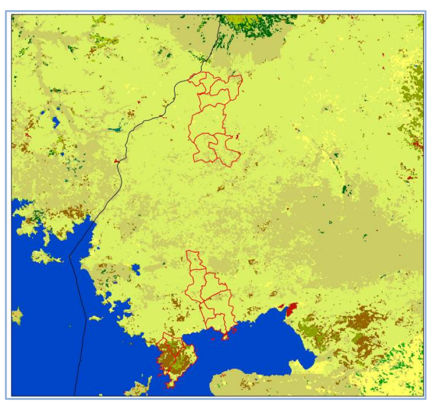
Approved VCS Methodology VM0017 'Adoption of Sustainable Agricultural Land Management, Version 1.0

2.2 Applicability of Methodology

This methodology is applicable to projects that introduce sustainable agriculture land management practices (SALM) into an agricultural landscape subject to the following conditions:

a) Land is either cropland or grassland at the start of the project.

The land use map below shows that the project land is dominated by a mixture of cropland and grassland, only in the South-western part of Kisumu some land is classified as a mixture of shrub land and small forest pockets. Considering that SALM activities are implemented within the individual farms on cropland and grassland no project activity will be implemented on forest land. However, the baseline and monitoring survey of the project will always assess the trees standing on the farms and exclude those areas exceeding the UNFCCC Kenya forest definition (30% crown cover, 0.1 ha minimum area, and 2 m minimum height). In fact, a very small percentage of the area has been excluded since some farmers have planted woodlots on their farmland. The forest in the area was cleared before or during the 1970ties. The high population density in the project area also indicates agricultural land use.



Mosaic cropland vegetation (grassland/ shrubland)

Mosaic vegetation (grassland/ shrubland/ forest)

Closed to open (>15%) shrubland (<5m)

Mosaic forest or shrubland (50-70%) / grassland (20-50%)

Figure 4: Land classification of the project area based on the GlobCover 2009 land cover map[4] (ESA 2010 and UC Louvain, 2010)

b) The project does not occur on wetlands

The total project area and the farms do not occur on wetlands following the definition of wetlands according to the 2003 IPCC GPG LULUCF guidance where a wetland category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories[5]. The map below demonstrates this.

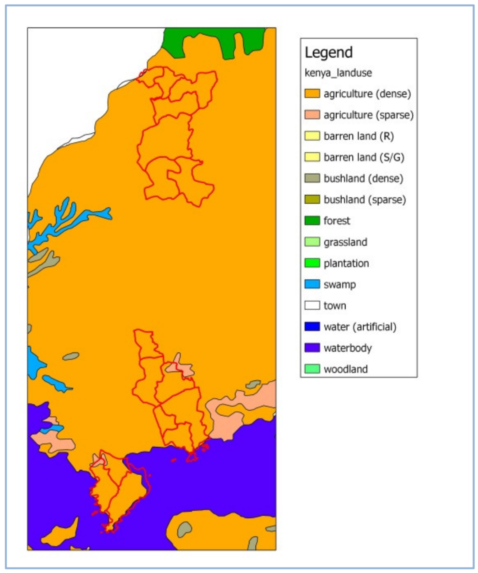


Figure 5: Land use classification of the project area (map is available from WRI 2011)

c) The land is degraded and will continue to be degraded or continue to degrade

Based on the methodology the CDM EB approved "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (Version 01) is applied to demonstrate that the project land is degraded and will continue to degrade:

Provide documented evidence that the area has been classified as "degraded" under verifiable local, regional, national or international land classification system or peer-review study, participatory rural appraisal, satellite imagery and/or photographic evidence in the last 10 years.

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[4] The GlobCover Land Cover product is the highest resolution (300 meters) Global Land Cover product ever produced and independently validated, derived from an automatic and regionally-tuned classification of a time series of MERIS FR composites

5 "Wetlands" as defined in "Annex A: Glossary" of the IPCC GPG LULUCF 2003. http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Glossary_Acronyms_BasicInfo/Glossary.pdf

Generally, studies at supranational scales indicate that land degradation is continuing unabated in Sub-Saharan Africa. Land degradation is the fundamental biophysical cause of declining per capita food production in Sub-Saharan Africa and this region including Kenya is the only region in the world where per capita food production has been on the decline for the last two decades (Muchena 2005). A study by Kamoni et al. (2007), which compared the soil organic carbon stocks (SOC) in 1990 with 2000 observed a general decline in SOC over this period due to the continued conversion of grazing land to subsistence agriculture and forest conversion to cropland. Using three different models (RothC, Century and IPCC default method) the same study estimates a net loss of soil C between 2000 and 2030 in Kenya.

More specifically, the highland districts in western Kenya where the project is located generally experience favorable agro-climatic conditions and therefore should be a food surplus area. In practice, they are heavily dependent on food imports whilst national poverty surveys consistently show them to be amongst the poorest in the country (Ndufa et al. 2005)[6]. Ndufa states that at the root of this problem in these districts are high population densities and, therefore small land holdings. Due to continuous cropping and little investment in soil fertility replenishment, the soil has become severely depleted. Neither phosphorus nor nitrogen levels are sufficient for even moderate agricultural performance. The table below illustrates some indicators related to land degradation of the study by Ndufa and compares them to the information from the Vi Permanent Farm Monitoring -monitoring in the project. The study refers to the highland districts around Lake Victoria and specifically to Vihiga and Siaya districts.

Table 4 Comparison of land degradation drivers

Indicators Ndufa et al. 2005	Vi Permanent Farm Monitoring survey (data from 2009)
Land holdings range between 0.5 and 2 ha	0.7 ha in Kisumu & 1.1 ha in Kitale
200 farms/ km^2	136 farms/ km^2 in Kisumu & 92 farms/ km^2 in Kitale
Maize yield 1000 kg/ha over two cropping seasons.	In Kisumu the maize yields ranged between 770 and 817 kg/ha between 2009 and 2010. In Kitale the average yield is with 1,484 kg/ha higher.
Most households are producing enough maize to feed themselves for a few months.	Food security in Kisumu 5.4 months; food security in Kitale 8.5 months
About 40% of farmers use some inorganic fertilizer	In Kisumu 28% of farmers use fertilizer; in Kitale 84% of farmers. In both locations farmers would reduce inorganic fertilizer use in the future as a consequence of

[6] *http://www.nrsp.org.uk/database/documents/2139.pdf*

	high capital needed.

This comparison shows that the project area is subject to continuous cropping and low soil fertility management which leads to sever soil degradation. See also 2.4 for more information on degradation in the project area.

d) *The area of land under cultivation in the region is constant or increasing in absence of the project*

Between 2000 and 2005 the amount of cropland in Kenya has increased from 5,374,000 ha to 5,721,000 ha through the conversion of forest and other land (FAOSTAT 2010)[7]. Kamoni et al. (2007) model estimates of soil C stocks in Kenya between 2000 and 2030 shows that conversion of natural vegetation to annual crops leads to the greatest soil C losses, particularly in grasslands; and this is an issue in all climate zones in Kenya from arid to humid.

e) *Forest land, as defined by the national CDM forest definition, in the area is constant or decreasing over time;*

Between 2000 and 2005, Kenya experienced a deforestation rate of 0.3% per year (FAOSTAT 2010). More specifically, as shown in Figure 6 the forest areas nearest to the project areas is the Kakamega Forest in the North East of Kisumu and the Mount Elgon National Park North of Kitale.

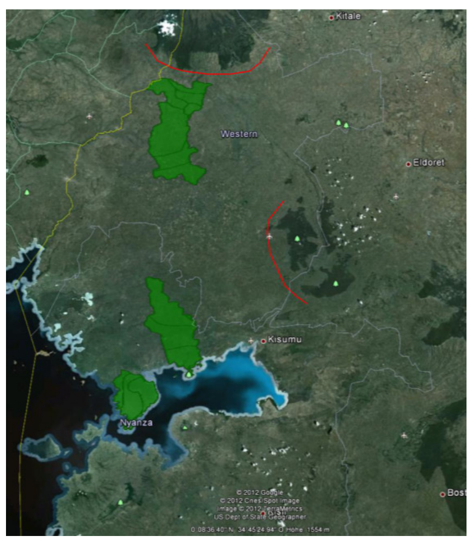

Figure 6 Identification of forest areas nearest (red lines) to the project locations (Google Earth 2012)

7 *FAO. 2010. FAOSTAT. http://faostat.fao.org/site/377/default.aspx#ancor Downloaded: 09 March 2010.*

A land use classification and land cover change analysis of the past 30 years of the Kakamega forest complex done by Lung et al.[8] shows that the forest area is decreasing as shown in the map below.

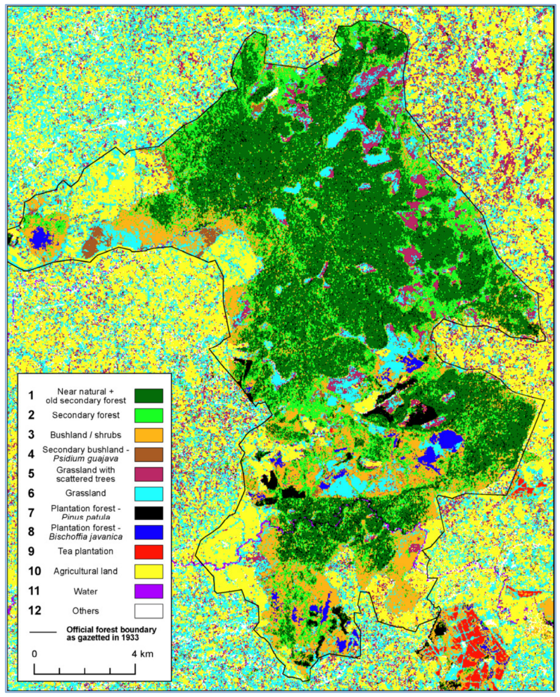

Figure 7 Land use change analysis of Kakamega Forest of the last three decades (Lung et al.)

In total, a decrease in forest area is observed due to clear felling of larger areas as well as due to selective logging opening the forest cover by numerous small gaps. The forests are placed in one of the world's most densely populated rural areas which is intensely used for subsistence agriculture. Due to continuously increasing population numbers the pressure on the forests is growing. For the local people the forests play an important role in satisfying their daily needs (e.g. fire wood, house building material; see Kokwaro, 1988). Other legal as well as illegal activities since the early colonial time at the beginning of the 20th century till today have resulted in forest degradation (Mitchell, in print). Only small patches of intact forest are left. The heavily disturbed Kakamega Forest is said to have been reduced to ca. 120 km² in 1980 (Kokwaro, 1988). KIFCON (1994) estimated the off-take of fuel wood as ca. 100,000 m^3 per year (Lung and Schaab).

f) *There must be studies (for example; scientific journals, university theses, local research studies or work carried out by the project proponents) that demonstrate that the use of the Roth C model is appropriate for: (a) the IPCC climatic regions of 2006 IPCC AFOLU Guidelines, or (b) the agro-ecological zone (AEZ) in which the project is situated.*

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[8] *http://www.isprs.org/proceedings/XXXV/congress/comm2/papers/174.pdf*

Using the IPCC climate zone stratification[9] both project areas in Kisumu and Kitale are located within the tropical montane zone.
Two studies have been chosen to demonstrate that the application of the RothC model is appropriate and that the model is validated for similar AEZs/ climate regions.
The first study is conducted by Kamoni et al. (2007)[10] who evaluated the ability of RothC and Century models to estimate changes in soil organic carbon (SOC) resulting from varying land use/management practices for the climate and soil conditions in Kenya. The Kabete long term fertility trial of this study is located in the same IPCC climate zone (tropical montane).
In addition, a second study by Kaonga and Coleman (2008)[11], located in the tropical montane zone of Zambia evaluated the soil organic turnover in fallow-maize cropping systems and tested the performance of the RothC model using empirical data.
The table below compares important parameters to demonstrate the similarity of study sites as well as similar parameters used to parameterize the RothC models compared with the project locations

Table 5 Comparison of parameters between research sites and project locations

Parameter	Kabete long term fertility trial (Kamoni et al. 2007)	Msekera fallow experimental site (Koanga & Coleman 2008)	Kisumu project area	Kitale project area
Country	Kenya	Zambia	Kenya	Kenya
Elevation	1787 m	1030 m	1200 – 1500 m	1200 – 1850 m
IPCC climate zone	Tropical montane	Tropical montane	Tropical montane	Tropical montane
Mean precipitation	981 mm	1000 mm	1381 mm	1683 mm
Mean annual temperature	21 °C	23 °C	23°C	21 °C
Clay content	64%	26%	39%	20%

[9] 2006 IPCC Guidelines, Vol.4 (1), Ch.3; the c IPCC classification scheme for default climate regions is based on elevation, mean annual temperature (MAT), mean annual precipitation (MAP), mean annual precipitation to potential evapotransporation ratio (MAP:PET), and frost occurrence.
[10] Kamoni P. T. et al. (2007). Evaluation of two soil carbon models using two Kenyan long term experimental datasets. Agriculture, Ecosystems and Environment 122. pp. 95-104
[11] Kaonga M. L., Coleman K. (2008). Modelling soil organic carbon turnover in improved fallows in eastern Zambia using the RothC-26.3 model. Forest Ecology and Management 256. pp 1160-1166

Conclusions from RothC model validation:

Study: Kaonga and Colemann (2008)

- Fitting the RothC model to experimental data from improved fallows in Msekera resulted in reasonable estimation of annual plant C inputs to the soil in sole maize and tree fallow stands.

- The fact that RothC calculated total annual organic C inputs reasonably well, and model predictions of SOC fitted the observed data to within experimental error, suggests that the model is giving reasonable simulations in this environment.

Study Kamoni et al (2007)

- Both RothC and Century models were shown to be useful tools for predicting changes in soil C stocks under Kenyan conditions.

2.3 Project Boundary

Geographic boundary

The project area generally is the sum of all farms where SALM practices are adopted over time. Therefore, the project area is increasing over time depending on how many farms are under SALM adoption. Following the guidance on grouped projects under the VCS (VCS Standard 3.0) the map below delineates the total project area within which all project activity instances occur during the crediting period. The boundaries of the project area follow the administrative boundaries of locations which are a fourth level subdivision below Provinces, Districts and Divisions. Locations are further subdivided into Sub-locations

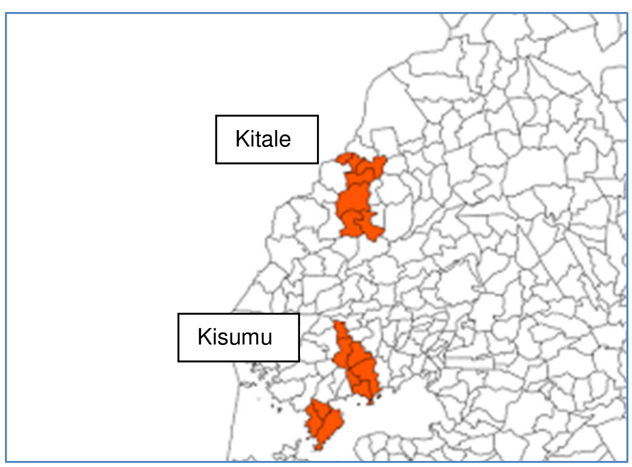

Figure 8 Extended project area based on the administrative boundaries of locations

Inclusion of project activity instances

Each farm where SALM practices are implemented will be geographically delineated by means of GPS tracking and only those farms tracked are included as project activity instance in the project. The tracking is done either by the Vi zonal coordinators or farmer resource person/s in each registered farmer groups who are trained to perform the tracking of individual farms (see flowchart below)

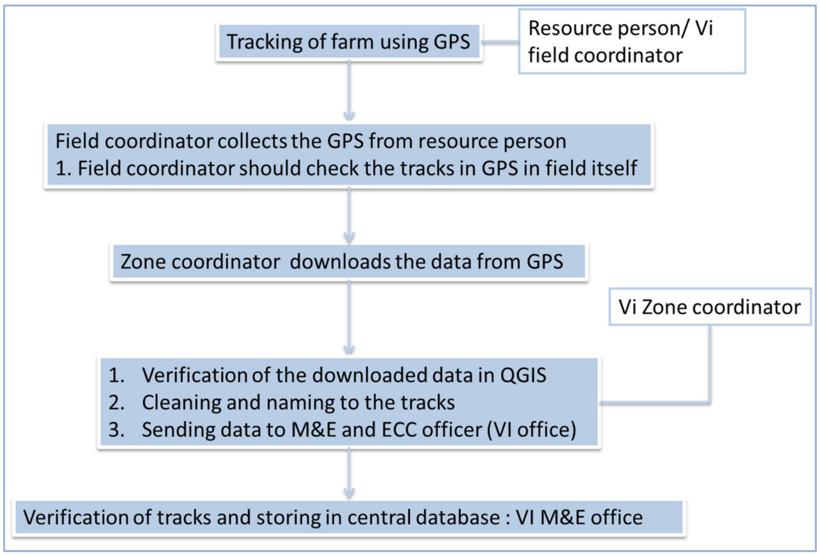

Figure 9 Organizational structure of farm boundary tracking

Initial project activity instances

The initial project activity instances included in this project description and subject to validation are all farms where SALM practices are already adopted or are being planned to adopt and for which the farm boundaries have been tracked. All shape-files of the farms are archived at the M&E unit of the central Vi office in Kisumu and a sample of one farmer group and individual farms can be found below.

Figure 10 Tracked boundaries of several farms in one farmer group

Figure 11 Individual farm boundary shown on Google Earth

Table 6 Summary of the first group of project instances

1st KACP project instances	No of farmer groups	Total No of farmers	Total Area (ha)	Average No members per farmer group
Kisumu	306	4,649	5,376	15
Kitale	354	6,224	6,799	18
Total 1st instances	660	10,873	12,174	16

Control establishment over project areas

Evidence of control over the project areas (project instances) is established through the farmer group contracting procedure in combination with the individual farmer commitment forms. Each farmer group registered under the project signs a contract agreement with the project proponent (Vi Agroforestry). The group agreement is complemented with the Farmer Commitment and Activity monitoring Form which will guide the farmer to plan, commit, implement SALM practices and monitor land productivity. It allows the farmer freely to promise and commit to undertake the Sustainable Agricultural Land Management (SALM) practices that improve soil fertility, increase farm productivity or crop yields, contribute to carbon emission reduction and enhance environmental conservation for a certain period starting from the year of signing the commitment form. The farmer will annually undertake self-assessment of his SALM activity implementation and report the progress to his/her group leadership. The form is signed by the individual farmer as well as by the corresponding group representative. Both templates are attached in section 7 and copies of contracted farmers groups and commitment forms are available upon request.

Carbon pools

As per the methodology, the following sources and sinks are included in the estimation of net GHG emission reductions. All sources or sinks are listed in the table below, but not all may be calculated as the project progresses. Some activities may not occur, while others may be insignificant sources in the project and so ignored.

Table 7 Carbon pools considered in this project

Carbon pools	Gas	Explanation
Above ground tree biomass	CO_2	A carbon pool covered by SALM practices. The increase in above ground biomass of woody perennials planted as part of the SALM practices is part of the methodology. The above ground biomass is calculated using the CDM A/R Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and the "Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands", AR-AMS0001
Below-ground tree biomass	CO_2	Below-ground biomass stock is expected to increase due to the implementation of the SALM activities. The increase in below ground biomass of woody perennials planted as part of the SALM practices is part of the methodology. "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and the "Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism

		implemented on grasslands or croplands", AR-AMS0001
Soil organic carbon (SOC)	CO_2	A major carbon pool covered by SALM practices.
Use of fertilizers	N_2O	Main gas for this source. Baseline and project emissions from synthetic fertilizer use are calculated using the CDM A/R Tool "Estimation of direct nitrous oxide emission from nitrogen fertilization"
Burning of fossil fuels	CO_2, CH_4, N_2O	CO_2 and non-CO_2 emissions are calculated using the tool Estimation of emissions from the use of fossil fuels in agricultural management

2.4 Baseline Scenario

As outlined in section 1.10 the overall situation in the project area is small scale subsistence farming causing long-term, permanent leaching of the soils aggravated by the high population densities and therefore overuse of the land for food production over the years. Vi Permanent Farm Monitoring[12] was used to identify the baseline conditions within the total project area and the results are shown below. Justification is provided by comparing the survey results with studies and literature representative for this region.

A rich body of scientific research on smallholder farm agrarian change and soil fertility management can be found for the Western Kenya region which is broadly representative of the situation found in other tropical highlands of East Africa due to its demographic and agro-ecological characteristics. Four particular studies are used to justify the baseline conditions as found in the farm survey (ABMS) of this project and the map below shows the locations of the studies in relation to the project area:

- Henry et al. (2009): Biodiversity, carbon stocks and sequestration potential in aboveground biomass in smallholder farming systems of western Kenya[13]
- Tittonell et al. (2005): Exploring diversity in soil fertility management of smallholder farms in western Kenya I and II.[14]
- Crowley and Carter (2000): Agrarian change and the changing relationships between toil and soil in Maragoli, Western Kenya (1900-1994)[15].

[12] *See section 4 for more information regarding the activity based monitoring system (ABMS) of the project*

[13] *1) http://www.agroparistech.fr/geeft/Downloads/Pub/Henry_et_al_2009_AGEE_129_C_and_biodiv_in_Kenya.pdf*

[14] *1) http://www.sciencedirect.com/science/article/pii/S0167880905001532*
2) http://www.worldagroforestry.org/downloads/publications/PDFs/ja05207.pdf

[15] *http://www.springerlink.com/content/v5h0054v62554378/*

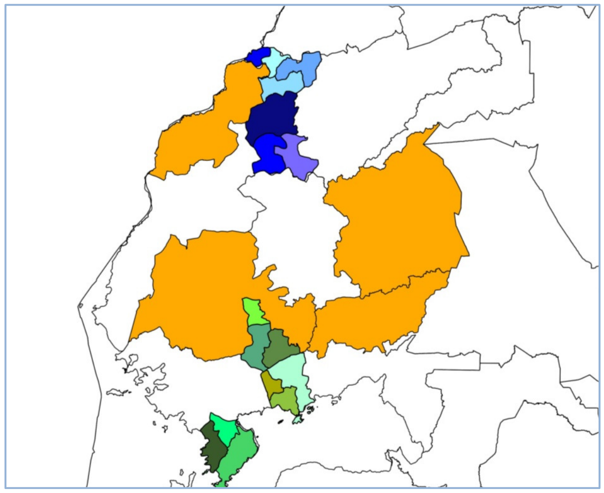

Figure 12 Location of scientific studies (orange color) in relation to the project area

The following figure illustrates the baseline conditions of a typical subsistence farm in Kisumu and Kitale. The values shown are average values taken from the Vi Permanent Farm Monitoring of the entire KACP project area. % refers to percent of farmers in the project location.

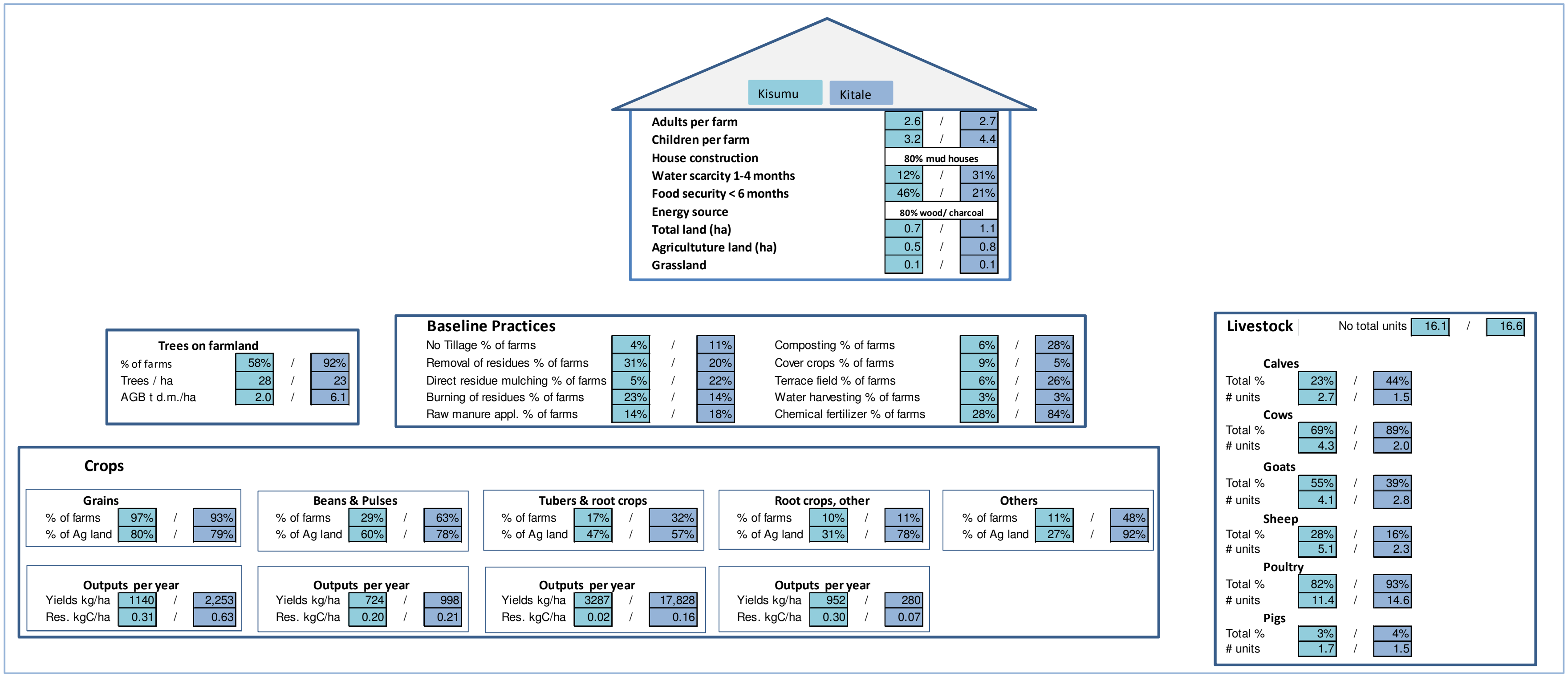

Figure 13 Baseline conditions of an average farm in Kisumu and Kitale

The general observation found in all studies is that population growth has resulted in extensive land fragmentation and degradation in the past decades. The areas surveyed experience some of the highest rural population densities in the world ranging from 400 to 1,300 inhabitants per km^2. This is in line with the situation in the project areas with around 820 km^{-2} inhabitants in Kisumu and 645 km^{-2} inhabitants in Kitale. Due to the high population pressure in the subsistence smallholder sector, average farm sizes reduced over the past decades now ranging from 0.6 ha to 2.8 ha according to literature. The Vi Permanent Farm Monitoring data result show that land holdings per household is 0.7 ha in Kisumu and 1.1 ha in Kitale. All studies confirm the alarming rate of soil fertility decline as a major reason for declining yields of food crops and, as farm sizes decline, the expansion of maize areas occurring at the expense of the other staple grains grown in the areas which is clearly hastening soil deterioration. According to the Vi Permanent Farm Monitoring data, the four dominant crop groups (according to FAO classification) in both project locations are grains with maize as the most dominant crop, beans & pulses, tubers & root crops and other root crops. Grains and maize respectively is by far the most widely cultivated crop with more than 90% of farms in both project locations and covering around 80% of the agricultural land. Maize is often intercropped with beans particular in Kitale (63% of farms) on more or less the same share of agricultural land as the grains. The distribution of the crop areas generally indicates a high level of intercropping.
Average grain production as a commonly used indicator for farm productivity ranges between 1.1 and 2.2 t $ha^{-1}year^{-1}$ in Kisumu and Kitale respectively which is in the range of 0.4-2.5 t $ha^{-1}year^{-1}$ as mentioned in the literature. Food security reportedly is in a decline in the project region. Crowley et al. (2000) reports that grain harvests, which were often sufficient to feed the family with some surplus to sell from the 1950 onwards, did not meet self-sufficiency needs in 1995. Only 3-15% of the farmers interviewed in 1995 reported that subsistence requirements from own maize are met. Tittonell et al. (2005) report self-sufficiency of maize in 2005 of around 7 months per year. In 2009, the Vi Permanent Farm Monitoring data reveal that 46% and 21% of the farmers in Kisumu and Kitale are food secure only for less than 6 months.
With regard to livestock, Crowley et al. (2000) identifies cattle ownership as one key criterion for distinguishing poorer from wealthier households. In 1995, the average number of cattle per farm ranged from 1 – 1.6 units which increased to around 4-5 in Kisumu (69% of farms) and 2 in Kitale (89% of farms) according to the 2009 Vi Permanent Farm Monitoring data.
The tree biomass based on trees standing on the entire farmland is estimated to be very low in Kisumu with 2 tonnes aboveground biomass per ha (on average 28 trees) and only 58% of the farmers had individual trees growing on their farms in 2009. In Kitale tree biomass is significantly higher with 6.1 t dm/ha and more than 90% of the farmers grow trees. Compared to this Henry et al (2009) calculated aboveground biomass of individual trees on farm land ranging between 8.1 and 10.2 t dm ha^{-1}.

With regard to management practices including SALM activities, there are significant differences between Kisumu and Kitale. In Kisumu, only few farmers already practice organic fertilization with compost, mulching or cover crops (5-9% of farms) while more than 30% of the households still remove plant residues from the fields or burn it (23%) in the baseline. In Kitale, a larger number of farms already practice composting and direct mulching (28-22% respectively).

In summary, the Vi Permanent Farm Monitoring survey of the project region revealed that the principle subsistence, multi-cropping farming of small-scale farmers persists over time and can be regarded as the baseline scenario.

2.5 Additionality

To identify the baseline scenario and demonstrate additionality of this project the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) is applied.

Procedure:

STEP 0. Preliminary screening based on the starting date of the project activity
The project was developed and is being implemented by Vi Agroforestry with the World Bank's BioCarbon Fund supporting the development of the carbon accounting methodology. The project funders include farmers (labour), Vi Planterar Träd, the Swedish International Development Agency (sida) and World Bank (BioCarbon Fund).
The first step to develop the project was taken 2007 when the World Bank (BioCarbon Fund) started to screen potential organizations in Kenya to do an agricultural soil carbon project. From 2007, the BioCarbon Fund and Vi agroforestry supported project preparation which involved the preparation of the Project Idea Note (PIN) and the Carbon Finance Document (CFD) which were reviewed by the BioCarbon Fund. The Kenya National Environmental Management Authority (NEMA), a Designated National Authority endorsed the project (see Letter of no-objection). This process led the World Bank to draft a Letter of Intent and signing a nine year (2009-2017) Emission Reduction Purchase Agreement (ERPA) on November 2010 with Vi Agroforestry. Therefore, the incentive from the planned sale of VCUs (partly as up-front funding) was seriously considered in the decision to proceed with the project activity. The project start date (July 2009) marks the starting point when Vi Agroforestry started project activities and monitoring in the field.

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity
Sub-step 1a. Identification of alternative land use scenarios to the proposed project activity
The following alternatives to the project activity will be evaluated:
1. The land-use and management prior to the implementation of the project activity, either grasslands or croplands;
2. Adoption of sustainable agricultural land management without the incentives from the carbon market (project activity); and
3. Abandonment of the land followed by natural regeneration or assisted reforestation.

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations
All alternatives comply with current laws and regulations

STEP 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

Table 8 displays the barrier analysis matrix which identifies alternatives and barriers. A more complete discussion of the barriers follows.

Table 8 Barrier analysis matrix

Alternative land use scenarios	Investment	Institutional	Technological	Local tradition	Prevailing practice	Local ecological conditions	Social conditions
Land-use and management prior to the implementation of the project activity							
Adoption of sustainable agricultural land management without the incentives from the carbon market (project activity)	X		X				
Abandonment of the land followed by natural regeneration or assisted reforestation					X		X

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers

1. The land-use and management prior to the implementation of the project activity has no barriers to implementation. Low input subsistence agriculture is by far the most dominant activity throughout the region. Based on the project monitoring data, the main source of income for farmers is from crop production with 71 %. Considering the generally favorable agro-climatic conditions for crop cultivation in the areas, this land management scenario is regarded as the baseline scenario.

2. Adoption of sustainable agricultural land management (SALM) practices without incentives from the carbon market faces two main barriers: investment and technological barriers; particularly the technological barrier is of fundamental importance as outlined below.

   The carbon project requires a written commitment from farmer groups to participate in the project and a robust farm monitoring system engaging the farmer to monitor his/her performance. These innovative systems are unique to a carbon project and will help farmer to reflect the impact of management practices and support targeted extension. Jaetzhold et al (2005)[16] stated in his Farm Management Handbook for Western Kenya that due to rapidly increasing population pressure farmer cannot practice fallow systems anymore and have to transform to intensive farming. Respective SALM technologies and farm enterprise support to increase value to agricultural commodities and link farmers with the market are lacking in the project region in the baseline

3. Abandonment of the land followed by natural regeneration is not possible anymore because of the high population density in the area (an applicability condition, see section 2.2).

Sub-step 2c. Determination of baseline scenario (if allowed by the barrier analysis)

Continuation of the pre-project land use*:* The current land use system has no barriers for implementation since the farmers are trapped in this so-called maize-focused poverty traps. According to Ndufa et al. (2005) the farmers are heavily dependent on food imports, whilst national poverty surveys consistently show them to be amongst the poorest in the country. At the root of this problem are high population densities and, therefore, small land holdings, and limited access to markets. As a result of continuous cropping with very little investment in soil fertility replenishment, the soils have become severely depleted. Many poor households in these districts are now caught in a “maize-focused poverty trap”, whereby their first agricultural priority is to provide themselves with maize for home consumption, yet yields are low and returns are insufficient to support investment in either organic soil fertility enhancement technologies or inorganic fertilizers. Thus, despite that the majority of average household puts large portions of its land under maize during both cropping seasons, it is still unable to feed itself for several months of the year (Ndufa et al. 2005).

The surveyed baseline data of the entire project area underpin these findings. Figure 13 in section 2.4 shows the baseline socio-economic and farm production data of an average farm household in the project area separately for Kisumu and Kitale. Remarkably are the food and water scarcity and high dependency on maize production.

STEP 4. Common practice analysis

VI Agroforestry has been providing advisory services for small-scale faming households in the Lake Victoria catchment for more than 20 years. The organization has projects –apart from Kenya - in Uganda, Tanzania and Ruanda using agroforestry techniques as a way of improving their production in a sustainable way and thereby increasing their incomes for improved living conditions. The programme runs six projects around Lake Victoria, two in Kenya, one in Uganda and two in Tanzania and one in Rwanda working with around 150.000 families, i.e. more than 1 million people[17]. However, only due to the carbon project a written commitment from farmer groups to adopt SALM practices and a robust farm monitoring system engaging the farmer to monitor his/her performance will be put in place. These innovative system are unique to a carbon

[16] *JAETZOLD, R., HORNETZ, B., SHISANYA, C.A. & SCHMIDT, H. (Eds., 2005- 2010): Farm Management Handbook of Kenya.- Vol. I-IV (Western, Central, Eastern, Nyanza), Nairobi (http://www.uni-trier.de/index.php?id=13823)*

[17] *See http://www.viskogen.se/English/Organisation.aspx for more information*

project and will help farmer to reflect the impact of management practices and support targeted extension.

Further, several action research projects have been implemented in the wider geographic region of the project by national and international (ICRAF, KARI, etc.) institutes to explore potentials for coordinated development interventions to enhance farmers livelihoods through the promotion of integrated soil fertility management and coordinated provision of support services to enhance livelihoods through these practices. For instance the UK Department for International Development's Natural Resource Systems (Research) Programme has been working within the food-crop based land use system in the highlands of western Kenya to pilot a new integrated approach to improving farmers' livelihoods (see Ndufa et al. 2005). These projects contributed a large body of information but have not implemented the adoption of SALM practices on a large scale.

Conclusion: The proposed AFOLU SALM project activity is not the baseline scenario and, hence, it is additional.

2.6 Methodology Deviations

None

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

The quantification of GHG emission reduction and removals in the baseline and the project is based on the data of the first Vi Permanent Farm Monitoring survey conducted in 2009 prior to project implementation. The results of this survey are compiled in an Excel based database. To analyze the different emission reduction and removals and to calculate the input factors for the soil model as well as the activity data of the entire project area, two Excel spreadsheets are developed separately for Kisumu and Kitale which are available upon request. Further, the Excel-based RothC Model has been parameterized for the two project strata and is available.

3.1 Baseline Emissions

Baseline emissions were estimated based on the data recorded during the Vi Permanent Farm Monitoring undertaken prior to the commencement of the project and are representative for the total KACP project area. See section 4 for more details on the monitoring design.

Baseline emissions due to inorganic fertilizer use

The Vi Permanent Farm Monitoring recorded the type and amount of fertilizers used in the baseline. In Kisumu 26 % of the farmers apply inorganic fertilizers on an average rate of 113 kg/ha. In Kitale the values are higher with 85 % of the farmers using fertilizers on an average rate of 325 kg/ha.

According to the CDM A/R tool *Estimation of direct nitrous oxide emissions from nitrogen fertilization*[18] the use of fertilizers in the baseline results in annual emissions of 0.01 and 0.17 tCO_2e per ha of agricultural land in Kisumu and Kitale respectively. As per the CDM Tool "Tool for testing significance of GHG emissions in A/R CDM project activities" (Version 01) the increases in fertilizer emissions in Kisumu is 0.3% of the total ex ante estimation of net anthropogenic GHG removals and can be neglected. In Kitale, however, the increase represents 6.5% and therefore will be deducted as a constant rate from the net anthropogenic GHG removals.
Therefore:
BEF_t (Kisumu) = 0
BEF_t (Kitale) = 0.17 tCO_2e per ha and year

Table 9 Ex-ante estimation of baseline emissions due to fertilizer use

t (years)	Total area (ha)	BEF_t in Kisumu (tCO_2e)	BEF_t in Kitale (tCO_2e)
1	2,500	0	427
2	5,000	0	854
3	7,500	0	1,282
4	10,000	0	1,709
5	12,500	0	2,136
6	15,000	0	2,563
7	17,500	0	2,991
8	20,000	0	3,418
9	22,500	0	3,845
10	22,500	0	3,845
11	22,500	0	3,845
12	22,500	0	3,845
13	22,500	0	3,845
14	22,500	0	3,845
15	22,500	0	3,845
16	22,500	0	3,845
17	22,500	0	3,845
18	22,500	0	3,845
19	22,500	0	3,845
20	22,500	0	3,845

Baseline emissions due to the use of N-fixing species

The Vi Permanent Farm Monitoring recorded the number and species of trees in the baseline. They have reached their equilibrium carbon stocks and therefore do not need to be monitored in

[18] *A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Version 01) EB 33, Annex 16. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-07-v1.pdf*

the baseline. Existing trees were surveyed. Only new trees added by the project will be considered in the project removals estimations.
There are as well some varieties of Napier grass that are nitrogen fixing but the project does not propose increasing or changing the amount of Napier grass planted.
Therefore baseline emissions changes due to the use of N-fixing species are zero, therefore:
$BEN_t = 0$

With regard to the applicability condition of the methodology the land to be degrading in the baseline the regional land classification approach of the CDM EB approved tool 'Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities' was followed. This means that degradation is classified at the regional level and even if a few sites within the project may be aggrading the regional trend is for constant or degrading land quality, and thus the presence of small amounts of N-fixing plants in the baseline do not violate the eligibility condition that the project lands be degraded.

Baseline emissions due to burning of biomass
The Vi Permanent Farm Monitoring recorded the project area where burning of biomass is a common practice in the baseline scenario. This corresponds to 34 % of total agricultural land in Kisumu and 18 % of total agricultural land in Kitale.
The project is promoting the cessation of biomass burning and thus emissions due to this practice are expected to decrease within the project.
Emissions are not estimated and are conservatively assumed to be zero in both the baseline and project scenario, therefore:
$BEBB_t = 0$

Baseline removals from existing woody perennials
As per the SALM Methodology, the baseline removals from woody perennials, $BRWP_t$, are calculated using the latest version of the CDM A/R Tool 'Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 02.1.0). Based on this tool, the default method is applicable for trees in the baseline since the mean tree crown cover in the baseline is with 4% less than 20% of the threshold crown cover reported by the host Party Kenya (30% crown cover). Further, with reference to equation 29 of the tool (change in carbon stock in baseline trees) the parameter ΔB_{FOREST} is set equal to zero from the start of the project since trees in the baseline have reached their equilibrium carbon stocks based on our survey that there were zero removals from agroforestry in the baseline.
Hence, the average standing stocks of trees inventoried prior to project implementation (taken from the first permanent farm monitoring in 2009) are 1.1 and 6.1 t d.m. ha^{-1} aboveground biomass in Kisumu and Kitale respectively. This amount will be deducted in the project and the baseline, referring to the equations in the methodology. Consequently, baseline trees need not to be monitored in the baseline. Only new trees added by the project will be considered in the project removals estimations.
Therefore, baseline removals from existing woody perennials conservatively assumed to be zero, therefore:

BRWP $_{t}$ **= 0**

Baseline emissions from use of fossil fuels in agricultural management
According to the information recorded in the first Vi Permanent Farm Monitoring in 2009, 0% of farmers in Kisumu used machinery in agricultural land management. In Kitale, 10% of the farmers use machinery with a total annual consumption of 488 liters of diesel or gasoline. Using the tool 'Estimation of emissions from combustion the use of fossil fuels in agricultural management' (Section VI.2 of the Methodology) results in annual 1.4 tCO_2e due to the use of fossil fuels which is insignificant compared to the project net anthropogenic GHG removals. Hence, these emissions are found to be *de minimus* and are assumed be zero in the baseline scenario.
BEFF $_{t}$ ***= 0***

Equilibrium soil organic carbon density in management systems
Among all SALM management practices promoted by the project the following were considered for soil organic carbon (SOC) estimations:

- Residue management – including both residue mulching and cover crops
- Composting
- Agroforestry

The RothC soil organic carbon model was used for SOC estimations. The Vi Permanent Farm Monitoring recorded the area of implementation of these practices in the baseline as well as the data required for the estimation of the corresponding model input parameters.

As stated in the methodology the ultimate goal is not the estimation of the absolute SOC in the baseline, but the estimation of the increase or decrease in SOC within the project. SALM practices need be considered for SOC estimations only when differences between baseline and project scenarios will result in SOC changes. This happens in two cases:

- The model input parameter is changing (e.g. due to increasing yields).
- The area under the SALM practice is changing (e.g. due to increasing adoption).

For *ex ante* estimations no change in model input parameters was considered. This is conservative as it is expected that yields – and thus soil inputs – increase as a result of the implementation of SALM practices. Only the increased adoption area was considered.

The Vi Permanent Farm Monitoring data were used to estimate the area under SALM practices in the baseline (see Table 10) as well as the input parameters used for both *ex ante* baseline and project scenarios (this is described in the next chapter).

Table 10 Adoption areas of considered SALM practices in the baseline scenario

SALM practices	Implementation area in the baseline scenario as % of agricultural land	
	Kisumu	Kitale
Residue management • First season • Second season	 17.5 % 12.3 %	 28.4 % 24.2 %
Composting • First season • Second season	 8.6 % 6.0 %	 32.4 % 27.5 %
Agroforestry	0 %	0 %

As explained further below, stratification into first and second season was applied for residue management and composting. The proportion of area cultivated in the first and second season was determined using the Vi Permanent Farm Monitoring as % of total cultivated area. This proportion was used to distribute the area under these practices for both seasons. The area under SALM practices in the baseline will deducted from the potential SALM area in the project scenario.

As only new areas where trees will be planted under the project scenario will be considered for SOC change estimations the implementation area of agroforestry is assumed to be 0 % in the baseline scenario.

Baseline removals due to changes in soil organic carbon

As per the SALM methodology it is conservatively assumed that baseline removals due to changes in SOC are zero, therefore:

$BRS_t = 0$

Total baseline emissions and removals:

$BE_t = BEF_t + BEFF_t + BEBB_t - BRWP_t$

3.2 Project Emissions

The *ex ante* project emissions were estimated based on the data recorded during the Vi Permanent Farm Monitoring undertaken prior to the commencement of the project and are representative for the total KACP project area.

The actual (*ex post)* project emissions will be estimated based on data from the Group monitoring of each group of project activity instances. See section 4 for more details.

Project emissions due to fertilizer use

The project is not promoting the increase in the use of fertilizers but the adoption of SALM practices that are expected to improve soil fertility and thus avoid the need of a higher fertilizer application. Comparing the ABMS data of the two monitoring components (Permanent Farm

Monitoring and farmer Group Monitoring) in the first three years of project implementation indicates that fertilizer use does not increase significantly in the project.

Table 11 Trends of fertilizer uses during the first three years of project implementations.

Year of assessment	ABMS Monitoring component	Total No of farmers assessed (Kisumu/ Kitale)	% use of fertilizer in Kisumu	% use of fertilizer in Kitale
2009[19]	PFM	110/ 100	26%	85%
2010	FGM	1,177/ 5,461	18%	88%
2011	FGM	3,201/ 763	18%	86%

However, during long-term project implementation with increasing farm incomes and increased access to capital through farmer group saving and loan programs, it is possible that farmers may increase use inorganic fertilizer. Hence, the ABMS monitoring system will monitor the use of fertilizers, and, if significantly increased, emissions will be calculated using the CDM A/R tool *Estimation of direct nitrous oxide emission from nitrogen fertilization*[20] and included in the project emissions.

Regarding ex-ante estimation of project emissions due to fertilizer use it is assumed that project fertilizer emissions are at least as great as the baseline fertilizer emissions for each project region, therefore,

PEF t (Kisumu) = 0

PEF t (Kitale) = 0.17 tCO2e per ha and year

Project emissions due to the use of N-fixing species

Since the project occurs on degraded lands so that the lands are nitrogen deficient it is assumed that the area cropped with N-fixing tree species in the project is more than 50% larger than the area under N-fixing species in the baseline.

For *ex ante* estimation it is assumed that 44%[21] of the trees planted in the project are N-fixing species. Using the tool “Estimation of direct nitrous oxide emission from n-fixing species and crop residues” (section VI.1 of the Methodology) the total emissions from N-fixing species in the project are 1,698 tCO_2e which is *de minimus* (less than 0.1%) compared to the total *ex ante* estimation of net anthropogenic GHG removals. Therefore, the increase in N-fixing species is assumed to be zero. The ABMS system will monitor the above ground biomass of N-fixing species, and include the annual emissions, if significant.

Project emissions due to the burning of biomass

As explained above the project is promoting the cessation of biomass burning and baseline emissions are expected to be greater than the project emissions. Based on the baseline PFM

[19] This year represents the baseline conditions

[20] *A/R Methodological tool “Estimation of direct nitrous oxide emission from nitrogen fertilization” (Version 01) EB 33, Annex 16. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-07-v1.pdf*

[21] *This value is derived from the seed records of Vi in 2010, meaning that 44% of the tree species seeds provided to the farms in the project are N-fixing species.*

survey (2009) 23% and 14% of the field residues were burned in Kisumu and Kitale respectively (see Figure 13). During the same survey it was found that the future burning would drop to 3% and 6% due to the adoption of SALM practices. And the latest (ex-post) data of the first project instance shows that currently 10% and 3% in the two project strata are burning residues in the project. Because the project has reduced burning, project emissions from biomass burning are less than baseline emissions. It is conservative to not count this emission reduction by calculating both baseline and project emissions from biomass burning to be zero. In Section 3.1, baseline emissions from biomass burning are assumed to be zero so here project emissions are also assumed to be zero, therefore,

$\boldsymbol{PEBB_t = 0}$

Project removals from woody perennials

The Vi Permanent Farm Monitoring recorded the number, species and DBH of trees planted within the farm areas.

Above ground biomass of trees in the baseline was estimated according to the CDM A/R tool *Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*[22] and using the allometric equation from Brown (1997)[23] Y = Exp (-2.134 + 2.530 In DBH). Based on this, trees above ground biomass was estimated in the baseline at 2 t d.m. / ha in Kisumu and 6 t d.m. / ha in Kitale.

For *ex ante* project estimation, it was assumed that agroforestry systems can reach 29 t d.m. / ha in aboveground biomass, which is the minimum potential AGB considered in Table 5.2 in the 2006 IPCC Guidelines (Volume 4), and that biomass accumulation rate is 2.6 t C/ ha/ year until the system reaches equilibrium, according to Table 5.1 in the same Volume. As a result it was considered that trees will grow starting at the baseline biomass stocks (1.1 t d.m. ha^{-1} in Kisumu and 6.1 t d.m. ha^{-1} in Kitale) during the first 5 years in Kisumu and 4 years in Kitale until they reach equilibrium.

Vi Agroforestry is promoting and providing seeds for a wide range of different agroforestry tree species to be planted within the farm land with different purposes. The principal distinction made here is with regard to the contribution of the tree species to the different carbon pools in the project:

- Long-living trees with the principal objective to produce timber/ biomass. Such tree species promoted by Vi include Grevillea, Moringa, Markhamia and Acacia species.
- Short-living, very fast-growing tree species with the principal objective to enhance soil fertility through N-fixing, producing mulch, composting material or feedstock for livestock. Tree species included in this category include Calliandra, Sesbania, Casuarina, Grilicidia or Leucaena species[24].

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[22] *A/R Methodological Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 02.1.0) EB 60, Annex 13. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v2.1.0.pdf*

[23] *Brown S. (1997) Estimating biomass and biomass change of tropical forests. A primer. FAO Forestry Paper No.134. Rome, Italy. 55*

[24] To categorize the tree species the ICRAF agroforestry database was used: http://www.worldagroforestry.org/treedb/index.php?keyword=Nitrogen_Fixing

Based on the amount of seeds provided by Vi in the project in 2011 the following conservative shares are assumed for the ex-ante estimations:

- 44% of the trees planted in the project are considered for biomass (project removals from woody perennials)
- 54% of the trees planted in the project are considered for SOC inputs (soil organic carbon sequestration)

For *ex ante* estimations it was further assumed that:

- The project will expand to 22,500 ha in Kisumu and 22,500 ha in Kitale over a period of 9 years.
- The period of time required by one farmer to implement all planned SALM practices is 3 years since the start of the project implementation.

Table 12 *Ex ante* estimates for project removals from woody perennials

t (years)	Total area (ha)	$PRWP_t$ in Kisumu (tCO_2e)	$PRWP_t$ in Kitale (tCO_2e)
1	2,500	4,151	4,151
2	5,000	12,453	12,453
3	7,500	24,907	24,907
4	10,000	37,360	37,360
5	12,500	49,813	45,662
6	15,000	58,115	49,813
7	17,500	62,266	49,813
8	20,000	62,266	49,813
9	22,500	62,266	49,813
10	22,500	58,115	45,662
11	22,500	49,813	37,360
12	22,500	37,360	24,907
13	22,500	24,907	12,453
14	22,500	12,453	4,151
15	22,500	4,151	0
16	22,500	0	0
17	22,500	0	0
18	22,500	0	0
19	22,500	0	0
20	22,500	0	0

During the project implementation the number, species and diameter at breast height of all trees planted within the project will be monitored for ex-post estimation according to the CDM A/R *Simplified baseline and monitoring methodologies for small-scale A/R CDM project activities* *implemented on grasslands or croplands with limited displacement of pre-project activities* AR-AMS0001[25].

Project emissions due to use of fossil fuels for agricultural management

As part of the first Vi Permanent Farm Monitoring in 2009 the farmers were questioned about the adoption of future management practices including the additional use of machinery. Based on this, less than 1% of the respondents will consider using any additional agricultural machinery on their fields in the future. Therefore, given also the project specific conditions of subsistence farming, the use of machinery and fossil fuels is not expected to increase during the project. However, the Vi ABMS system will continuously monitor the use of machinery (see the PFM template in section 7.4) and, if significantly increased, emissions will be calculated using the CDM A/R tool 'Estimation of emissions from combustion the use of fossil fuels in agricultural management' (Section VI.2 of the Methodology).

The implementation of the project results in emissions from vehicles used by the Vi field extensionists for travelling. In the total project area there are 28 field advisors who use gasoline motorcycles. It is conservatively assumed that each of them covers a distance of 50 km per day and works 5 days a week during the year. Using the same tool provided in the methodology this would result in annual emissions of 31 t CO_2e in the total project area. This value represents less than 1% of the annual project net anthropogenic GHG emissions and removals and can be neglected.

Hence, project emissions due to use of fossil fuels for agricultural management are found to be *de minimus* and are assumed to be zero.

$\boldsymbol{PEFF_t = 0}$

Project equilibrium soil organic carbon density in management systems

Stratification

In the project areas there are two possible cropping seasons. The first season is from April to September and corresponds to the long rains period. This is the main season and usually has a higher productivity. The second season is from October to March and corresponds to the short rains period.

As inputs of organic matter from residue management are dependent on residue production, a stratification into first and second season was done to assess the differences in productivity and thus in residue production.

Composted manure is applied at the beginning of the cropping season. First and second season were modeled separately in order to account for climate differences at the time of application.

The most important stratification is the distinction between the two project locations Kitale and Kisumu. The reason for these two strata are organizational and, more importantly, biophysical reasons. Throughout this PD all the specific conditions are always shown separately for these two locations. For the modeling of soil organic carbon and the estimation of actual GHG benefits two parameters are of particular importance:

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[25] *AR-AMS0001 "Simplified baseline and monitoring methodologies for small-scale A/R CDM project activities implemented on grasslands or croplands with limited displacement of pre-project activities (Version 6.0)".* http://cdm.unfccc.int/methodologies/DB/91OLF4XK2MEDIRIWUQ22X3ZQAOPBWY

1. Climate: As shown in section 1.9, the average temperature is not significantly different on an annual basis; however, the monthly distribution of the temperature in combination with significantly higher precipitation has a significant impact on different cropping systems as well as soil organic processes.
2. Clay content of the soil: The clay content as an important driver of soil carbon sequestration is significantly different in the two project locations (see map). Therefore HWSD[26] database was used to analyze the clay contents in the project region. Based on the location of the Vi Permanent Farm Monitoring farmers in each project stratum the average clay content in Kisumu is 43.9% at a standard error of 4% whereas in Kitale the average clay content is 23.6% at a standard error of 7%[27]. Further stratification within these two clay strata was done but the variation within these two strata is too low to result in different modeling results of soil organic carbon.

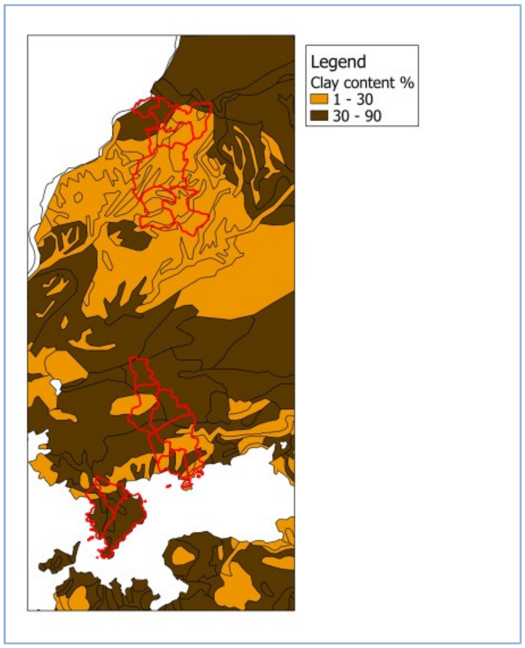

Figure 14: Two clay strata considered in the project

Model input parameters

As mentioned above the RothC soil organic carbon model was used for *ex-ante* SOC estimations. The model input parameter for the different SALM practices were assessed as follows and using data recorded by the Vi Permanent Farm Monitoring.
In the case of agroforestry a default value was used for *ex ante* estimations.

- Residue management: mulching and cover crops

The Vi Permanent Farm Monitoring recorded the productivity for each crop and for each of the two cropping seasons. The amount of crop residues produced was estimated indirectly from the

[26] http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/

[27] A shape file of locations of the Permanent Farm Monitoring farmers was used with the HWSD data set and the clay content of the top soil at each location was derived

crop production using the equations listed in Table 11.2 in Volume 4 of the 2006 IPCC Guidelines[28]. As required by the methodology the area weighted average value was used. A more detailed description is provided in 7.2.
During the project implementation yields will be monitored in order to account for yield response and thus any change in input parameters. The use of specific cover crops (such as mucuna, lablab beans) will be recorded.

- Composting

The Vi Permanent Farm Monitoring recorded the number of livestock per animal type in each farm. The amount of manure produced was estimated using volatile solids production values defined in Tables 10A-4 to 10A-9 in Volume 4 of the 2006 IPCC Guidelines.
The amount of composted manure available at each farm was estimated based on information provided by the farmers and on a study about traditional manure management practices by smallholder farmers in Kenya[29]. As required by the SALM methodology the area weighted average value was used for SOC estimations. A more detailed description is provided in 7.2.
During project implementation the number and type of animals will be monitored in order to account for any changes in input parameters.

- Agroforestry

The *ex-ante* increase in SOC due to agroforestry was considered as 0.5 tC / ha / year. This is a default value provided by the CDM methodology AR - AMS0004 *Approved simplified baseline and monitoring methodology for small scale agroforestry – afforestation and reforestation project activities under the clean development mechanism.*
Seed records from Vi Agroforestry about the number and species of seeds distributed in 2010 were used to assume that 54% of tree species planted are specifically used for soil fertility enhancement and litter production based on the ICRAF Agroforestry database (ICRAF 2012)[30]. Only these species were taken into account and SOC increase was adjusted proportionally.
During project implementation the number and species of trees planted will be monitored.

For each SALM practice the input parameter used for modeling and the resulting SOC at equilibrium are shown in the next tables. As mentioned in the SALM methodology the transition period required for SOC to be at equilibrium after a change in land use or management practice is considered 20 years.

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[28] Intergovernmental Panel on Climate Change (2006) 'Volume 4. Agriculture, Forestry and Other Land Uses', in Eggleston, H.S., Buendia, L., Miwa, K., Ngara, T. and Tanabe K. (eds) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Institute for Global Environmental Strategies, Japan
[29] *Tittonell, P., Rufino, M.C., Janssen, B.H. and Giller, K.E. (2010) Carbon and nutrient losses during manure storage under traditional and improved practices in smallholder crop-livestock systems – evidence from Kenya. Plant Soil 328: 253-269*
[30] http://www.worldagroforestry.org/treedb/index.php?keyword=Nitrogen_Fixing

Table 13 Annual/ seasonal model carbon inputs and cumulative SOC gains (SOC at equilibrium) for Kisumu

SALM practices	Annual/ seasonal input of carbon (tC/ha)	Cumulative SOC gain over 20 years (tC/ha)
Residue management • First season • Second season	 0.249 0.140	 0.688 0.488
Composted manure • First season • Second season	 0.673 0.673	 1.962 2.125
Agroforestry (annual)	-	5.445

Table 14 Annual/ seasonal model carbon inputs and cumulative SOC gains (SOC at equilibrium) for Kitale

SALM practices	Annual/ seasonal input of carbon (tC/ha)	Cumulative SOC gain over 20 years (tC/ha)
Residue management • First season • Second season	 0.450 0.291	 1.275 1.058
Composted manure • First season • Second season	 0.356 0.356	 0.953 1.032
Agroforestry	-	5.445

Ex ante estimation of project removals due to changes in soil organic carbon

For ex ante estimations it was assumed that:

- The project will expand to 22,500 ha in Kisumu and 22,500 ha in Kitale over a period of 9 years.
- The period of time required by one farmer to implement all planned SALM practices is 3 years since the start of the project implementation.
- SALM practices are already implemented in the baseline scenario as determined in the Vi Permanent Farm Monitoring (see Table 10).

Table 15 Ex-ante Project removals due to changes in SOC

t (years)	Total area (ha)	PRS_t in Kisumu (tCO_2e)	PRS_t in Kitale (tCO_2e)
1	2,500	1,563	1,309
2	5,000	3,126	2,618
3	7,500	4,690	3,928
4	10,000	9,379	7,855
5	12,500	14,069	11,783
6	15,000	18,759	15,711
7	17,500	23,449	19,638

8	20,000	28,138	23,566
9	22,500	32,828	27,494
10	22,500	37,518	31,422
11	22,500	42,208	35,349
12	22,500	42,208	35,349
13	22,500	42,208	35,349
14	22,500	42,208	35,349
15	22,500	42,208	35,349
16	22,500	42,208	35,349
17	22,500	42,208	35,349
18	22,500	42,208	35,349
19	22,500	42,208	35,349
20	22,500	42,208	35,349

Total *ex ante* project net GHG emissions and removals by sinks

Table 16 Ex-ante actual net project GHG emissions and removals by sinks in Kisumu

t (year)	Total Area (ha)	PEF_t (tCO_2e)	PEN_t (tCO_2e)	$PEBB_t$ (tCO_2e)	$PRWP_t$ (tCO_2e)	$PEFF_t$ (tCO_2e)	PRS_t (tCO_2e)	PE_t (tCO_2e)
1	2,500	0	0	0	4,151	0	1,563	-5,714
2	5,000	0	0	0	12,453	0	3,126	-15,580
3	7,500	0	0	0	24,907	0	4,690	-29,596
4	10,000	0	0	0	37,360	0	9,379	-46,739
5	12,500	0	0	0	49,813	0	14,069	-63,882
6	15,000	0	0	0	58,115	0	18,759	-76,874
7	17,500	0	0	0	62,266	0	23,449	-85,715
8	20,000	0	0	0	62,266	0	28,138	-90,405
9	22,500	0	0	0	62,266	0	32,828	-95,095
10	22,500	0	0	0	58,115	0	37,518	-95,633
11	22,500	0	0	0	49,813	0	42,208	-92,021
12	22,500	0	0	0	37,360	0	42,208	-79,568
13	22,500	0	0	0	24,907	0	42,208	-67,114
14	22,500	0	0	0	12,453	0	42,208	-54,661
15	22,500	0	0	0	4,151	0	42,208	-46,359
16	22,500	0	0	0	0	0	42,208	-42,208
17	22,500	0	0	0	0	0	42,208	-42,208
18	22,500	0	0	0	0	0	42,208	-42,208
19	22,500	0	0	0	0	0	42,208	-42,208

20	22,500	0	0	0	0	0	42,208	-42,208
Cumulative								**-1,155,995**
Average per year								**-57,800**
Average per hectare per year								**-2.6**

Table 17 Ex-ante actual net project GHG emissions and removals by sinks in Kitale

t (year)	Total Area (ha)	PEF_t (tCO_2e)	PEN_t (tCO_2e)	$PEBB_t$ (tCO_2e)	$PRWP_t$ (tCO_2e)	$PEFF_t$ (tCO_2e)	PRS_t (tCO_2e)	PE_t (tCO_2e)
1	2,500	427	0	0	4,151	0	1,309	-5,033
2	5,000	854	0	0	12,453	0	2,618	-14,217
3	7,500	1,282	0	0	24,907	0	3,928	-27,553
4	10,000	1,709	0	0	37,360	0	7,855	-43,506
5	12,500	2,136	0	0	45,662	0	11,783	-55,309
6	15,000	2,563	0	0	49,813	0	15,711	-62,961
7	17,500	2,991	0	0	49,813	0	19,638	-66,461
8	20,000	3,418	0	0	49,813	0	23,566	-69,961
9	22,500	3,845	0	0	49,813	0	27,494	-73,462
10	22,500	3,845	0	0	45,662	0	31,422	-73,239
11	22,500	3,845	0	0	37,360	0	35,349	-68,864
12	22,500	3,845	0	0	24,907	0	35,349	-56,411
13	22,500	3,845	0	0	12,453	0	35,349	-43,957
14	22,500	3,845	0	0	4,151	0	35,349	-35,655
15	22,500	3,845	0	0	0	0	35,349	-31,504
16	22,500	3,845	0	0	0	0	35,349	-31,504
17	22,500	3,845	0	0	0	0	35,349	-31,504
18	22,500	3,845	0	0	0	0	35,349	-31,504
19	22,500	3,845	0	0	0	0	35,349	-31,504
20	22,500	3,845	0	0	0	0	35,349	-31,504
Cumulative								**-885,614**
Average per year								**-44,281**
Average per hectare per year								**-2.0**

3.3 Leakage

Estimation of leakage

Based on the methodology, the only source of leakage possible as a result of the project is the leakage from a switch to non- renewable biomass use or fossil fuels and the ex-ante estimate of leakage is assumed zero. Charcoal in the project region is only produced from on-farm sustainable sources or is purchased. As outlined in section 1.13 none of the farmers use residues or manure for cooking and heating based on the monitoring data in 2009. Respective fuels have low energy content and produce substantial smoke therefore they are also not the preferred fuel wood source. The methodology further states that If the ABMS survey data show that 10% or fewer project households use non-renewable biomass from outside the project or fossil fuels to replace the biomass diverted to agricultural fields, then the leakage is considered insignificant and ignored. Based on the latest Group Monitoring data (2011) 1% of all farmers of the first project instances in Kisumu use manure while 3% of the first project instances in Kitale use manure. Finally, food security is not threatened by the project since the project will contribute to increasing yields, which is the precondition to increase soil carbon stocks. Therefore, there is no likelihood of any leakage from the project.

Therefore:

$LHE_t = 0$

3.4 Summary of GHG Emission Reductions and Removals

The ex-ante net anthropogenic GHG removals by sinks are estimated using equation 8 of the methodology:

$$\Delta R_t = BE_t - PE_t - LHE_t$$

The *ex ante* estimation of net anthropogenic GHG removals are shown in Table 18.

Table 18 *Ex ante* estimation of net anthropogenic GHG removals

	Kisumu Project Region				Kitale Project Region			
t (year)	BE t (tCO_2e)	PE t (tCO_2e)	LHE t (tCO_2e)	ΔR t (tCO_2e)	BE t (tCO_2e)	PE t (tCO_2e)	LHE t (tCO_2e)	ΔR t (tCO_2e)
1	0	-5,714	0	5,714	427	-5,033	0	4,606
2	0	-15,580	0	15,580	854	-14,217	0	13,363
3	0	-29,596	0	29,596	1,282	-27,553	0	26,271
4	0	-46,739	0	46,739	1,709	-43,506	0	41,797
5	0	-63,882	0	63,882	2,136	-55,309	0	53,173
6	0	-76,874	0	76,874	2,563	-62,961	0	60,397
7	0	-85,715	0	85,715	2,991	-66,461	0	63,470
8	0	-90,405	0	90,405	3,418	-69,961	0	66,544
9	0	-95,095	0	95,095	3,845	-73,462	0	69,617
10	0	-95,633	0	95,633	3,845	-73,239	0	69,393
11	0	-92,021	0	92,021	3,845	-68,864	0	65,019
12	0	-79,568	0	79,568	3,845	-56,411	0	52,566
13	0	-67,114	0	67,114	3,845	-43,957	0	40,112
14	0	-54,661	0	54,661	3,845	-35,655	0	31,810
15	0	-46,359	0	46,359	3,845	-31,504	0	27,659

16	0	-42,208	0	42,208	3,845	-31,504	0	27,659
17	0	-42,208	0	42,208	3,845	-31,504	0	27,659
18	0	-42,208	0	42,208	3,845	-31,504	0	27,659
19	0	-42,208	0	42,208	3,845	-31,504	0	27,659
20	0	-42,208	0	42,208	3,845	-31,504	0	27,659
Cumulative				**1,155,996**				**824,092**
Average per year				**57,800**				**41,205**
Average per hectare per year				**2.6**				**1.8**

Total Project cumulative	**1,980,088**
Total Project average per year	**99,004**
Total Project average per hectare and year	**2.2**

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	Unit	Description	Recording frequency	Source
$BSN_{t=0}$	kg	Synthetic fertilizer use	Project start	Vi Permanent Farm Monitoring
$Crop_{i,t=0}$	kg d.m./ha	Harvested annual dry matter yield for crop *i*	Project start	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$Area_{i,t=0}$	ha	total annual area harvested of crop *i* or n-fixing trees *i*	Project start	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$Areaburnt_{i,t=0}$	ha	annual area of crop *i* or n-fixing trees *i* burnt	Project start	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$MB_{C,t=0}$	t d.m.	Mass of crop residues burnt	Project start	Vi Permanent Farm Monitoring & Farmer Group Monitoring
C_F	unitless	Combustion factors that depend on vegetation type	Project start	National or regional studies
$BA_{C,m_C,t=0}$	ha	Baseline areas in cropland with management practice,	Project start	Vi Permanent Farm Monitoring

		m_C		
$SOC_{C,m_C,t=0}$	tC/ha	Soil organic carbon density, to a depth of 30 cm, at equilibrium for cropland with management practice, m_C	Project start	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$BP_{C,m_C,t=0}$	t/ha/month	Baseline production in cropland per month with management practice from within the project , m_C	Project start	Modelled
$BR_{C,m_C,t=0}$	t/t prod/month	Baseline fraction of production returned as residues per month (calculated from $BP_{C,m_C,t=0}$) in cropland with management practice, m_C	Project start	Vi Permanent Farm Monitoring
$BM_{C,m_C,t=0}$	t/ha/month	Baseline manure input in cropland per month with management practice, m_C	Project start	Vi Permanent Farm Monitoring
$BCC_{C,m_C,t=0}$		Baseline cover crop flag per month in cropland per month with management practice, m_C	Project start	Vi Permanent Farm Monitoring
$\overline{Temp}_m$	℃	Average temperature per month	Project start	Local weather records
$\overline{Prec}_m$	mm	Average precipitation per month	Project start	Local weather records
$\overline{Evap}_m$	mm/day	Average evapotranspiration per month	Project start	Calculated

4.2 Data and Parameters Monitored

Data / Parameter	Unit	Description	Recording frequency	Source
PSN_t	kg/year	Synthetic fertilizer use per year	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$PA_{C,t}$	ha/year	Areas in cropland	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring

$PA_{G,t}$	ha/year	Areas in grassland	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
PF_t	USD/kg	the price of inorganic fertilizer	Annually	National or regional studies
$Crop_{i,t}$	kg d.m./ha	Harvested annual dry matter yield for crop *i*	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$Area_{i,t}$	Ha/year	total annual area harvested of crop *i* or n-fixing trees *i*	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$Areaburnt_{i,t}$	Ha/year	annual area of crop *i* or n-fixing trees *i* burnt	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$MB_{C,t}$	t d.m./year	Mass of crop residues burnt	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
C_F	unitless	Combustion factors that depend on vegetation type	Project start	National or regional studies
$FC_{j,t}$	Litres	Fossil fuel consumed in vehicle or equipment recorded by vehicle and fuel type	Annually	Estimated from Vi records
$PA_{C,m_C,t}$	ha	Project areas in cropland with management practice, m_C	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$SOC_{C,m_C,t}$	tC/ha	Soil organic carbon density, to a depth of 30 cm, at equilibrium for cropland with management practice, m_C	Every five years	Modelled
$PP_{C,m_C,t}$	t/ha/month	Production in cropland per month with management practice from within the project, m_C	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$PR_{C,m_C,t}$	t/t prod/month	Project fraction of production returned as residues per month (calculated from $PP_{C,m_C,t}$) in cropland with management practice, m_C	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$PM_{C,m_C,t}$	t/ha/month	Project manure input in cropland per month with management practice, m_C	Annually	Vi Permanent Farm Monitoring & Farmer Group

				Monitoring
$PCC_{C,m_C,t}$		Project cover crop flag per month in cropland per month with management practice, m_C	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$\overline{Temp}_m$	°C	Average temperature per month	Over the previous five years	Local weather records
$\overline{Prec}_m$	mm	Average precipitation per month	Over the previous five years	Local weather records
$\overline{Evap}_m$	mm/ day	Average evapotranspiration per month	Over the previous five years	Calculated
D	Years	Transition period	Every five years	National or regional studies

Data / Parameter	Unit	Description	Recording frequency	Source
$B_{biomass,t}$ / $B_{fossilfuel,t}$	tonnes/ year	Quantity of biomass from outside the project or fossil fuel used in place of the amount of biomass used in cooking and heating diverted to the agricultural system in the project	Annually	Vi Permanent Farm Monitoring & Farmer Group Monitoring
$f_{NRB,t}$	dimensionless	Fraction of biomass that comes from non-renewable sources	Start of the project	If the data on $f_{NRB,t}$ is available, it is calculated as per the procedure of AMS I.E methodology. For situations, where the data on $f_{NRB,t}$ is not available $fNRB_{,t}$ =1 shall be used (i.e., $fNRB_t$ value is fixed at 1), which is conservative.
$NCV_{biomass}$ / $NCV_{fossil\ fuel}$	TJ/ tonne	Net calorific value of the non-renewable biomass or fossil fuel substituted	Start of the project	IPCC defaults, National or regional studies
$EF_{fossilfuel}$	tCO_2/ TJ	Emission factor for the projected fossil fuel consumption	Start of the project	Default value of 81.6 tCO_2/TJ I as per AMS I.E

4.3 Description of the Monitoring Plan

The basic idea is that agricultural activities in the baseline will be assessed and adoption of SALM practices will be monitored as a proxy of the carbon stock changes using activity-based model estimates.
The graphic below summarizes the ABMS project monitoring system in the KACP.

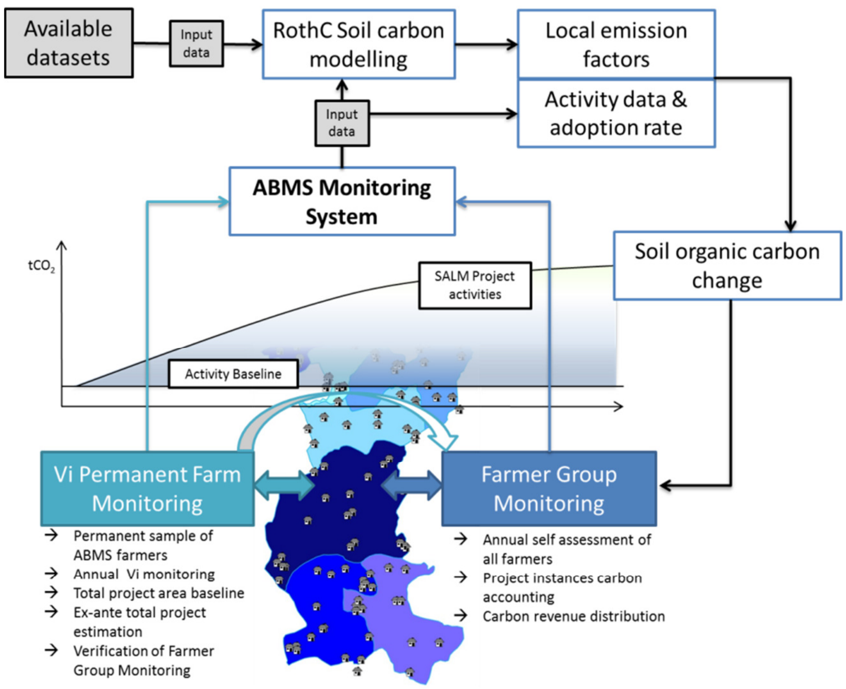

Figure 15 Monitoring structure of the KACP

The ABMS monitoring is structured in two different surveys, the Vi Permanent Farm Monitoring and the Farmer Group Monitoring which is explained in more detail below. Organizationally, the field data from these two surveys are collected, cleaned and aggregated first for each project location Kisumu and Kitale and then centrally processed, analyzed and archived at the central project monitoring and evaluation unit at the Vi main carbon project office in Kisumu.
The data gathered from the field are the input values to run the RothC carbon model to derive local SOC emission factors, and secondly to determine the area under SALM adoption (adoption rate). In addition to the locally monitored field data, available datasets are used to parameterize the RothC models separately for Kisumu and Kitale, e.g. climate data and soil data.

The basic distinction between the two monitoring systems is that the Vi Permanent Farm Monitoring is entirely implemented by the field officers of Vi Agroforestry on permanent sample farms, so-called ABMS farmers and is representative for the whole KACP project area. It is used to establish the total KACP baseline conditions and to estimate the ex-ante actual GHG emissions and removals for the whole project area (45,000 ha). Further it monitors the overall project performance in terms of project implementation (SALM adoption, crop responses) and is used to verify the results of the Group Monitoring.

The Farmer Group Monitoring on the other hand is a farmer-self assessment system within each of the registered farmer groups. Farmers annually record all relevant data themselves which are needed to monitor the KACP and report the data to the Vi field officers via a strong system of verification and data aggregation. These data, representing a full inventory of all farms in the project instance(s), are used to model the actual (*ex-post*) GHG emissions and removals (from SOC and tree biomass) of a particular group of project instances (see example of the first instance below) during a verification event. Further, on the basis of the results of this Group Monitoring the carbon benefits will be distributed to the farmers of a particular project instance.

Vi Permanent Farm Monitoring A representative sample of farm households will be interviewed periodically throughout the project's lifetime based on a structured questionnaire. Questions refer to current and future management practices to anticipate the adoption of improved SALM practices and to monitor the adoption within the entire KACP project.

The selection of farms to be sampled was driven by the average site conditions and farming systems and the accuracy requirements of the carbon accounting standard applied. In this project, a stratified random sampling approach was selected. Based on the requirements of the SALM methodology, the project proponent shall use a precision of 15% at the 95% confidence level as the criteria for reliability of sampling efforts. Based on the required precision level, the sample size (number of farms) was determined for each of the two project areas in Kisumu and Kitale based on the yield data of grains (maize) and beans, the most important crop groups in the project. Since crop yield is -after conversion into residues-one of the principle inputs to the RothC model, it is a suitable parameter to determine the variability and the required sampling size. A test survey was done to evaluate the variance and to determine the required sampling size. This pretesting is important since, apart from managing random errors of sampling procedures there is also the need to cope with systematic errors (bias), particular during the survey situation itself. By improving the survey through intensive training and capacity building the random error of the mean value (i.e. yield) can be further reduced.

After calculating the mean value of the yield and the standard deviation, the spatial variability was characterized in terms of the coefficient of variation (CV) Once the CV is calculated, the number of sampling farms for the Vi Permanent Farm Monitoring survey at a 15% accuracy and 95% confidence interval, was given by

$$n = \left[\frac{1.7}{15} \times CV\right]^2$$

Where,

n is the number of sample farms needed

1.7 is the t number of standard deviation needed to achieve the desired confidence level, typically obtained from a t table.

15 is the allowable error (or uncertainty) in percent, and

CV is the coefficient of variation in percent.

For the first survey in 2010 we selected 200 farmers based on a pretesting of 30 farms to evaluate the variance and to determine the minimum sampling size. The Vi Permanent Farm Monitoring will be repeated periodically over 20 years with annual intervals within the first 10 years and 3 to 5 year intervals onwards which considers the proportionally higher adoption rates during the first half of the project. The monitoring of trees in the project was done at the start of the project (to assess the constant baseline biomass stocks) and will be repeated at every verification event and at least every 5 years in accordance with the standard requirements of the CDM A/R tools applied.

In order to detect biased management at the permanent sample farms an additional 20 farms are selected and monitored every year. And, to account for an increasing number of adopters of SALM practices over time the sample size increases by an additional 5% per year within the first 10 years.

The Vi Permanent Farm Monitoring is a strong tool to not only monitor agricultural practices and input and output cycles of, for instance, biomass, but to also reveal important livelihood issues directly linked with agricultural subsistence farming. All the data, general farm data, agricultural data, socio-economic data presented in PD to describe the baseline conditions and to model the ex-ante carbon benefits are drawn from this survey. In the frame of the KACP an ABMS guideline was elaborated with detailed description of sampling, survey methods (elaboration of questionnaires) and verification methods (pre-testing/ retesting) to manage uncertainty. The template of the questionnaire is provided in section 7.4; a summary of the survey procedure is given below:

Step 1	• Stakeholder awareness raising to create an entry point in the village, region (farmers, NGOs, Gov agencies)
Step 2	• Sensitisation and trust building of farmer groups
Step 3	• Project recruitment
Step 4	• Vi Permanent Farm Monitoring (to be conduced annually always after the second cropping season)
Step 5.1	• Pretesting the ABMS among 30 respondants using the three-phased pretest procedure; calculate the CV and the sample size needed
Step 5.2	• Selecting permanent sampling farms stratified by agroecological zones, systematic grid raster and random selection within the raster
Step 6	• Informing farmers about the survey and its purpose
Step 7	• Drawing the sketch from the farm using the map in the survey template
Step 7.1	• Defining fields and GPS tracking of boundaries
Step 8	• Conducting the interviews using the survey template
Step 8.1	• Cross-checking the answers of the respondent during the questionnaire with the sketch map
Step 9	• Retesting of 10% of the Vi Permanent Farm Monitoring sample size (none of these farms should be part of the ABMS sample)
Step 10	• Entry of survey data into prepared database (data entered need to be re-assessed by independent person to ensure quality)
Step 11	• Plausibility check of survey data (identification of entry errors, extrme values and outliers using standard statisitcal procedures)
Step 12	• Parametrise and/or run the carbon model (RothC) with the survey data to calculate local SOC default values
Step 13	• Calculating ex-ante total project carbon offsets using local carbon default values ; compiling annual report

The KACP Vi Permanent Farm Monitoring database in Excel format contains all surveys done throughout the project and is available upon request.

Farmer Group Monitoring

This component of the KACP M&E system is a full inventory of all farmers participating in the project. The approved carbon accounting methodology stipulates that the ViA sampling effort should reach a precision of 15% at 95% confidence level. According to the Farmer Group Monitoring (FGM) data from 2010 and 2011, this quality benchmark was reached.

Based on the design and data requirements of the ABMS each farmer when registered through the farmer group will be trained in conducting a farmer self-assessment on an annual basis. The basic design is that for each group registered (signing the group contract with Vi) one farmer is selected as the Farm Group Resource Person (FGRP). The resource person will be trained how to enter the specific farm data into the farmer self-commitment form (see section 7 where the template is presented) considering the specific data requirements (e.g. units of crop yields, etc.) and how to manage potential error sources.

However, it was agreed that the quality assurance system for the FGM should still be further improved by adopting the following procedure:

Farmers are trained in participatory planning, data collection, and record-keeping by ViA extension staff. Individual farmers are also supported Farmer Group Resource Persons (FGRP), who have been appointed by the farmer groups (evidence: staff and training records);

- FGRP verifies data from each farm at plot/field level and also assists farmers to fill in commitment form, if necessary (evidence: FGRP signs each commitment form);
- Farmer Group Leader/FGRP aggregates group monitoring data (evidence M&E group summary). Farmer Group Leader/FGRP is responsible for data quality;
- ViA extension worker is assisting throughout the process and makes a follow up if there are inconsistencies in the documentation. The extension worker visits at least 20 percent of farmers at field level every year (evidence: group summary - staff level, note books);
- This information is then collected and, after cross-checking of data, sent to the project office where it is entered into the KACP Group Monitoring Database.

In line with the Vi Permanent Farm Monitoring a retesting of the data is done by Vi.
Related to the carbon monitoring:

- Actual monitoring of input values for the SOC modeling, i.e. crop yields and yield increase over time. Only the most dominant crops are monitored and used for the modeling to reduce uncertainty of the modeling, i.e. maize, beans and sorghum.
- Actual monitoring of trees planted. Trees will be monitored following the standard monitoring requirements of A/R project, i.e. at every verification event and at least every 5 years.
- Actual monitoring of SALM practice adoption, i.e. residue management, composting, cover crops, etc.
- Actual monitoring of livestock numbers and grazing regimes
- Actual monitoring of activities related to project emissions, e.g. cooking with fossil fuels

Related to project implementation

- SALM training needs assessment of individual farmer groups/ farmers
- Overall farm development monitoring (e.g. farm enterprise)
- Extension performance monitoring of the individual project locations (28 locations)

Another important task of this monitoring component is to establish the carbon revenue distribution system to the different farmer groups. The revenue distribution system has to be simple, transparent and robust.

As already explained above the data of this group monitoring will be used to model the actual amount of carbon benefits separately for each group of project instances entering the project over time. An example of the first group of project instances is given below.

SOPs and quality control (QC) and quality assurance (QA) procedures undertaken for data monitored
As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan is part of the ABMS Guidelines and covers procedures as described below for:

1. Collecting reliable field measurements and verifying methods used to collect field data;
2. Verifying data entry and analysis techniques; and
3. Data maintenance and archiving. Especially this point is important, as time scales of project activities are much longer than technological improvements of electronic data archiving. Each point of importance for project activities is treated in the following section.

Procedures to ensure reliable field measurements
Collecting reliable field survey data is an important step in the quality assurance plan.
Those responsible for the field surveys are trained in all aspects of the field data collection and data analyses. Following good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, the ABMS guidelines describe in detail all steps to be taken of the field surveys, field verification and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the surveys in a consistent fashion. To ensure the collection and maintenance of reliable field data:

a) Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
b) The pretesting phase of the surveys is crucial and absolutely compulsory in order to check the quality and reliability of the questionnaire. “If you don’t have the resources to pilot test your questionnaire, don’t do the study.” To summarize the main tasks of the pre-testing include:
   - Test the questionnaire design in an iterative process
   - Check the wording of the questionnaire (clarity of questions)
   - Calculate the variance (standard deviation) of certain parameters
   - Check and identify all difficulties and potential errors sources during the interview situation
c) As already described above the retest monitoring serves to control potential bias of the ABMS over the lifetime of the project. It will be checked that the farmers being interviewed within the frame of the Vi Permanent Farm Monitoring do not receive special treatment with regards to training and adoption of selected SALM practices. In other words, it must be assured that the sample of farms remains representative for all farms in the project. Therefore it is envisaged to select 10% of the Vi Permanent Farm Monitoring sample size.

d) The documentation will list all names of the field team and the project leader will certify that the team is trained;
e) New staff adequately trained.

Reliable carbon estimates require proper entry of data into the data analyses spreadsheets.
Possible errors in this process can be minimized if the entry of field data is cross-checked and, where necessary, internal tests incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

Data maintenance and storage
Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant.
Copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite.
Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application. Copies of all raw data, reports of analysis and supporting spreadsheets will be stored in a dedicated long-term electronic archive for at least 2 years following the end of the last crediting period in 2030.

4.4 Verification of Farmer Group Monitoring Data

Since the data for the Farmer Group Monitoring will be generally collected by the farmers themselves as outlined above, there needs to be a data verification system in place to ensure that the data reported to the Vi extension officers are real, transparent and verifiable. Therefore, two strategies are used to verify the data:

1. Farmer resource person approach: As explained earlier, one farmer resource person within each group is trained in this monitoring system and the responsible Vi field officer for a particular region is constantly keeping contact to all resource persons in the groups. When the resource person reports the annual farmer self-assessment data back to Vi, the field officer is verifying the data and randomly checking a number of farms within each of the groups.
2. The Vi Permanent Farm Monitoring data is used to verify the Group Monitoring data (see Table 19). The standard error of the Group Monitoring is very low compared to the Permanent Farm Monitoring. The t-test for equality of means showed for 3 out of 4 values that both data sets are from the same population, i.e. the mean values are not significantly different.

Table 19 Verification of important project parameters of the Farmer Group Monitoring system

Parameter	Vi Permanent Farm Monitoring (2010)		Group Monitoring data (2010)		t-test for Equality of Means
	(kg ha^{-1})	Std error	(kg ha^{-1})	Std error	Sig. (2-tailed)
Maize yield Kisumu	1,089	9%	1,178	4%	.418
Maize yield Kitale	1,802	7%	1,635	4%	.217
Beans yield Kisumu	415	20%	466	5%	.548
Beans yield Kitale	498	16%	796	7%	.002

Overall it shows that both data sets match and that the permanent farm monitoring system as well as the data of the first project instances are both representative for the whole project area because the first project instances are equally distributed within the entire project area. The next data collected from the ABMS farmers will be done in early 2012 which then can be used to verify the latest Group Monitoring data. With regard to the adoption rate of carbon relevant SALM practices, Table 20 compares the anticipated adoption rate assessed in the Vi Permanent Farm monitoring in 2009 (ex-ante) with the actual adoption of SALM practices assessed in the Group Monitoring 2011 (ex-post). In Kisumu, the anticipated adoption rate perfectly matches with the actual adoption rate whereas the adoption rate in Kitale is significantly higher in the first project instances compared to the ex-ante estimation in 2009 which was very low.

Table 20 Adoption ex-ante compared to ex-post of the two monitoring systems

Practices	Adoption area as % of agricultural land			
	Kisumu Vi Permanent Farm Monitoring (ex-ante)	Kisumu Group Monitoring (ex-post)	Kitale Vi Permanent Farm Monitoring (ex-ante)	Kitale Group Monitoring (ex-post)
Removing crop residue	14%	17%	17%	17%
Burning of residues	3%	10%	6%	3%
Use of residues for mulching	57%	61%	37%	88%
Composting of manure	75%	62%	63%	89%
Use of cover crops	53%	52%	25%	73%

This verification of data will be conducted throughout the project to monitor data changes (yield increase) and to ensure that data are real and verified.

4.5 Example of net anthropogenic GHG emissions and removals for the initial project instances

Project removals due to changes in SOC were estimated for the first project year in the first group of project instances.
Baseline information was based on Vi Permanent Farm Monitoring data as explained before for ex ante estimations.
The information required for actual (ex-post) project estimations was obtained from the Group Monitoring database. Adoption areas were recorded and input parameters were obtained indirectly from records on yields and livestock.
Only maize, beans and sorghum were considered for residue management estimations and they were modeled separately. The distribution between first and second seasons for residue management and composting was assumed to be the same as in the baseline scenario.
The first table gives again an overview of the first group of project instances; the second table shows the actual adoption of SALM practices based on the Group Monitoring data of 2011.

Table 21 Summary first project instances

1st KACP project instances	No of farmer groups	Total No of farmers	Total Area (ha)	Total Agricultural land (ha)	Average No members per farmer group
Kisumu	306	4,649	5,376	3,347	15
Kitale	354	6,224	6,799	4,984	18
Total 1st instances	660	10,873	12,174	8,332	16

Table 22 Actual adoption of SALM practices of the first project instances

SALM practices	Adoption area as % of agricultural land	
	Kisumu	Kitale
Removing crop residue	17%	17%
Burning of residues	10%	3%
Use of residues for mulching	61%	88%
Composting of manure	62%	89%
Use of cover crops	52%	73%

The estimation of the carbon removals followed the same way as outlined in the methodology and the ex-ante estimation only that the input values were taken from the full enumeration of the Group Monitoring. The results of carbon benefits after one year are shown in Table 23. The uncertainty in the model output was estimated following the steps described in the methodology.

The uncertainty obtained in Kisumu was between 15% and 30% and the estimate was adjusted. The uncertainty in Kitale was below 15% and no deduction was required.

Table 23 SOC removals estimations in the first group of project instances

	Kisumu	Kitale
PRS_1	643 tCO_2e	1,274 tCO_2e
UNC_1	20 %	12 %
$PRS_{Adj,1}$	587 tCO_2e	1,274 tCO_2e

PRS_t Estimate of project removals due to changes in soil organic carbon in year 1, t CO_2e.

UNC_1 The uncertainty in the output model

$PRS_{Adj,t}$ An adjusted estimate of project removals due to changes in soil organic carbon in year 1, t CO_2e.

5 ENVIRONMENTAL IMPACT

ESF Consultants Ltd. conducted an independent Environmental and Social Assessment (ESA) of the Kenya Agricultural Carbon Project.

The objectives of this study were to ensure that environmental impacts by the project are explicitly addressed and incorporated into the development decision making, describe project components and activities anticipated during all project phases, analyze the alternatives for the project in terms of environmental and social impacts, anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant negative effects of the programme, ensure that the most significant environmental impacts of the target group (the farmers and their organisations) are addressed in a satisfactory and adequate manner and ensure that the productivity and capacity of natural systems is protected and that ecosystems services are maintained by the methods used by project.

Based on the assessment of this study, its anticipated that the project will achieve its objectives and at the same time have additional beneficial impacts including carbon sequestration, improved soil condition, water conservation, increase in biological diversity at the farm level, restoration of degraded areas, improvement to rural economy/micro economy, climate change adaptation by small scale farmers, increased food productivity in western Kenya, firewood supply, community capacity building and institutional development, community awareness on climate change, poverty alleviation, improved nutrition and gender mainstreaming in rural economy.

Although the overall objective of the Kenya Agricultural Carbon Project (KACP) is to increase farm production, contribute to climate change mitigation, generate carbon revenues, enhance biodiversity and reduce vulnerability to climate change, there are adverse potential impacts that could result from the project activities. These are

1. Risk of invasive tree species

2. Spread of pest and diseases

Based on the findings of this study, an environmental and social management has been developed to avoid, minimize, mitigate potential project impacts as well as enhance the beneficial impacts. Some of the mitigations are given below:

The project beneficiaries have been trained in good farming husbandry and pest management and an Integrated Pest Management (IPM) plan is in place.

The KACP considered in this study is environmentally feasible due to the fact that it proposes measure to mitigate climate change among small scale farmers while at the same time improving farm productivity using sustainable technologies that not only safeguard the environment but also have incremental benefits of carbon revenue generation.

The full report is available upon request.

6 STAKEHOLDER COMMENTS

A typical farmer in the project region is currently experiencing rapid depletion of per capita arable land (population density in the project region is approx. 400 pers. /km2), heavy soil degradation leading to stagnating yield production and critical food insecurities.

Intervention activities of Vi Agroforestry in previous projects lead to significant impacts on crop production through the adoption of agroforestry and farming techniques. Figures taken from an environmental impact assessment of the Lake Victoria Development Programme being implemented by Vi Agroforestry and the Swedish Cooperative Centre (SCC) indicate that over 81% of the respondent farmers have noted improvement in nutrition and food security as a direct benefit from Vi Agroforestry intervention activities.

7 SUPPORTING INFORMATION

7.1 Roll out procedure of the project

The initial project roll out plan is 9 years covering 45,000 ha. The project developer will sign a contract which each farmer group An extension officer will work during the intensive phase (year 1 to year 4) will recruit and work with 600 farmers in a location per year and at the end of four years worked with 2400 farmers/households. Altogether, there are 28 field extension locations within the project. Average land holding that potentially can be under SALM per household is assumed to be approximately 0.5 ha.
During the first 6 years, approx. 10,800 farmers will be recruited and worked annually.
Adoption of SALM by new farmer within existing group will be monitored. However, recruitment within groups is very rare and will stop according to the latest VCS AFOLU guidance. If new farmer joins he/she gets new ID for his own instance. The project target region is defined in the PD and cannot be extended in line with latest VCS AFOLU guidance.
PD will include all groups that are mapped and have signed commitment forms.
In case of force majeure she/he will be excluded from the project (death, serious ill or beyond anyone's control). Otherwise remaining group members have to accept that his/her non-performance will punish the group performance.

After the intensive extension has phased out partners, service providers and stakeholders with strong leadership from SCC-VI will sustain the project in a cost effective way.
The project is guided with participatory planning, monitoring and evaluation farmer led implementation system.
All extension officers in the field and partners will be trained on SALM practices. The extension officer will sensitize as many farmers as possible through existing traditional institutional structures such as Barazas and other organized meetings or groups (e.g. schools, local NGOs, etc.).

7.2 Soil Organic Carbon Modeling

The carbon stock changes in the soil due to a change of management practices in the project area are calculated by using a model approach. The soil model used for this purpose is the Rothamsted carbon model RothC – Ver. 26.3[31]. We developed a simplified version of the model in Excel on the basis of the RothC – Ver. 26.3 EXCEL developed by the Australian Greenhouse Office (2002).

The model calculates the soil carbon stock changes due to changes of inputs of crop residues and manure in the soil. The increase or decrease of soil organic matter (SOC) in the soil is the result of the decomposition of the added organic materials.
The inputs required by the model are:

- Clay content in the soil (%)

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[31] *Coleman K, Jenkinson D.S. (2007) RothC-26.3 – A model for the turnover of carbon in soil, Model description of user guide. http://www.rothamsted.bbsrc.ac.uk/aen/carbon/mod26_3_dos.pdf*

- Climate parameters: monthly mean, minimum, maximum temperature (℃), monthly precipitation (mm), monthly pan evaporation (mm)
- Additional residue inputs, due to crop management changes ($tC\ ha^{-1}$)
- Additional manure inputs, due to manure management changes ($tC\ ha^{-1}$)
- Soil cover in each month (bare or covered)
- Decomposability of the incoming plant material (ratio between Decomposable Plant Material, DPM and Resistant Plant Material, RPM)

Soil data

Data on the soil type and its clay content are derived from the Soil and Terrain Database for Kenya (KENSOTER), at scale 1:1 million. The dataset was compiled in the framework of the GEFSOC project (Batjes *et al.* 2004[32]).

Residues inputs

The calculation of residues inputs from the crops are based on productivity data collected from farms in the project area and on equations from the Volume 4 of the 2006 IPCC Guidelines[33].

For the baseline scenario the productivity for each crop at each cropping season is available from the information collected in the Vi Permanent Farm Monitoring . The harvest fresh yield is converted to amount of residues produced on the basis of the equations reported in Table 11.2 in Volume 4 of the 2006 IPCC Guidelines. The amount of aboveground residues is equal to:

$$R_a = a*b*Y + c$$

Where

R_a	aboveground residues, t d.m. ha^{-1}
Y	harvest fresh yield for each crop, t f.m. ha^{-1}
a, *b*, *c*	equation factors reported in Table 24

The amount of carbon of crop residues is calculated by multiplying the amount of aboveground residues (R_a) with a default carbon fraction (Table 24).

Only crops for which there is an equation are considered in residue estimations.

For baseline and *ex ante* project estimations general equations are used (corresponding to crop groups). The area weighted average residue value (tC / ha) is estimated for each cropping season and used for the modeling.

[32] Batjes N.H., Gicheru P. (2004). Soil data derived from SOTER for studies of carbon stocks and change in Kenya (ver. 1.0; GEFSOC Project). Report 2004/01, ISRIC - World Soil Information, Wageningen

[33] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

For *ex post* project estimations crop specific equations will be used and different crops will be modeled separately. Crop productivity will be recorded by the Group Monitoring system (see chapter 4).

Table 24: Constants to calculate the amount of residues produced by different crops

Crop / crop group	Dry matter fraction of harvest product (*a*)	Slope (*b*)	Intercept (*c*)	Carbon fraction (*e*)
Crops				
Maize	0.87	1.03	0.61	0.47
Wheat	0.89	1.51	0.52	0.4
Winter wheat	0.89	1.61	0.4	0.4
Spring wheat	0.89	1.29	0.75	0.4
Rice	0.89	0.95	2.46	0.4
Barley	0.89	0.98	0.59	0.4
Oats	0.89	0.91	0.89	0.4
Millet	0.9	1.43	0.14	0.4
Sorghum	0.89	0.88	1.33	0.4
Rye	0.88	1.09	0.88	0.4
Soybean	0.91	0.93	1.35	0.4
Dry bean	0.9	0.36	0.68	0.4
Potato	0.22	0.1	1.06	0.4
Peanut	0.94	1.07	1.54	0.4
Alfalfa	0.9	0.29	0	0.4
Non-legume hay	0.9	0.18	0	0.4
General				
Grains	0.88	1.09	0.88	0.4
Beans & pulses	0.91	1.13	0.85	0.4
Tubers	0.22	0.1	1.06	0.4
Root crops other	0.94	1.07	1.54	0.4
N-fixing forage	0.9	0.3	0	0.4
Non-N-fixing forages	0.9	0.3	0	0.4
Perennial grasses	0.9	0.3	0	0.4
Grass-clover mix	0.9	0.3	0	0.4

Manure inputs

For the ex-ante estimation manure inputs are calculated by a model based on:

- Information from the Vi Permanent Farm Monitoring on the amount of farm animals in each farm
- Factors from the 2006 IPCC Guidelines to calculate the amount of manure produced by animal type (Tables 10A-4 to 10A-9 in Volume 4).

The estimation of composted manure available at each farm is based on several assumptions. These are based on information on practices obtained from the farmers and on parameters and an equation obtained in a study on smallholder crop – livestock systems developed in Kenya[34].

- All the manure produced in the farm is collected during 3 months
- Fresh residues are added to the manure in a dry matter ratio of 3 manure : 2 residues
- The carbon fraction of manure is 39.9 % and of residues is 47 %
- The mixed materials decompose during 2 months
- The amount of composted manure after the maturation period is estimated as:

$$Y_t = Y_0 + EXP(-2.22 * t^{0.53})$$

Where:

Y_t	Composted manure resulting after t years (tC)
Y_0	Initial amount of manure + residues (tC)
t	Composting period (years)

- This process is repeated for each cropping season.
- The amount of composted manure available at each farm and each cropping season is referred to the agricultural land. The area weighted average value is used for the modeling.
- Composted manure is applied at the beginning of each cropping season.
- These values are used for baseline and *ex ante* project estimations.
- For *ex post* project estimations number and type of livestock will be recorded in order to update these values (see chapter 4).

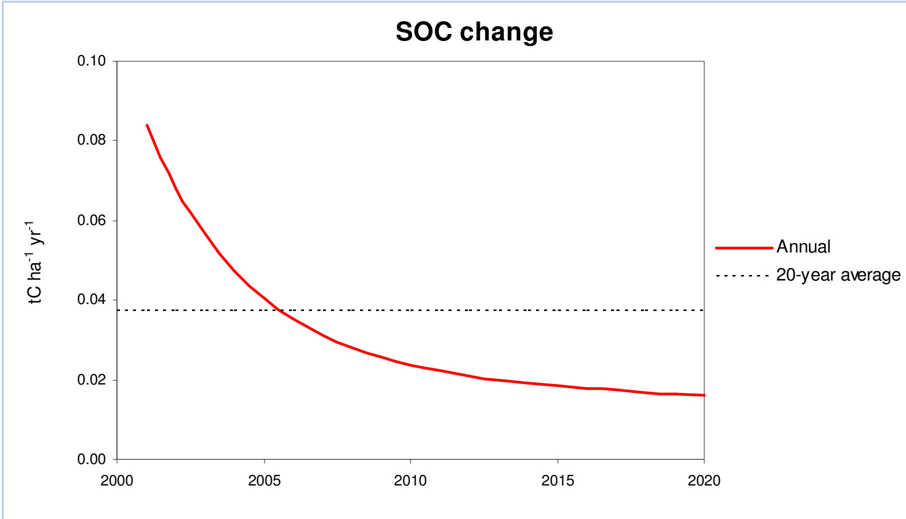
Calculation of annual changes in soil organic carbon stocks

The RothC model calculates the annual changes in soil organic carbon. The rate of change is dependent on the time from the change in management practice. For the estimation of GHG emissions and removals due to a change in management practice we use the average annual carbon stock over the first 20 years.

An example of the difference between the annual and average carbon stock changes is shown in Figure 16.

Figure 16: Annual and average changes in soil organic carbon

[34] *Tittonell, P., Rufino, M.C., Janssen, B.H. and Giller, K.E. (2010) Carbon and nutrient losses during manure storage under traditional and improved practices in smallholder crop-livestock systems – evidence from Kenya. Plant Soil 328: 253-269*


SOC change
0.10
0.08
0.06
0.04
0.02
0.00
tC ha-1 yr-1
2000
2005
2010
2015
2020
Annual
20-year average

7.3 VI Agroforestry – Farmer Group contract

Vi AGROFORESTRY

CONTRACT AGREEMENT

between

The Foundation Vi Planterar träd (hereafter called Vi Agroforestry)

and

Name of group	
Year of group establishment Group established year	
Group registration	
Chairperson	
Secretary	
Treasurer	
Postal Address	
EAST-COORD (X)	
NORTH-COORD(Y)	
Tel No	
County	
Division	
Location	
Village	

……………………………………………………… **Farmer Group in their joint effort to;**

1. Achieve our shared vision of a sustainable environment offering good living conditions for farmer families.

2. Empower small-scale holder families on sustainable agricultural land management for increased farm productivity and generation of carbon revenues.
3. Contribute to the implementation of the United Nations Convention on Climate change (UNFCCC) ratified by the Government of Kenya.

Have agreed as follows:

The agreement is between the Farmer group and Vi Agroforestry in the framework of the World Bank Biocarbon Fund.

This agreement between ____ group and Vi Agroforestry serves to assign the Verified Emission Reductions produced by the farmer group through the adoption of sustainable agricultural land management activities to Vi Agroforestry and in exchange the farmer group will receive support as highlighted under Vi-Agroforestry obligations.

Section a) Duration

Unless earlier terminated, this agreement is valid for ……… years to 2017 and is to run concurrently with the identical period as is Emission Reduction Purchase Agreement signed by Vi Agroforestry and the trustee of the Biocarbon Fund.

Section b) Vi Agroforestry Project's Obligations

1. Training of farmer group on selected sustainable agricultural land management practices:
    - Composting of crop residuals and manure
    - Rotational agriculture, conservation farming
    - Agroforestry, tree planting, establishment of tree nurseries
    -
2. supplying to the group:
    - Starter tree seeds,
    - Knowledge in farm planning,
    - Training in enterprise selection, business planning and marketing
    - Financial services
3. Organizational development
4. Provide incentive payments for Verified Emission Reductions out of sustainable agricultural land management activities implemented by the farmer group as follows:
    - Farmer group, 60%

2

  - Viagroforestry Project advisory services, 35%
  - Marketing and administration, Stockholm, Sweden, 5%

5. Enhance group capacity to develop setting up benefit distribution scheme within the farmer group members.
6. Ensuring a transparent and credible systems of transfer of funds from Biocarbon fund to farmer groups. Ensuring functional participatory monitoring and evaluation systems paid for out of Vi project advisory service budget.
7. Ensuring that grievances between individual farmers and/or farmer group members with the farmer groups are resolved expeditiously through the establishment and funding of a clear, transparent and sufficiently independent forum to redress such grievances paid for out of Vi project advisory service budget. The establishment of this grievance mechanism should be satisfactory to the trustee of the Biocarbon fund and periodic information in this regard should be made available to the trustee of the Biocarbon fund upon request.
8. Administering the project.
9. Passing onto the Farmer Group any notices it receives from the trustee of the Biocarbon fund that are relevant to the Farmer Group.
10. Collecting from the Farmer Group, and if necessary confirming the accuracy of, all information required to be collected under the monitoring plan and the applicable safeguard measures (including, but not limited to, the mitigation, monitoring, consultation and institutional measures recommended in the Environmental and Social Assessment Report), and report such information to the trustee of the Biocarbon fund.

Farmer Group's Obligations

1. Implementation of sustainable agricultural land management practices on ________hectares by the farmer group.
2. Ensuring individual farmer group members Implementing Sustainable Agricultural Land Management Activities implement such activities on land to which they have title or right of use.
3. Participate in Monitoring and evaluation of the project activities and cooperate in implementing the monitoring plan for the project and the applicable safeguard

measures (including, but not limited to, the mitigation, monitoring, consultation and institutional measures recommended in the Environmental and Social Assessment Report) and any due diligence plans and covenants listed in the Emission Reduction Purchase Agreement signed by Vi Agroforestry and the trustee of the Biocarbon fund. The group will undertake coordination of Farmer Self Assessment as adopted Sustainable Agricultural Land Management implementation and monitoring plan

4. Submitting to Vi Agroforestry minutes of its monthly meetings on progress of the implementation of Project Activities, including the handling of grievances related to the Project and resolutions thereof (if any), and cooperate with Vi Agroforestry to prepare the bi-annual Project progress reports, including progress on the implementation of the plans and measures described in paragraph 3 above and the handling of grievances related to the Project and resolutions thereof (if any), for submission to the Trustee.
5. Protect the Sustainable land management interventions from fire, browsing or grazing animals and effects of drought
6. Promptly informing Vi Agroforestry about any instances that may negatively affect the ability of the group to carry out their obligations under the Agreement.
7. Form proper governance structures within the group to ensure order in carrying out project activities and resource utilization and distribution.
8. Elect group officials in a manner that is done democratically to ensure proper representation of the group members and genders.
9. Open a bank account in the name of the group in a reputable local bank.
10. Establish and manage a benefit-sharing scheme with its members, as acceptable to the trustee of the Biocarbon fund, that will ensure fair distribution or usage of benefits from the sale of the emission reductions.
11. Cooperate with trustee of the Biocarbon fund and the appointed external validator and verifier in relation to verification of the project emission reductions, including providing relevant staff, employees and contractors of the trustee, validator and verifier with access to all relevant property and records.
12. Represents that the Farmer Group has not sold, and will not sell, any GHG reductions or emission reductions of any kind arising from the adoption of

sustainable agricultural land management practices to any party other than Vi Agroforestry, and agrees to assign all its legal rights to any such GHG reductions and emission reductions to Vi Agroforestry, including all the rights to the issuance and forwarding of such emission reductions as issued units under any applicable carbon standard.

13. Satisfy any obligations in respect of applications for all licenses, permits, consents and authorizations required to implement the activities.
14. At all times operate and maintain the Farmer Group's plant, machinery, equipment and other property, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound engineering, financial, environmental and social practices.

Section c) Entry into operation, Amendment and termination

1. This contract shall become operational after it has been signed by Vi Agroforestry and the farmer group.
2. This contract can only be amended after a mutual agreement by both parties has been reached.
3. This contract may be terminated by Vi Agroforestry at any time if it finds that the farmer group has acted in breach of the conditions in this agreement. Prior to the termination of this Agreement due to a breach by the farmer group, the Vi Agroforestry shall provide notice of the alleged breach to the farmer group with the opportunity to cure the alleged breach of the Agreement within 30 days after the notice was submitted. If the farmer group fails to cure a breach within 30 days of such notice to the satisfaction of Vi Agroforestry, the latter may terminate this Agreement.
4. In case of the occurrence of a Fund Participant Payment Failure under Section 7.03(b) of the ERPA, Vi Agroforestry will bear no liability to this contract. See Annex 1. extract from the ERPA, attached to this contract,
5. The farmer group may terminate this contract at any time if it finds that the Vi Agroforestry has acted in breach of the conditions in this agreement. Prior to the termination of this Agreement due to a breach by Vi Agroforestry, the farmer

5

group shall provide notice of the alleged breach to Vi Agroforestry with the opportunity to cure the alleged breach of the Agreement within 30 days after the notice was submitted. If the Vi Agroforestry fails to cure a breach within 30 days of such notice to the satisfaction of farmer group, the latter may terminate this Agreement.

6. This agreement will only be signed by a group legibly identified recorded with members participated in the carbon baseline and the documentation to adopt SALM activities (selected management activities from the "menu" and the available adoption area) as outlined in the Farmer Self Assessment.

7.4 VI Agroforestry - Vi Permanent Farm Monitoring survey template

Vi Permanent Farm Monitoring

YEAR

Interviewer:	**Date:**
Comments:	

General information

Name:	
Age:	
Occupation	
Group name:	
Sub-location:	

Geographic demarcation of the farm

For all new permanent farms: The farm boundary and all relevant farm structures (fields) should be tracked using the GPS. Use the 'operational manual for tracking farm boundaries' for guidance. In addition, take one waypoint (farm waypoint) at the homestead.

For repeating surveys of permanent farms: Use a print out of the tracked farm to compare all monitored data. **New tracking** is only needed if the geographic design of the farm changed (new fields, change in total area, etc.)

District code	Division code	Location code	GPS number	Default Name of the farm waypoint

Write down the default track name as given in the GPS (Default name of the track is the current date followed by serial number).

Tracked farm structure	Default Name of Track	Area in acre
Total farm boundary		
Field 1		
Field 2		
Field 3		

Page 1

Questionnaire

Use the print out of the tracked farm for checking the relevant data

Land tenure	
What is the legal status of your land?	
Lease:	☐
Respondent himself/herself has full ownership:	☐
Full ownership within the family:	☐

Land use	
How much land are you holding or working?	
Total land area incl. subplots (acres):	
Agricultural land (acres):	
Grassland (acres):	
Settlement (acres):	
Other (acres):	

Household cooking and heating	
What fuels are used in your household for cooking and heating? (enter time in hours/day of each fuel)	
Wood or charcoal:	
Manure:	
Grasses:	
Kerosene, naphtha or other fossil fuel:	

Fields with crops

How many fields with crops do you have and which crops do you grow on each of them?

Field ID	Crops

Page 2

Crop yields assessment						
Please describe each of your crops in terms of yields produced during the last two crop seasons						
				1st season	2nd season	
Field ID (same as table on page 2!)	**Field Area (acres)**	**Crop type** (enter code)	**% crop share of the field acreage**	**# of local units** (enter 0 in case of crop failure)	**# of local units** (enter 0 in case of crop failure)	**Comments**

Page 3

Monitoring of current agricultural practices for each field ID identified (make sure you have enough copies of this table for each field)				
Please "tick" if you apply/ don't apply the following practices in your field throughout the last two crop seasons (please always tick either 'yes' or 'no')				
Year: ☐ **Field ID:** ☐ (please make sure that Field ID corresponds to previous tables!)			**1st season**	**2nd season**
Do you practice "no till"?			☐Yes ☐No	☐Yes ☐No
Do you practice "reduced tillage"?			☐Yes ☐No	☐Yes ☐No
Use of residues	Do you (partially) burn the crop residues?		☐Yes ☐No	☐Yes ☐No
	Do you (partially) use the crop residues for direct mulching?		☐Yes ☐No	☐Yes ☐No
	Do you (partially) use the crop residues for feeding livestock?		☐Yes ☐No	☐Yes ☐No
	Do you (partially) use the crop residues for cooking and heating?		☐Yes ☐No	☐Yes ☐No
	Do you (partially) use the crop residues for composting?		☐Yes ☐No	☐Yes ☐No
Use of manure	Do you distribute raw manure directly to the field?		☐Yes ☐No	☐Yes ☐No
	Do you compost raw manure and residues before distributing to the field?		☐Yes ☐No	☐Yes ☐No
Do you use cover crops?			☐Yes ☐No Species:	☐Yes ☐No Species:
Soil water conservation	Do you terrace your fields?		☐Yes ☐No	☐Yes ☐No
	Do you have any water harvesting structures?		☐Yes ☐No	☐Yes ☐No
Use of fertilizers (please specify your fertilizer application)	N fertilizer (NPK, CAN, etc.)	Insert brand name(s)		
		Kg/liters applied of each fertilizer		
	Foliar fertilizer	Insert brand name(s)		
		Kg/liters applied of each fertilizer		
Use of machinery	Do you use gas or diesel powered machinery?		☐Yes ☐No	☐Yes ☐No
	How much gas do you use per year?			
	How much diesel do you use per year?			

Page 4

7.5 VI Agroforestry – Farmer Self commitment Form & Group Summary Record

FARMER COMMITMENT AND ACTIVITY MONITORING FORM

This form allows the farmer freely to promise and commit to undertake the Sustainable Agricultural Land Management (SALM) practices that improve soil fertility, increase farm productivity or crop yields, contribute to carbon emission reduction and enhance environmental conservation for the period of ________ year(s) starting from year ________ to ______. The farmer will annually undertake self assessment and report the progress to his/her group leadership.

This form will guide the farmer to plan, commit, implement SALM practices and monitor land productivity.

FARMER DETAILS

Name of the farmer ………………………………………………….. Sex…………………Age…………………

Occupation……………………Group Name…………………………………Village………………………………………

Sub-location…………………Location……………………Division………………………District…………………………..Year………………

Legal land tenure status (tick): Own ☐ Lease ☐ Family☐

Land use acres: Total land [ ] gricultural land [ ] Settlement land [ ] razing land [ ] ther land [ ]

Current crops and Sustainable Agriculture Land Management practices on the farm

Field ID	Field Acreage	Crop (based on the list)		No. of units produced		SALM practices (based on the list)		Cover crop species (based on the list)		No of units inorganic fertilizer used	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season

Current livestock and HH cooking and heating information

Livestock type	Total No.	No. under improved management
Calves		
Cows		
Goats		
Pigs		
Poultry		
Sheep		

HH cooking and heating in hours/day	
Firewood	
Charcoal	
Kerosene	
Manure	
Grasses	

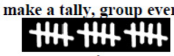
Sustainable Land Management Practices to be undertaken (next season/year)

Field ID	Field Acreage	Crop variety / No. project trees		SALM practices to be undertaken	
		1st season	2nd season	1st season	2nd season

Livestock		
Type	No.	No. under improved management
Calves		
Cows		
Goats		
Pigs		
Poultry		
Sheep		

HH cooking and heating (hours/day)	
	hours / day
Firewood	
Charcoal	
Kerosene	
Manure	

Current trees on the farm planted after2009

Field ID	Field Acreage	Tree species codes (based on the list)	DBH class ticking For each tree on the field just make a tally, group every five trees in one DBH interval  DBH classes						
			0-10 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm	50-60 cm	60-70 cm
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70
			0-10	10-20	20-30	30-40	40-50	50-60	60-70

COMMITMENT

FARMER SIGNATURE…………………………………………………DATE………………………………………

GROUP'S AUTHORISED SIGNATORY………………………………. DATE………………………………………..

NOTE: REFERENCES ON SPECIFICATION ON LOCAL UNITS AND SALM PRACTICES GUIDE AT GROUP LEVEL

GROUP BACKGROUND

Group name:	When group formed Month: Year:	When started to interact with SCC Vi-Agro forestry Month: Year:
Location	Contact person:	YEAR OF ASSESMENT__________________________________
Zone/Division:	Telephone to contact person:	GPS coordinates W/E: _ _ . _ _ _ _ _ N/S: _ _ . _ _ _ _ _
Group registered as: ☐ Self help group ☐ Women ☐ Youth group ☐ CBO ☐ Co-operative ☐		

GROUP ACTIVITY SUMMARIES		Land use areas (acres)					Land tenure (tick where appropriate)			Household cooking and heating (hours/day)				
No	Name of the farmer	Total land area including sub plots (acres)	Agricultural land (acres)	Grazing ground (acres)	Settlement (acres)	Others (acres)	Leased (tick)	Own land (tick)	Family land (tick)	Wood (hours/day)	Charcoal (hours/day)	Manure (hours/day)	Grasses (hours/day)	Kerosene, other fossil fuel (t hours/day)
	TOTAL													

1st Season

GROUP ACTIVITY SUMMARIES		SALM practices (acres)											Crops yields (local units) and areas (acres)											
No	Name of the farmer	Total area under SALM (acres)	Burning residues (acres)	Residues for direct mulching (acres)	Residues for feeding livestock (acres)	Residues for cooking and heating (acres)	Residues for composting (acres)	Manure for composting (acres)	Cover crops (acres)	Inorganic fertilizers (acres)	No of units inorganic fertilizer used (units)	Trees planted after 2009 (acres)	Maize yield (units)	Maize area (acres)	Beans yield (units)	Beans area (acres)	Sorghum yield (units)	Sorghum area (acres)	Sweet potatoes (units)	Sweet potatoes (acres)	Cassava (units)	Cassava (acres)	Groundnuts (units)	Groundnuts (acres)
	TOTAL																							

2nd Season

GROUP ACTIVITY SUMMARIES		SALM practices (acres)											Crops yields (local units) and areas (acres)											
No	Name of the farmer	Total area under SALM (acres)	Burning residues (acres)	Residues for direct mulching (acres)	Residues for feeding livestock (acres)	Residues for cooking and heating (acres)	Residues for composting (acres)	Manure for composting (acres)	Cover crops (acres)	Inorganic fertilizers (acres)	No of units inorganic fertilizer used (units)	Trees planted after 2009 (acres)	Maize yield (units)	Maize area (acres)	Beans yield (units)	Beans area (acres)	Sorghum yield (units)	Sorghum area (acres)	Sweet potatoes (units)	Sweet potatoes (acres)	Cassava (units)	Cassava (acres)	Groundnuts (units)	Groundnuts (acres)
	TOTAL																							

GROUP ACTIVITY SUMMARIES		Trees planted after 2009 (number of trees per DBH class)								Livestock (number)					
No	Name of the farmer	0-10 cm	10-20 cm	20-30 cm	30-40 cm	40-50 cm	50-60 cm	60-70 cm	70-80 cm	Calves (number)	Cow s (number)	Goats (number)	Pigs (number)	Poultry (number)	Sheep (number)
	TOTAL														