Murchison- Semliki Landscape:

Feasibility study for REDD

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May 2011

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Summary

Natural forests in the Murchison-Semliki landscape in Western Uganda are disappearing at a rate of 8,000 ha per year. This REDD+ (Reduced Emissions from Deforestation and Forest Degradation) feasibility assessment aims to measure whether carbon funds could be used as a mechanism to provide an incentive to stop this forest loss. The rapid conversion of these remaining forest fragments to farmland is driven by subsistence and cash crop farming together with unsustainable extraction for timber. Adding to this problem is the low productivity of the fields, high population density and growth, large demand for timber and immigrants moving into the area looking for land.

This study is part of a larger initiative funded under GEF to find new ways to conserve the unique biodiversity of the northern Albertine Rift by providing the rural population alternative livelihood options and at the same time strengthening the capacity of the national conservation agencies. Revenue from carbon credits has been identified as one of new ways to combine conservation with rural development.

A feasibility study was published in July 2010 for the northern part of the Murchison-Semliki Landscape dealing with the forests between the Budongo and Bugoma Forest Reserves (Ebeling & Namirembe 2010). This study confirms the lower carbon density of the northern forests, and it high-lights generating carbon credits from planting forests and a mix of incentives including expending the current cultivation of agroforesty cash crops for the international market.

The REDD project mainly focuses on a mosaic of private and community forests in the districts of Masindi, Buliisa, Hoima, Kibaale, and Kyenjojo, approximately 122,876 ha. The REDD project intends to provide a mix of incentives to forest land-owners, including direct payments, assistance with land-titling, enhancing agricultural productivity, reforestation, and promoting alternative income-generating activities.

The quantitative parameters used to calculate the carbon benefits are calculated based on plot and remote sensing data. The average carbon density of forests in the landscape is 375 tCO2e/ha, 440 tCO2e/ha for “Tropical High Forest (THF) fully stocked” and 165 tCO2e/ha for "THF depleted”. Emission from conversion to farmland with annual crops is estimated at 410 tCO2e/ha. The deforestation rate outside protected areas is 5.1 % annually or 8,367 ha based on historic deforestation between 2005 and 2010. In the absence of a REDD project all the private forests in the landscape will have been cleared in 15 years.

Baseline emissions from deforestation are calculated at 1.7M tCO2 in the first year and leveling off to a maximum of 31M tCO2e in year 15 including a 30% discount for leakage and annual average discount of 6% for non- performance. Benefits from regeneration are relatively small with 304,339 tCO2e per year excluding a discount of 30%. Net carbon benefits are projected to be 15 M tCO2 on average per year for the first 14 years and 31M tCO2e on average per year afterwards.

Net revenues from avoided deforestation are projected to reach 78 M USD (5 USD/tCO2e) on average per year for the first 14 years and a maximum of 153 M USD over the rest of the project life time, because that is all the existing private forest. The transaction costs comprising project development, monitoring, validation and verification, are estimated at 220,000 USD.

1. Project Description

Project Context and Background

Assessing the feasibility of a REDD project in the Murchison-Semliki landscape is part of the development of a sustainable financing system for the conservation of the northern Albertine Rift forests. A UNDP/GEF project 'Conservation of Biodiversity in the Albertine Rift Forests of Uganda' (CBARFP), implemented by WWF, has facilitated a strategic planning process aimed at identifying feasible means of conserving the forest landscape of the northern Albertine Rift (M-S landscape) and its unique biodiversity, and ensuring the long-term financing of the required conservation actions.

The Wildlife Conservation Society (WCS) was subcontracted under this project to assess the feasibility of REDD funding to conserve the remaining forests in part of the landscape (south of Bugoma Forest Reserve and west towards Itwara Forest Reserve). The Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) together with Jane Goodall Institute (JGI) and WCS combined resources to ensure that the whole of the landscape (including all forest east of Bugoma up to Budongo Forest Reserve) was assessed in the same feasibility assessment. This assessment therefore combines all the available information to allow an evaluation of the potential for REDD+ funding to conserve the remaining natural forest in the Murchison-Semliki Landscape.

The Murchison-Semliki landscape contains three relatively large central forest reserves (Budongo, Bugoma and Kagombe) interconnected by patches of "fully stocked" and degraded "tropical high forest" including many smaller CFRs surrounded by farm/grassland, and papyrus swamps. Topography is gentle with elevations around 1,100 m. Climate on the plateau above the escarpment with Lake Albert is moderately hot with temperatures ranging between 19/27 ˚C and a mean annual rainfall around 1,500 mm, distributed over two seasons (March/May and September/December).

In total, the forests in the landscape outside the forest reserves cover some 122,867 hectares ranging in size from 4 ha to 3,400 ha (Figure 1). These forests mainly along rivers are in various states of degradation. The key deforestation driver is conversion of forest to farmland for subsistence and commercial agriculture by the resident community. Forests have also been cut to control crop-raiding by wildlife, mainly by immigrants but with the permission of the resident community. Degradation drivers include the commercial extraction of timber for export, and to a lesser extent charcoal for urban markets and fuel wood for local use.

According to the Ugandan Bureau of Statistics (www.ubos.org), population density is high and growing faster than the national rate of 3.2%. A significant proportion of the inhabitants are immigrants from the Democratic Republic of Congo (DRC), Rwanda, Sudan and southern Uganda. The average household size is about seven persons and poverty levels are high. Land is mainly under customary tenure, passed on through inheritance and with no formal titles. Agriculture is extensive using hand tools and fire. Fuel wood is gathered from local forests. Cash crops cultivated are sugarcane, tobacco, cotton, maize, rice, beans and potatoes. (Akwetaireho *et al.* 2011).

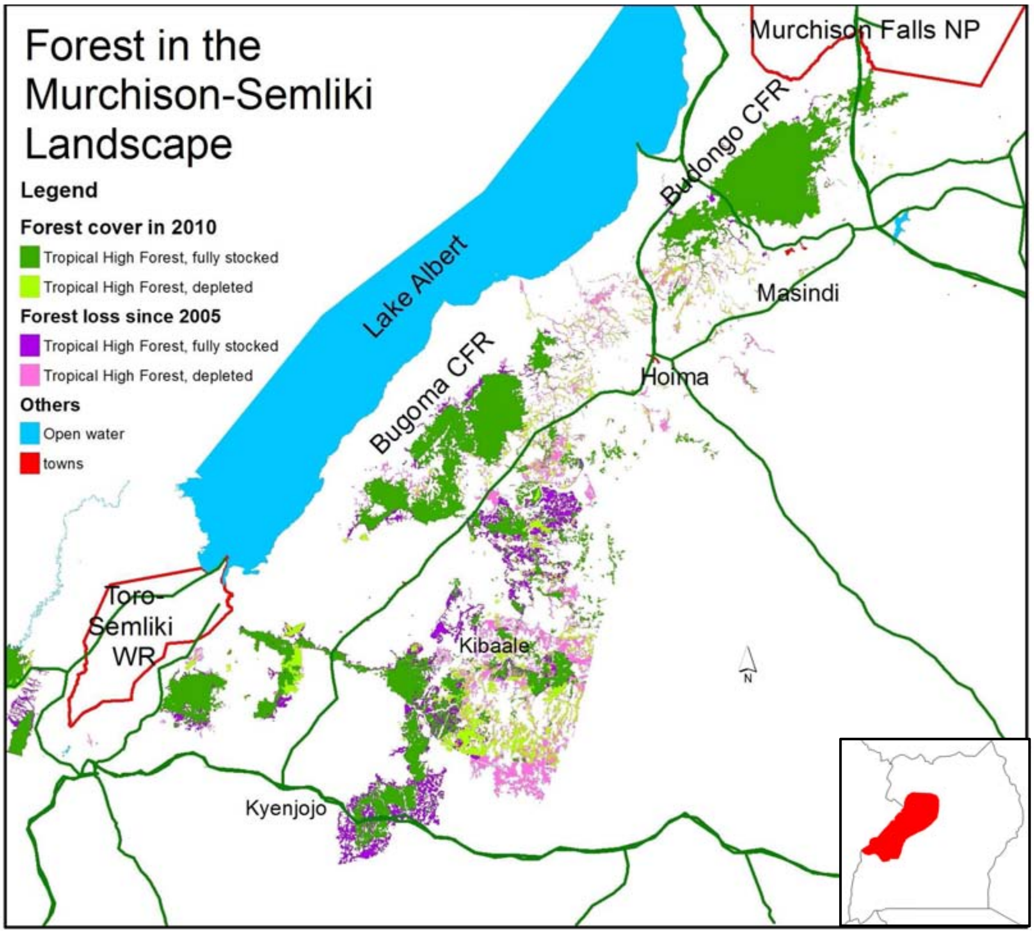

Figure 1. Map of the natural forests of the Murchison-Semliki Landscape indicating. Dark green: primary forests, light green: secondary forest, dark purple: primary forest loss, light purple: secondary forest loss since 2005.

1.2 Main Project Objectives and Outcomes

In this feasibility analysis, the potential of a REDD+ project is assessed and whether its carbon incentives are able to stop or slow down conversion of forest into other land uses. Significant obstacles to overcome in order to implement a REDD project are: local land tenure, demand for agricultural land in combination with a high population growth, and unsustainable natural resource extraction for timber from forest and charcoal from woodland.

The privately owned forests are the main focus of this study, but the forest reserves are also taken into consideration, because of the potential risk of leakage[1]. The successful implementation of a REDD project in the landscape requires that some of the revenue is earmarked for protecting these reserves by financing law enforcement under the direction of National Forest Authority (NFA) and district forest authorities because if leakage occurs then these emissions would have to be discounted from those avoided by the project and hence the revenues would be discounted.

[1] 'leakage' is displaced deforestation and degradation outside of the project areas due to the REDD project.

1.4 Land Tenure and Policy Context

Tenure Regimes in the REDD Project Area and their Relevance
Land in Uganda is either government owned or privately owned, and defined as "land and all that grows on it". Subsequently a landowner is also the tree owner except in situations where additional arrangements such as leases and licenses have been made.

The following land tenure systems are recognized: 1) customary, 2) freehold, 3) *mailo* and 4) leasehold. Land tenure is formally governed by the Constitution of Uganda 1995, the Land Act 1998, the Registration of Titles Act, Customary Land law and Lands Bill. The Constitution lays down the fundamental principles with regard to land ownership; the Land Act governs land ownership, land administration and resolution of land disputes, while the Registration of Titles Act deals with the registration and transfer of titles to land. The Lands Bill from January 2011 has strengthened occupier rights.

Customary tenure is the most common type of tenure in Murchison-Semliki landscape. Most forests under customary tenure are community lands owned by traditional institutions. Members of that community have open access to the land providing that they conform to the rules and regulations of that community. The communities can convert these forests to Community Forests by complying with the provisions of section 17 of the Forest and Tree Planting Act, 2003.

Freehold tenure is not very common in the landscape and mainly applies to large commercial farms owned by companies. The owner can hold his registered land in perpetuity which enables him to exercise full powers of using and developing the land, or taking and using produce from the land, and may enter into any transaction in connection with the land, including selling, leasing, mortgaging or pledging, and subdividing.

Mailo tenure is another form of tenure which allows the holding of registered land in perpetuity, but unlike freehold it permits the separation of ownership of land from the ownership of developments on land made by a lawful or bona fide occupant (who has lived on the land for 12 years or more). The holder can exercise all the powers of ownership like freehold, but he is subjected to the arrangements and statutory rights of the persons lawfully living on his land.

Leasehold tenure is a form of contractual agreement reached between the landlord or leaser and the tenant or lessee with the exclusive possession of the land for a defined period in return for a rent or premium. Under this form of land tenure the determination of carbon rights will depend on the conditions of the lease. On expiry of the lease land tenure reverts to the leaser/landlord.

Under customary tenure, the use of forests and woodlands is practically open-access. The tenure security is dependent on active agriculture or settlement. Land is generally not officially registered or even properly surveyed. Boundaries often demarcate only active fields and the settlement on the land, which are mutually agreed upon among neighbors.

However, forests are legally required to be registered. For example, the Hoima Environment Bill has the following clause: 'An owner of land on which there is natural or plantation forest exceeding 5 ha shall be required to register the forest which is rich in biodiversity or has high ecological importance, with the District Land Board (DLB) to be a Private Forest.'[2]

Forests are restricted to outsiders and they can only obtain access through leasing or renting. Mailo land tenure is common in Kibaale district and conflicts can arrive when settlers claim land of an absentee landlord. Bone fide occupants – with documentation of sale or ownership from the district - have planting rights and can claim benefits from trees (REDD+).

Forest conversion on private land is legal and no authorization is required from the District Forest Officer, except for clear cutting of a large area. Logging valuable timber species can only be done by registered tree cutters with an annual license from the district forest office. A District Forest Officer can only restrict harvesting via a directive (letter) stating the reasons for the restriction. To transport and sell logs the owners have to obtain a permit, which is issued after verification of the stumps, and they have to pay tax. No formal proof of land ownership is required.

National Policy Context Relevant to the Project
Conserving forests in Uganda has been promoted through enacting national legislation. In 1994 the National Environment Management Policy (NEMP) was adopted promote sustainable management of forest resources in protected areas, private and public land. The 2001 National Forestry Policy promoted public participation and partnership between governments and private companies in forest management. In 2003 the National Forestry and Tree Planting Act promoted registration of private forests with the local government District Forestry Services and the District Land Board. At a local level the Hoima Environment and Natural Resources Management Bill 2010 was passed on May 11th 2011).

The Ugandan government drafted a Vision for 2035 with explicit references to carbon trading as a means of conserving forests for climate change mitigation. In the latest version of the Uganda REDD readiness Preparatory Proposal (R-PP) from January 2011 submitted to the World Bank Forest Carbon Partnership Facility (FCPF).

At local level, district ordinances are being developed with support from WWF, CARE and ACODE in Kyenjojo, Kibaale, Hoima and Masindi districts, clarifying the legal basis for managing forests on private land.

1.5 Carbon Rights

At present there exists no explicit legislation on carbon property rights in Uganda. From the national forestry legislation, private forest landholders with strong title have the right to enter into any transaction in connection with their land, which should include generating carbon credits. A definitive clarification of who holds forest carbon rights is important and will become crucial for the project's ability to generate and commercialize carbon credits lawfully, including its distribution and utilization between stakeholders. In support of the project it would be useful to have a 'letter of non-objection', common in CDM projects, from

[2] Hoima District Local Government Environment and Natural Resources Management Bill 2010 (draft), part IV, section 20, clause 2 (c).

the central government. In return the central government can claim the right to regulate the sale of carbon or the transfer of carbon rights by issuing licenses or imposing taxes.

ECOTRUST has been implementing a Plan Vivo programme in Bushenyi District where they request participating farmers to demonstrate long-term use rights, in the form of a land title, title of customary ownership, purchase agreement, or bequeathing letter. For improved forest management on communal lands, Communal Land Associations have been registered which are in the process of acquiring title of communal ownership. Currently, the Ministry of Local Government is still processing the change in title despite approval by local government.

2. The Project's Carbon Benefits

2.1 Project Boundaries

The project boundaries are determined as those forests *outside of protected* areas in the districts of Hoima, Kibaale and Kyenjojo and parts of Buliiso and Masindi Districts - in total some 122,876 ha of tropical high forest in various states of degradation, but not including woodlands (of which there are another 120,000 ha). The remnant tropical high forest (2,000 ha) and woodland (100,000 ha) in most of Masindi district are not included except for the relevant corridor areas (figure 1): recently deforestation rates have dropped significantly in Masindi as very little private forest is left.

2.2 Baseline Scenario

The baseline scenario is to determine future green house gas emissions over the project life time. Volume of emissions is determined by deforestation rate and carbon density. To take effective measures and develop incentives to stop deforestation it is important to identify the reasons or driving forces and agents.

The following data was collected and analyzed:
- To identify and quantify the economic driving forces of deforestation a socio-economic survey interviewed 345 households (Akwetaireho *et al.* 2011/in prep.)
- To determine the historic deforestation and degradation for projected deforestation of the project life time Landsat images from two time periods (3 dates): 1996, 2005 and 2010 were analyzed
- To estimate the above ground biomass (AGB) of the existing forests trees in 172 circular plots were measured.

2.2.1 Main Deforestation Drivers

The socio-economic study showed that subsistence farming and small- to medium-scale farming for commercial production are the **primary proximate drivers** of deforestation. Most of the households combine substance farming with planting cash crops. Tobacco and upland rice are the main cash crops accounting for 15% of the households each, followed by groundnuts (9%), cassava (8%) and sweet potatoes (8%) (table 1). Historically, in Masindi district, large tracts of forest have been cleared for sugar cane, whereas in Hoima it has been tobacco. Maize and rice are planted for subsistence as well as for the market, and rice is

Table 1. The ten most important cash crops (actual and relative) and their impact on the forest.

Produce	Households	Percentage	Forest cleared
Upland rice	45	15%	yes
Tobacco	45	15%	yes
Groundnuts	28	9%	yes
Cassava	23	8%	no
Sweet potatoes	23	8%	no
Maize	20	7%	yes
Bananas	18	6%	no
Beans	18	6%	no
Timber	11	4%	yes
Sugarcane	10	3%	yes

Data: Akwetaireho, *et al.* (2011)

rotated with tobacco in some cases. Most of the forest is cleared with a few standing trees, and the logged trees are sold for timber or turned into charcoal. Forest is also being cleared to control crop raiding by animals.

Underlying deforestation drivers for **commercial** agriculture have been the national and international demand for sugar (e.g. Masindi) and tobacco (e.g. Hoima). The conversion of forest to farmland has been propelled by the incorrect belief of local farmers that tobacco can only be produced on forest soils, and the over-application of fertilizers with subsequent soil exhaustion for sugar (Ebeling *et al.* 2010). Upfront costs to start production have been facilitated by the high demand for timber in southern Sudan. The **main underlying driver** of **subsistence** farming is the shortage of farmland and too many people depending on natural resources for subsistence and cash. The lack of knowledge to increase or maintain productivity of the existing fields propels the conversion of forest to farmland.

2.3 Main Degradation Drivers

The main **proximate driver** for degradation is unsustainable and increasingly indiscriminate harvesting for timber affecting a wide range of species and tree age classes which ultimately prevents the forest from recovering. Recovery of the forest depends on the availability of future canopy tree in the understory. Therefore, cutting poles for construction and bean stakes and sub-canopy agriculture such as for potatoes suppress the regeneration capacity of the degraded forests

The timber supplies mainly regional and national demand and, to a lesser extent, local needs for construction materials. Charcoal production is not a major driver for degradation. It ranked 51st as source of income and only 10 households interviewed (2.9%) produced it averaging 336 USD per year (Akwetaireho, *et al.*, 2011). Most of the charcoal is produced from woodland. The **underlying driver** for degradation is an insufficient supply of sustainably produced timber and a strong demand from southern Sudan. There are no large plantations and forest owners do not manage their forests sustainably.

2.4 Main Deforestation and Degradation Agents

Resident community members clear their forest in response to their need for subsistence or cash. There is no “unclaimed forest” left in the region and **immigrants** can only clear forest with permission of the resident community either to produce crops or to establish land tenure for the resident community members.

The households interviewed were classified according to their annual income from cash crops and timber (table 2). 50% of the households generate less than $1500 per year from cash crops and timber, 38% generate between $1,500 and $5,500 and 12% generate more than $5,500 up to the maximum of $41,000. The $41,000 represents a selling event of timbre, a slow growing cash “crop” and the income should realistically be spread over the period until the next harvest. In case of a period of 40 years annual income becomes $1025.

Households in the corridors are the agents of past, present and future deforestation and degradation. Their distribution within the landscape, density and access to the forest determines by which method carbon emissions should be calculated to become accepted for the potential carbon buyers. There are two basic different methods, mosaic and frontier deforestation developed by the BioCarbon Fund and each is published in separate documents, RED-NM-001/version 01 and REDD-NM-002/version 01.3, respectively. The BioCarbon Fund administered by the World Bank is a public/private fund aiming to deliver and potentially purchase carbon reduction emissions from among others REDD-projects. But the delivery and potential purchase of emission units is linked with their methodology to calculate the (removed) emissions.

The appropriate method to use in Murchison-Semliki landscape is mosaic deforestation as “at project commencement most of the *project area* is already accessible to *deforestation* agents” (guiding document RED-NM-001/version 01). Population density in the region is around 130 people per square kilometer, determined from extrapolations from the democraphic data available at the Ugandan Bureau of Statistics (www.ubos.org). Hence, there are 32 M people in a landscape stretching 24, 853 km^2.

To estimate the costs of certain project activities it is important to have an estimate of the households in the corridor areas which are the main beneficiaries of the project. There are some 16,000 tobacco growers registered in the region and they represent 15% of the interviewed households. Therefore, some 106,667 households are estimated to reside in the corridors. There is no unclaimed forest in the corridors or project area and all of the forest is accessible by the households.

Table 2. Annual income from cash crops and timber classes		
annual income class (USD/ household)	number of households	relative
0 ≤ − <500	66	19%
500 ≤ − < 1,000	59	17%
1,000 ≤ − < 1,500	44	13%
1,500 ≤ − < 2,000	30	9%
2,000 ≤ − < 2,500	29	9%
2,500 ≤ − < 3,000	29	9%
3,000 ≤ − < 3,500	20	6%
3,500 ≤ − < 4,000	8	2%
4,000 ≤ − < 4,500	7	2%
4,500 ≤ − < 5,000	6	2%
5,000 ≤ − < 5,500	7	2%
5,500 ≤ − < 6,000	7	2%
6,000 ≤ − < 6,500	3	1%
6,500 ≤ − < 10,000	14	4%
10,000 ≤ − < 20,000	6	2%
20,000 ≤ − < 30,000	3	1%
30,000 ≤	2	1%

2.5 Baseline Deforestation and Degradation Trend

The historical trend of land use and land cover change was determined comparing three points in time: 1995, 2006 and 2010 (see Laporte *et al.* 2008 for more details on the methods used) . Land-use change and associated carbon emissions and removals were determined at a landscape level. Historic baseline net deforestation and degradation at landscape level has been calculated over the periods 1995 to 2005 and 2006 to 2010.

Land-use classification
Landsat images were chosen for the remote sensing analysis because of their better and more complete coverage over the landscape and for three different points in time, compared to both ASTER and spot images. The Landsat images were analyzed based on parameters of brightness, greenness, and wetness according to Crist and Cicone (1984), and Collins and Woodcock (2003). It was not possible to use an automated analysis because the images were not taken during the same season and the difference in phenology caused an additional difference in brightness, greenness and wetness of the vegetation.

Five land cover unit classes could be recognized in sufficient detail with a minimum of error: 1) Tropical High Forest (THF) fully stock and 2) THF depleted, 3) planted forest, 4) colonizing forest and 5) “Other”. The class of “Other” also comprises woodland which was difficult to distinguish from other land cover units such as shrubland and fallowing fields. Recognizing woodland as a separate class would have resulted in a biased coverage, without the necessary “ground-truthing” for the images of 2010.

Therefore, the land use change of Other to THF fully stocked represents the succession or development of woodland into THF, whereas the change from THF to Other represents deforestation. The change from THF to planted forest infers first deforestation and replanting afterwards. The change from Other to planted forest could either represent a change from woodland to planted forest or farmland to planted forest.

Deforestation
In between 1995 and 2005 (10 years), 35,386 ha of “Tropical High Forest fully stocked” became deforested, and 34,676 ha between 2006 and 2010 (5 years). Correspondingly, the deforestation rate practically doubled (factor 1.96) since 2006. Similarly, 15,715 ha of already depleted Tropical High Forest were cleared between 1995 and 2005 and 41,228 ha between 2006 and 2010. The actual deforestation rate of both types of forest between 1995 and 2005 was 5,111ha per year and 15,181ha per year between 2006 and 2010.

Degradation
25,111 ha of THF fully stocked became degraded between 1995 and 2005, whereas only 5,179 ha between 2006 and 2010. Consequently, the degradation rate dropped by a factor 2.4, from 2,511 ha per year to 1,036 ha per year.

Regeneration
Between 1995 and 2005, 5,006 ha of degraded THF became THF fully stocked and 4,818 ha of Other or woodland changed to THF fully stocked. Between 2006 and 2010 regeneration increased considerable with 16,394 ha of depleted THF changing to THF fully stocked and 17,717 ha of Others/woodland to THF fully stocked. This is an increase in regeneration rate of a factor 6.9. It is mainly due to dense woodland around north western Budongo becoming so dense it appears to look like THF fully stocked but in reality it is colonizing forest rather than mature forest. The signature on the images could not be distinguished however so it is classified as THF fully stocked.

Other land use changes
Other land use changes are “Other to planted forest” and “Other to Colonizing forest”. Colonizing Forest was classified because the trees had small crowns and had a different signature on the satellite images as a result. The land use changes from colonizing forest are very small with no ha colonized between 1995 and 2005 and 3 ha between 2006 and 2010. The changes in area of planted forest between 1995 and 2005 were slightly positive (202ha) as 1458 ha changed from Other to planted, but 1256 ha changed from planted to Other. The difference for 2006 and 2010 was negative, 2348 ha of planted forest was deforested and only 948 ha was planted.

Net changes
Deforestation almost doubled (factor 1.96) between the periods 1995-2005 and 2006-2010, degradation dropped by a factor 2.4 and regeneration increased by a factor 7. However, the net changes in hectares of forest cover are negative for both periods, resulting in a loss of 41,217 ha and 41,793 ha, respectively. Consequently, overall net deforestation basically doubled between the two periods. Weighting the two actual deforestation rates with the time periods result in an average deforestation rate of 8,367ha/yr.

Table 3. Land cover change between 1995 and 2005;

	1995-2005(10 yrs)		2006-2010 (5 yrs)	
land-cover change	Surface area (ha)	annual rate (ha/yr)	Surface area (ha)	annual rate (ha/yr)
Stable				
THF, fully stocked (THF)	102,571		73,262	
THF, depleted (THFd)	36,326		10,325	
Other* (stable)	2,412,016		2,436,687	
Planted Forest (PF)	1,843		895	
Deforestation				
THF, fully stocked to Other	-35,386	-3,539	-34,676	-6,935
THF, depleted to Other	-15,715	-1,572	-41,228	-8,246
Planted Forest to Other	-1,256	-126	-2348	-470
Degradation				
THF, fully stocked to THF, depleted	-25,113	-2,511	-5,179	-1,036
Deforestation -Regeneration				
THF, fully stocked to Planted Forest	-7	-1	0	0
THF, depleted to Planted Forest	-2	0	-41	-8
Regeneration				
THF, depleted to THF, fully stocked	5,066	507	16,394	3,279
Other to THF, fully stocked	4,818	482	17,717	3,543
Other to Planted Forest	1,458	146	948	190
Other to Colonizing Forest	0	0	3	1

* “Other” comprises besides farmland, marshes, shrubland, grassland and most importantly also woodland.

2.6 Carbon Pools Considered

Carbon cycle, pools and fluxes

In a REDD project the following carbon pools are eligible for carbon accounting: above ground biomass (AGB), below ground biomass (BGB), deadwood, leaf litter, soil carbon, and long-lived woody products. These pools are intermediary and temporary stages within the carbon cycle and transitions between these pools are referred to as flux. The carbon cycle is not limited to these pools and also includes the atmosphere, lithosphere and hydrosphere. Quantifying these pools and the fluxes is still a science despite the ever increasing accuracy.

The largest terrestrial pool of carbon is forest and tropical forest in particular. In tropical regions the distribution of carbon over the different pools mentioned above is skewed towards the above ground biomass. Dead biomass, leaf litter and soil carbon are decomposed quickly by fungi and bacteria due to high temperatures and humidity inside the forest. Only under more seasonal climatic circumstances does dead wood, leaf litter and soil carbon accumulate due to the suboptimal conditions for fungi and bacteria during a drier or colder season.

Land-use change from forest to agriculture skews the distribution towards the atmosphere through burning of the above ground biomass, and decomposition of the below ground biomass. Heavy rains will redistributed the remaining biomass on fields to the rivers, lakes and wetlands. More carbon is removed as crops are harvested over the years until the fields ultimately are abandoned to fallow. Over time a secondary forest may become established on the old fields, but when the land is overexploited it may become a red desert.

Estimation of carbon pools

Above and below ground biomass are the two most studied carbon pools. Above ground biomass is estimated using algorithms based on destructive sampling, measuring and weighting trees. Algorithms incorporate parameters such as diameter at breast height (dbh), height and wood density to facilitate large scale assessments using plots and transects. Several algorithms exist and even the so-called “pan-tropical” versions give different estimates of biomass for similar tree parameters due to the differences in between tropical forests.

The other carbon pools are more difficult to measure and costly. It is labor intensive to estimate below ground biomass through direct measurement, but it is well correlated to the above ground biomass in a ratio of 0.26 (Cairns et al. 1997). Dead wood and soil carbon are spatially patchy distributed due to the stochaic occurrence of gap formations in response to storm events. In addition, dead wood has a transient wood density and soil carbon is costly due to lab analyses.

The pool of long lived woody products is an anthropogenic pool as the fossil fuel. The idea that these products are a net sink of carbon is becoming increasingly disputed[3]. Both the production of these products and their use is a net source of GHG emissions. The use of most woody products does not extent beyond a standard project life time of 20 years and more, after which they are either burned or discarded in a landfill. Woody products in landfill are a

[3] Ingerson, A. 2009 Wood Products and Carbon Storage: Can Increased Production Help Solve the Climate Crisis? Washington, D.C.: The Wilderness Society.

Table 4. Carbon density (tCO_2e/ha), based on 172 circular plots (radius 20m)	
Tropical High Forest, fully stocked	440
Tropical High Forest, depleted	163
Farmland with remnant trees	30

Table 5. Landscape average carbon density				
land-use	ha	tCO_2e/ ha	ratio	average density
Tropical High Forest, fully stocked	107,372	410	0.87	358
Tropical High Forest, depleted	15,504	135	0.13	17
	above ground			375
	below ground			98

Table 6. Mean values for total carbon stocks (tC per ha) for different forest types in tropical Africa.
From: Proforest (2009)

Forest type	Mean	tCO_2e/ha
Tropical dry intact forest	251	920
Tropical moist intact forest	240	880
Tropical dry plantation forest	158	579
Tropical moist degraded forest	113	414

source of methane, a GHG 16 times more powerful than carbon dioxide. Also the production of wood, especially in tropical regions is a net source of GHGs. To harvest the commercial viable trees logging roads and skidder trails are created destroying many hectares of forest.

Project carbon pools
For this feasibility assessment, only above ground biomass and below ground biomass have been accounted for, as these pools are well correlated and direct measurements accurately estimates above ground biomass.

2.7 Carbon Stocks Affected

Carbon calculations followed the Biocarbon Fund methodology of mosaic deforestation (guiding document: red-nm-001-version 01). Carbon densities were calculated using the method of nested sampling. The location and number of the plots for a representative sampling of the landscape was determined using the software program DISTANCE 6.2 (Thomas *et al*. 2009).

For 172 plots the above ground biomass (AGB) was calculated and converted into metric tonnes carbon dioxide (tCO_2e). The most conservative pan tropical algorithm was used (Baker *et al.* 2004) to calculate biomass based on height and diameter.

Carbon density for THF fully stocked ranged from 350 tCO_2e/ha to 838 tCO_2e/ha, for THF depleted from 81 to 235 tCO_2e/ha and converted farmland from 30 ±5 tCO_2e/ha from both

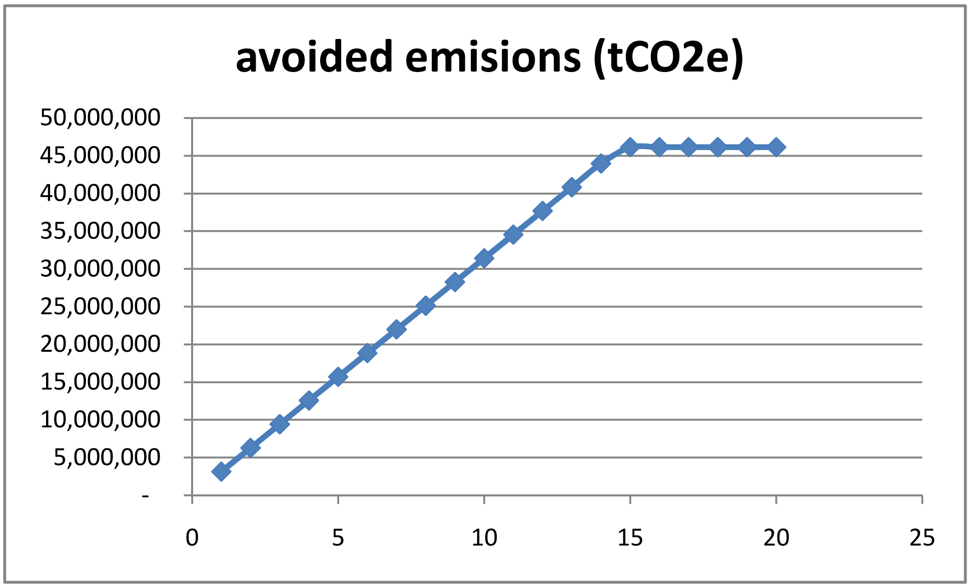

Figure 2. Avoided emissions from deforestation over a project life time of 20 years

annual crop biomass and remnant tree biomass. Conversion of THF fully stocked to farmland creates an emission 410 tCO2e/ha and 135 tCO2e/ha from THF depleted to farmland.

The landscape average carbon density has been set at 375 tCO2e/ha by weighting the averages for THF, fully stocked and THF depleted by their surface area in the landscape (table 5.). For comparison the carbon density of forests across Africa have been added to illustrate difference in biomass in different climatic settings. The forests of Murchison-Semliki are relatively low in carbon density (compare table 4 with table 6).

2.8 Overall Baseline Emissions

The historical baseline of deforestation and forest degradation increased from the first period of 1995-2006 and the second period of 2006-2010. Over the same two periods population grew accordingly and subsequently the pressure for land. Population is projected to grow continuously over the next few decades. Therefore, the linear deforestation trend has been projected over the project life time.

- Emission factor on average for landscape: 375 tCO2e/ha
- Project area at landscape level: 122,876 ha
- Deforestation rate: 5.1 %/year (8367 ha/year)

Based on these parameters, all the remaining private forests will have been cleared in 14 years with an average avoided emission per year of 23.6 M. In year 15 and after the total avoided emissions reaches the asymptotic maximum of 46 M tCO2e for the rest of over the project life time.

3. Project Scenario and Net Carbon Benefits

3.1 Project Performance Risk

Project performance is set in this assessment at 75% in the first year, 90% in the second year and 95% over the project life time. These are ambitious figures. On the other hand, several project proponents have been working with farmers groups in the region and educating them about the potential for REDD+ funds and helping form them into forest owners associations (e.g. WWF, Nature Harness, Chimpanzee Sanctuary and Wildlife Conservation Trust, Uganda Carbon Bureau, ECOTRUST and Jane Goodall Institute). Therefore, these percentages could be achieved as a result of their efforts in the landscape.

3.2 Leakage

To obtain net carbon benefits, gross emission reductions need to be adjusted for potential leakage, i.e. deforestation and degradation outside the project boundaries. Potential sources of leakage are: 1) activity shifting by local residents/land-owners, and immigrants, 2) displaced timber extraction and 3) displaced fuel wood production. Immigrants are not dealt with separately here because there is no unclaimed forest in the landscape and immigrants cannot clear forest without permission from the resident community.

Leakage can happen at a regional and national scale. The potential leakage "belt" in the region is the Central and Local Forests Reserves, and the privately owned non-project forests. At a national scale the forests around Lake Victoria and its islands are potentially at risk, especially when produce from the Murchison-Semliki region has been supplying urban or international markets.

Deforestation over the last 5 years has affected 93.4% of all the forest in the landscape and degradation only 6.6% (calculated from table 3). Projecting this trend over the project life time, the potential leakage from degradation alone is relatively small compared to potential leakage from deforestation. Therefore, almost all leakage will be from avoided deforestation.

Crops for which forest is cleared are tobacco, upland rice, maize, ground nuts and sugar (see table 1). Tobacco and sugar are mainly produced for the international and national market, respectively. Potential leakage from these two cash crops will be minimal, especially when tobacco and sugar companies are made aware of their impact. The risk of leakage from upland rice, maize and ground nuts production can be real since these commodities are grown for the regional or urban markets.

1) *Leakage from Activity Shifting*
In principle the risk of local leakage from displaced agriculture is low, because farmers will not allow encroachment from their neighbors on their land. On the other hand, market forces may be strong and non-project forests may be converted at higher rate than in the 'business as usual' scenario. Therefore, an initial leakage discount of 20 to 10% is set to account for displaced agriculture to non-project forests. Over the project life the discount can be reduced after verifications have proven the project's performance.

2) *Displaced Timber Extraction*
The land-use analysis showed that deforestation is must high than degradation, 93.4% and 6.6%, respectively. Intuitively a deforested area yields more timber than selective logging causing only degradation. There is the potential risk that illegal logging inside the forest reserves will increase, and the only way to mitigate this risk is by intensive protection. Therefore a leakage discount of 10% is set.[4]

3) *Leakage from Displaced commercial fuel wood production*
The production of charcoal or fresh fuel wood is very low in the landscape. In the socio-economic study less than 3% of the households generated cash from charcoal and it was not a main source of income. Therefore, this risk of leakage is considered very low and is not accounted for.

3.3. Project Emissions

Project emissions from implementing the proposed REDD project activities will come mainly from fossil fuel for transportation and purchasing materials with an associated carbon footprint. Since, it is the project's aim to stop deforestation and forest degradation there are no project activities which involve burning wood for logging, fuelwood or clearing. In the most recent guidelines of IPPC, the project emissions from fossil fuel do not have to be accounted for when they are less than 5% of the carbon benefits. The carbon benefits for first year of the project are 3.1M tCO2e. The maximum allowed project emissions from fossil fuel are 785,018 tCO2e, which are 5% of the 3.1M tCO2. Subsequently, the maximum allowed emissions from fossil fuels are the equivalent of 8 billion km of driving based on an emission factor for diesel of 0.002672 tCO2e per liter and a fuel efficiency of 30km per liter.

3.4 Carbon Benefits from Avoided Deforestation

The maximum carbon benefits generated from avoiding deforestation in the landscape are equal to the projected baseline emissions from deforestation, adjusted for non-performance by a deduction of 25 % in year 1 and 10% in year 2 and an additional discount for leakage of another 30%.

Historic deforestation projected over the project life time shows that all privately owned forest will have been cleared in the 14th year. This sets the maximum gross carbon benefits at 46M tCO2e /yr (gross) in year 15 until the end of the project life. In the first year of the project 3.1M tCO2e (gross) are planned to be avoided or 1.6 M tCO2e (net) including discounts and non-performance; similarly, 46M tCO2e/yr (gross) and 30.6 M tCO2e/yr (net) after the 14th year starting from year 15 (table 8).

[4] WWF is currently implementing a DANIDA-funded project aiming at documenting and tracking timber sources and movements within and through Uganda, which will provide baseline information in relation to the timber trade and potential improvement of forest governance.

Table 7. Comparison of benefits from regeneration and avoided deforestation over a project life time of 20 years			
Benefits	Total (MtCO2e)	Annual (MtCO2e/yr)	Ratio R/D (%)
Regeneration (R)	4.2	0.21	0.7
Avoided deforestation (D)	606	30	

3.5 Carbon Benefits from Avoided Degradation and Regeneration

Avoided degradation
Land-use dynamics over the last 5 years have shown that degradation is occurring at a relatively low rate compared to deforestation, 0.6% versus 5.1% (calculations from table 3). Consequently, within a period of 15 years all forests will have been cleared, including those hectares of forest which have become degraded in the previous 14 years at the start of the project.

In those 14 years before these forests are ultimately cleared by deforestation drivers, an estimated 3.3 M tCO2e will have been generated from avoided degradation, at a degradation rate of 1036 ha per year, with an average carbon emission of 275 tCO2e/ha for degrading THF fully stocked (410 -135 tCO2e/ha).

These benefits will not be claimed. Firstly, because there is not an approved methodology by which these benefits could be calculated, but more importantly, because its contribution in this landscape is low and short-lived.

Regeneration
The land-use land-cover analysis showed that there are 15,504 ha of degraded forest in the landscape and based on the carbon measurements they have an average carbon density of 135 tCO2e/ha. Protected from any further degradation these forests could regenerate and become 'fully stocked' THF with a conservative average carbon density of 410 tCO2e/ha. The maximum benefits from regeneration are 275 tCO2e/ha (410-135 tCO2e/ha) and multiplied by the 15,504 ha creates a total of 4.2M tCO2e sequestered.

If the degraded forests have sequestered 4.2 M tCO2e over 20 years, then the average annual maximum of carbon from regeneration is 213,177 tCO2e per year. Compared the benefits from avoided deforestation per year are only 0.7% of benefits from avoided deforestation, 213,177 versus 30,320,071 tCO2e (table 7).

These benefits will not be claimed, because they are very small (0.7%) compared to the total benefits from avoided deforestation. Besides, there is not an approved methodology to calculate these benefits from regeneration.

3.6 Net Carbon Benefits of Project Activities

Baseline emissions from avoided deforestation are calculated at 1.6 M tCO2e for the first year and reaching a maximum of 30.7 M tCO2e per year in the 15th year and for the rest of the project life time and adjust for non-performance, leakages (see Table 8.)

Table 8. Net carbon benefits from deforestation, including discounts for non-performance and leakage.

year	deforestation (tCO2e)	non-performance	leakage (30%)
1	3,140,073	2,355,055	1,648,538
2	6,280,145	5,652,131	3,956,492
3	9,420,218	8,949,207	6,264,445
4	12,560,291	11,932,276	8,352,593
5	15,700,364	14,915,345	10,440,742
6	18,840,436	17,898,415	12,528,890
7	21,980,509	20,881,484	14,617,039
8	25,120,582	23,864,553	16,705,187
9	28,260,655	26,847,622	18,793,335
10	31,400,727	29,830,691	20,881,484
11	34,540,800	32,813,760	22,969,632
12	37,680,873	35,796,829	25,057,780
13	40,820,946	38,779,898	27,145,929
14	43,961,018	41,762,967	29,234,077
15	46,115,630	43,809,849	30,666,894
16	46,115,630	43,809,849	30,666,894
17	46,115,630	43,809,849	30,666,894
18	46,115,630	43,809,849	30,666,894
19	46,115,630	43,809,849	30,666,894
20	46,115,630	43,809,849	30,666,894

Table 9. Landscape and project characteristics		
Parameters	*value*	*description*
project area (ha)	122, 876	Total area of forests outside the Budonga and Bugoma in the districts of Hoima, Kibaale, Kyenjojo and Masindi
Tropical High Forest , fully stocked (ha)	107,372	intact and mature tropical moist semi-deciduous forest (primary)
Tropical High Forest , depleted (ha)	15,504	degraded tropical moist semi-deciduous forest (secondary)
baseline deforestation	5.1%	8367 ha per year based on the reference period 2006-2010
baseline degradation	0.6%	1036 ha per year based on the reference period 2006-2010
Non-performance in year 1	75%	Sub-optimal performance of the project due to shifted instead of changed behavior of engaged farmers and forests owners
Non-performance in year 2	90%	
Non-performance project life time	95%	
Average carbon density of THF fully stocked (tCO2e/ha)	440	Above Ground Biomass based on carbon measurements
Average carbon density of THF depleted (tCO2e/ha)	135	
Average carbon density of farmland (tCO2e/ha)	30	
Conversion of THF fully stocked to farmland (tCO2e/ha)	410	Emissions from THF fully stocked to farmland
Degrading THFfully stocked (tCO2e/ha)	275	Emissions from forest to farmland
Carbon removals from THF depleted to fully stocked (tCO2e/ha)	275	Carbon sequestered by recovering THF depleted to THF fully stocked
Regeneration rate from THF depleted to fully stocked (tCO2e/ha/yr)	5.9	Average growth rate of THF depleted
Total leakage discount	30%	Discounts for leakage shifted agriculture and displaced timber harvesting

4 Project Activities

The range of project activities to be developed for implementation is determined by their cost-effectiveness and practicality, the carbon revenue, demand from the communities, carbon buyers and local and national government.

Project activities are intended to tackle the driving forces and agents of deforestation and forest degradation. These activities also have to have a net positive effect on the well-being of the rural communities participating in the project. In addition, some aspects of the activities will be determined by the carbon buyer targeted. For instance, a true compliance buyer is primarily focused on carbon credits with a low risk whereas a voluntary buyer is more likely to accept risky credits in return for community and biodiversity benefits.

The complex socio-economic context of this project and the low carbon density of its forests are not ideal for a true compliance buyer and compensation payments based on opportunity costs alone. The majority of the households receive between $500 and $3,500 per year from crop production based on forest conversion for a few years. With a carbon density of only 375 tCO2e/ha and on average only 3 ha per household the maximum payment for carbon credits is $1875 for the entire project life time of 20 years, or $94 per year. More is discussed in section 6.3.

Therefore, activities should focus on bringing rural development and increase crop yields to slow down the turnover of the existing forests. The circumstances under which the project has to perform are challenging because of the high population density, low productivity of the fields, profitable short-term land-use alternatives and the small forest per house hold. But if this situation is not reversed an irreversible tipping point will be reached in 15 to 20 years.

Rural development
Improving the livelihoods of the rural population is important for the success of the project. Presently, too many people depend on natural resources for subsistence and cash. If their traditional ways remain unaltered, all natural resources in Uganda will have been exhausted in 30 to 40 years and in the project area in 15 to 20 years. Model studies for the Albertine Rift predict an initial drying period of 20 years (Seimon *et al.* 2009). If without the REDD project all the private forests are cleared and climate becomes increasingly drier, there is the genuine risk crops will fail and people will be forced to displace elsewhere for subsistence agriculture and will become so-called “climate refugees[5]”.

Improving field productivity is essential to lessening their dependence on the forest, together with adding value to their produce and providing alternatives to obtain cash. Currently, their only way to obtain cash for education, sanitation, health care, household goods and clothing is planting cash crops or logging trees for timber or charcoal. Alternative solutions for power and clean water, like solar panels, biogas installations, or rainwater collectors are too expensive.

[5] Climate refugees are people who are displaced from their homeland due to an environmental disaster related to global warming. Therefore it is essential to provide them with sustainable alternatives.

To facilitate the decision of farmers and forest owners to participate in a REDD+ project they could be offered a package deal of direct payments, capacity building, and services.

The direct payments would be linked to conserving the forest on their land and provide them with cash for running their household and to create a financial buffer. Capacity building would focus primarily on increasing productivity of their farmland, services on acquiring land title and accessing micro-financing.. Ideally, these activities would be coordinated with e.g. National Agricultural Advisory Services (NAADS) programme to commit government to reduce deforestation.

These activities are also designed to mitigate any potential leakage and non-performance. Leakage is defined as shifted deforestation and degradation outside the project boundaries as a result of the REDD project, whereas non-performance is continued deforestation and degradation by farmers and forest owners within the project boundaries. Non-performance and leakage by the farmer or forest owner will be mitigated by stipulating that when one individual within the farmer group or association does not conserve his forest, all direct payments and services will stop for all farmers within that group.

The following potential activities are outlined in more detail:

- **Field productivity and adding value to produce –** Improvement of the soil can be achieved by creating a liquid solution of chicken manure (chicken tea manure) by soaking it in water for 3 to 4 weeks, after which the solution is spread over the fields. Hemp is planted as an insecticide and after harvest above ground crop biomass is composted or left on the fields to mulch and fields is not burned. Simple and sustainable agricultural techniques such as this have been extensively trialed in East Africa by organizations such as ICRAF and other NGOs.[6]

  In collaboration with the National Agricultural Advisory Services (NAADS), a practical workshop could be held to teach instructors the use of these techniques, followed by workshops held throughout the landscape to instruct the farmers. The farmers can be taught in poultry rearing techniques or alternatively they can buy the manure from chicken farms depending on accessibility. Existing farmer associations can set up a trading center and sell their products to Kampala where there is a large enough market for organic produce. In time a green label can be developed and validated by an organization as Wildlife Friendly (www.wildlifefriendly.org).

- **Services –** Improvement of social services such as primary education, health care and family planning can be sought through collaboration with NGOs who have a mission to pursue these objectives. These are also key government priorities for GOU funding and a good use of future oil revenues. Alternatively REDD funding would to contribute directly to DLG programmes complementary to GOU. Taxes from carbon revenue could also be earmarked towards social development projects.

- **Carbon enhancement –** In some part of the landscape forest are thin, especially between Bugoma and Budongo) (Figure 1) and low in carbon density (section 2). Therefore, rehabilitation of the degraded forests and replanting forest will be needed to generate

[6] For example, WCS has extensive experience in Zambia applying such techniques: the products grown are organic and sold under the green label “it’s wild” by a local community trading center adding value to the commodities (www.itswild.org)

sufficient carbon benefits. These activities require a different methodology, which can be pursued under VCS, Clean Development Mechanism (CDM) and Plan Vivo. Reforestation through a Plan Vivo scheme is already implemented by ECOTRUST and the easiest approach is to scale up their activities within the project boundaries.

- **Agroforestry –** Presently, cash crops are mainly produced for the national, regional or local market with limited prospect on added value on their produce. Producing for the international market is much more lucrative especially when crops such as tobacco, coffee, tea or cacao can be marketed as a "wildlife friendly", "environmentally sustainable", "fair trade" or "carbon neutral". These crops also reduce or eliminate any current or potential conflict with wildlife and crop raiding animals. Currently, Barclays is exploring how to finance conservation in combination with sustainable agriculture in Africa and this could be a potential support for this activity.

- **Land title –** Presently, most of the forest are held under customary land title. This is not the strongest land title but it is recognized by the local government. Transferring customary land title to free hold is a long and expensive. An individual transfer costs some $800 and takes at least three months. For only the corridor areas with an estimated 106,677 households the costs would accumulate to $85M. This is beyond the financial capacity of the project. Alternatively, a letter of no-object from the central government like in CDM projects is issued safeguard the effort and future of the efforts of this project.

Other activities occurring in some parts of the landscape and supported by the National Agricultural Advisory Services (NAADS) (www.naads.or.ug) are providing advice on better farm management practices to maintain yield production by minimizing tillage, limiting soil erosion, conserving soil water, and promoting agroforestry. Future activities to increase productivity include irrigation to continue production of off season crops and develop community tree nurseries, tea production, and horticulture. These activities could promote forest conservation by linking up at the sub-county level with the goals in the Sub-county Environmental Action Plans (SEAPs).

5. Risks to Generating Carbon Benefits and Revenues

A REDD project is business deal for carbon credits (tCO2e) and commercial techniques are used to assess the riskiness of the investment, like any other business deal. Unlike carbon credits generated from a technical project (e.g. wind mills), the carbon credits from a REDD project have a higher chance of becoming reversed, for instance lost due to a natural wildfire. In short, is the carbon buyer sure of his investment and how are things arranged in case of a default from the carbon seller?

Business deals in general are risky, which are managed through insurances. Since the insurance sector is not engaging in the REDD business, risks associated with carbon credits are managed by creating a buffer pool. This amount, a percentage of the total amount of credits, depends on the characteristics of the project and its context, but also the buyer. A compliance buyer will be focused on verified carbon credits; where as a voluntary buyer is willing to accept more "risky" credits because of its social and/or biodiversity co-benefits.

There are also project implementation risks. There is the risk that 1) farmers and forest owners might try to deceive and continuing some extraction from their forest or 2) are forced to cut forest to generate a substance amount of money in case of a monetary emergency or 3) prefer to pursue a more profitable alternative land-use activity. To mitigate these risks, the project will negotiate a group commitment from farmer or forest owner associations with a societal mechanism or process which will encourage individual behavior to comply with the rules of the project. In addition, to avoid monetary emergencies a model based on the Village Savings and Loan Associations (VSLA)[7] developed by CARE could be implemented.

5.1 Risk Assessment using the VCS guidelines and Buffer determination

The most recent VCS guidelines were followed to assess the risk level of the project and associated buffer discount. The AFOLU Non-permanence Risk tool (VCS Version 3) thoroughly deals with risks and classified them into three categories: internal risks, external risks and natural risks, and further into sub-categories such as project management, financial viability and community engagement.

The assessment tool contains tables with statements like “Project cash flow breakeven point is greater than 10 years from the current risk assessment” and a score. Statements which correspond with the project have to be chosen and which results in a total score. The total score is translated to a percentage for the buffer pool. The lower the total scores the lower the risk discount. In some sub-categories having a mitigation plan helps to lower the score.

Internal risks

Internal risks comprise the following sub-categories: project management, financial viability, opportunity costs and project longevity.

“Project Management” deals with the tree species planted, enforcement to avoid encroachment, expert knowledge and presence on the ground of the project proponents. Mitigation plans have to consist of “adaptive management plans in place” and individuals with “significant” experience in all aspects of a REDD project.

In this project the plus part of the REDD+ project is more easily implemented by expending the Plan Vivo activities of ECOTRUST. Therefore, the risk associated with the tree species planted does not apply. Also encroachment is unlikely to happen since all of the forest is private and relatively small. Expert knowledge is present or could be incorporated by associating expertise within the NGOs from outside Uganda. Proponents of this project have been active for some years in this landscape. The overall score is at least 0 and including mitigation -4.

“Financial Viability” deals the number of years in reaching the breakeven point of the project cash flow, and the percentage of funding secured for the project. Mitigation deals with the availability of “callable financial resources of the 50%< of total cash out before the project reaches breakeven”. “Cash flow in” is defined as: a) commercial revenue streams assessed for the project, b) secured revenue, c) projected revenue of sale credits and d) secured donor/upfront/pre-payments/ equity or loans. “Cash flow out”: a) project implementation

[7] http://www.vsla.net/

costs, b) validation/verification/registration, c) interest expenses/ repayment loans/ forward purchase agreements and equity distributions.

In this subcategory it is more tentative to choose a statement which corresponds with the project. The breakeven point depends on the project activities to be implemented. Therefore, for this project the statement of reaching the breakeven point between 4 and 7 years was chosen with a score of 1 and the percentage of secured funding between 15% and 40% with a score of 2. These two statements were chosen since partners have a potential carbon buyer for the carbon credits. Mitigation could come from donors like NORAD or corporations willing to invest in activities[8]. The total score was 3 or in the worst case 6.

"Opportunity costs" deals with the net present value (NPV) of the most profitable alternative land-use activity. NPV or "discounted cash flow" analysis is a commercial method to calculate the viability of an investment. Other aspects included are a net positive community impact and the subsistence as the biggest driver. Mitigation comes from "project proponent is a non-profit organization", and "project is protected by a legally binding commitment to continue management practices […] over the […] project crediting period" or longer.

This requirement of the risk assessment is new and was published after the socio-economic surveys were completed. Therefore, to accurately compare this project with the most profitable alternative land-use alternative additional information has to be collected from the households. A chose from the statements is furthermore complicated because they include costs for the project activities which have not been decided yet. An intermediary statement chosen based from the currently available data on the opportunity costs, the net positive community impact and subsistence as the main drive. Total score was 2.

"Project Longevity" deals with the continuation of the project activities to maintain GHG reduction during and beyond the project life time and a legal agreement to support this. It also sets a newly published crediting period or project life time of 30 years. In absence of a like legal agreement, the statement "without legal agreement or requirement to continue the management practice" was chosen to be conservative. The total score of this sub-category is 18, which is high (formula: 24 – (project longevity/5).

External risks:
External risks comprise the following sub-categories: Land ownership and resource tenure, community engagement and political risk.

"Land ownership and resource tenure" deals with the discrepancy between ownership and resource access/use rights and dispute. Mitigation comes from a legally binding commitment to continue practices over the project life time or a plan solve disputes. In the case of this project ownership and resource access/use rights are held by the same entity and there is very little dispute over land tenure due to the high population density. The mitigation does not apply. The total score was 0.

"Community engagement" deals with the dependence of communities on the project area (within 20 km), their participatory engagement and net positive benefits for the communities following CCBA[9] standards. Mitigation comes from a net positive impact on social and

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[8] Project proponents are soliciting corporations willing to contribute to activities
[9] Climate Community and Biodiversity Alliance

economic well being of the communities. In this case the statement "less than 20% of the households […] have been consulted with a score of 5 and a mitigation score of -5 for net positive impacts on the well-being of the communities. Total score was 0.

"Political risk" deals with "governance score" according to the World Bank's six indicators governance indicators, with mitigation among others from participation in REDD initiative funded by the World Bank Forest Carbon Partership Facility, registered CDM afforestation/reforestation, and national FSC body. The mean of Governance Score mentioned in the World Bank Report for Uganda in 2008 was positive. Current developments may have turned it down. Including the R-PP submitted by Uganda, the total score is 0.

Natural risks:
Natural risks comprise the occurrence and frequency of natural event which could harm the carbon benefits. The likelihood of occurrence is defined as the historical average events over the last 100 years and significance as the percentage of the project areas affected by fire, disease and extreme weather. Likelihood ranges between events less than every 10 years to once every 100 years and significance between 70% of carbon stocks lost and less than 5%.

Fire is part of the natural ecology of this landscape and it is assumed the highest natural risk in the project area. Historically, fire has not been strong force affecting the distribution of the forests. Therefore, from table the likelihood of an event happening "every 25 years to less than 50 years" and a significance of only "minor or less than 5% to less than 25% loss of carbon stocks" were chosen.

The overall total of scores was 25 which is the equivalent of a discount of 25%. To lower this discount is best achieved by lowering the score for project longevity which was 18.

5.2 Stakeholder Buy-in

To ensure stakeholder buy-in, the project will be presented as a business opportunity arranged in an attractive package deal with direct payments, technical support and services. NGOs, such as WWF, Jane Goodall Institute, ECOTRUST, CSWCT, NAHI, and WCS are active in the landscape, and have already tested the willingness of farmers and forest owners to participate in PES projects. Consequently, farmer and private forest owner associations have been established and some kind of land title has already been secured in some cases. Consultations with the local and central government need to take place to ensure their support and collaboration. Local governments of the districts have already expresses their interest in the project.

6. Financial Feasibility

The financial feasibility of the project is determined by comparing its carbon finance potential (net carbon revenues) with its implementation and opportunity costs incurred over the project life time. A comprehensive quantitative assessment of the project's overall economic viability can only be conducted when the implementation activities have been budgeted in detail.

Project feasibility in terms of its carbon finance potential is determined by:

- projecting the net carbon credit generation potential,
- calculating the carbon revenues, and
- subtracting carbon-cycle related transaction costs.

6.1 Carbon Credits Generated for Trading

The net creditable carbon benefits from avoided deforestation have been presented in table 8 and adjusted for:

- non-performance discount of 25% in the first year, 90% in the second year and 95% in the third year and for the rest of the project lifetime.
- leakage of 30% for shifted activities and displaced logging, and
- a discount of 30% for complications to accurately measure regeneration

After the VCS risk assessment an additional

- 25% buffer has been discounted, but which are partly reclaimable after verification events over the project life time

Net carbon benefits are projected to be 1.9M tCO2 in the first year, gradually increasing to 11 M in the 5th year, 21M in the 10th year and ultimately leveling out to a 31M in the 15th year until the end of the project life time. The carbon buffer for VCS is not drawn from above ground biomass, but alternatively from below ground biomass which is the equivalent of 26% of the total biomass according to the ratio of 0.26 (Cairns *et al.* 1997).

It is important to understand that the project can only generate revenue after its initial and periodic verifications validating the project's performance. Verification costs for an external auditor and the collection of the monitoring data ranged between $20,000 and $40,000 which will determine cash flow of the project. Alternatively, these costs could in principle also be shared between the carbon buyer and seller depending on the negotiated contract (Hawkins *et al.* 2010).

6.2 Carbon Revenues Generated

Carbon revenues are a function of the net carbon credits, transaction costs, the commercialization model adopted, and carbon prices.

6.2.1 Transaction Costs
The main transaction costs for the project are:

• drafting a PDD, including the monitoring plan,
• assessing environmental, social and biodiversity benefits (for CCBA standards),
• periodic monitoring of non-performance, leakage and regeneration,
• holding stakeholder consultations,
• validation of the PDD by an external auditor,
• initial and periodic verification by an external auditor,
• registry fees (commercial registry), and certification fees (VCS),

Additional, costs associated with the transaction costs are:

• local sales and income tax, (property tax and VAT)
• legal advisory fees,
• costs of project marketing.

The estimated transaction costs are presented in table 10. Transaction costs like validation, registry fees, and certification fees, are relatively fixed and depend on external service providers. Verification costs are flexible and depend on the interval. Other costs are specific to the project context, such as consultation with communities.

The costs for the PDD will not be as high for this particular project, because some of the data collected for this feasibility study can be used for the future PDD, i.e. carbon, socio-economic and biodiversity data. Furthermore, some of the data and information collected for this study has already been partially written up into a PDD following CCBA standards by WCS. The monitoring plan can also be developed based on the experience of collecting the data presented in this study.

Stakeholder meetings have already been held in the preparation for the R-PP. The general outcome of these meetings can be incorporated in the further development of the project. Meetings at a local level, with the local governments of Hoima, Kenyoyo and Kibale have been held in February this year and the NGOs active in the landscape have regular meetings with their participants. More meetings will be required with the local and central government and between the project proponents to develop an effective, transparent and simple payment.

There are the additional costs related to taxation at a central and local level, because the farmers or forest owners would potential receive income from carbon credits. The tax related costs vary between 6-10% at the local level and taxation at a national level could add another 18% based on VAT. The central government should be made aware that the benefits from REDD are still not sustainable and preferably a tax break on carbon benefits should be negotiated for at least 10 year. The costs on legal advice and marketing could also be covered by the carbon revenue or alternatively be covered by donor money.

Transaction costs to further develop and validate the project are estimated at 220,000 USD, which include, finishing the PDD, validation, verification, monitoring and legal advice.

Table 10. Transaction costs			
costs		Amount (USD)	description
PDD		150,000	Completion of a PDD following CCBA standards and ultimately VCS
validation		40,000	third party validation of the project
Monitoring	carbon	20,000	proponent and third party checking planned avoided deforestation
	social	20,000	idem, CCBA requirement
	biodiversity	20,000	idem, CCBA requirement
Verification		20,000	third party verification of the project performance (periodic) every 5 years
Fees	registration (USD/tCO2e)	77,200	APX, TZ1, CdD; 0.05 USD/ tCO2e for annual average of the project life time
	certification (USD/tCO2e)	154,400	VCS; 0.10 USD/ tCO2e for annual average of the project life time
Taxes	central		VAT
	local	6%	Personal tax and income tax -no property tax?
carbon price	Commodity	2	Forward sale
	average	5	After validation
	Premium	10	Buyer dependent
Land title registration		85,333,600	Land title and registration currently costs 800 USD per transfer and the estimated population is 106,677
Implementation	Direct payments (USD/yr)	1366	payments to offset income from cash crops for 81% of the households
	Increased productivity	220,000	training to instruct farmer in productivity techniques
Legal advice		20,000	
Marketing		6,000	

6.2.2 Marketing and Sales

The objective of the REDD project is to sell carbon credits and finance activities which will ensure the project's aim to reduce emissions from deforestation and degradation. Depending on the volume of the credits and their sale, all or some of the activities can be financed from the carbon revenue. If the revenue of carbon credits is not sufficient to finance all the activities donors or companies could be approached. Donors will most likely only fund activities with a certain output realized within a certain period. Securing donor money for the long run will most likely not feasible.

Depending on the deforestation rate and socio-economic forces revenue may have to be generated quickly. If the pressure on the forest is lower, maximizing the volume of the carbon credits may be the objective. The price at which the carbon credits are sold depends on the delivery terms. Guaranteed carbon credits, like after a verification event of an ongoing REDD project, can be sold for a higher price than credits planned for the future; these are termed prompt delivery and forward delivery, respectively.

The transaction with the lowest risk is the prompt delivery of existing credits or offsets. There is a medium risk with a forward sale of future offsets and a high risk of forward credit for so-called Ex-Ante offsets. In the forward sale the seller is the main risk taker and if the project fails to deliver the seller has to provide alternative offsets from other projects. In the forward credit, the risk is with the buyer, since the delivery is not guaranteed. Forward crediting is more appropriate for a donor who is not required to offset its carbon footprint within a certain period and for a certain number of offsets.

Deforestation in the Murchison Semliki landscape is high and ideally the REDD project starts to generate revenue as soon as possible. This could be pursued in different ways or in combination:

- a low risk transaction would require early and frequent verification events to sell guaranteed offsets, but each verification costs between $20,000 and $40,000 and has to be deducted from the revenue.

- a medium risk transaction would require a forward sale delivering a number of future offsets within a certain period, e.g. 50% of the project planned offsets in 5 years time.

- a high risk transaction of forward crediting for ex-ante offsets. This transaction is more difficult to sell to commercial buyers, but a donor may be willing to take the risk especially when rural development and conserving biodiversity are the primary focus of the donor.

Because of the high deforestation rate, for this project a quick delivery of offsets is suggested which could be pursued by a combination of a forward sale of a portion of the project carbon credits, a later delivery of guaranteed offsets after verification, but ideally a donor would like to invest in the project by providing a forward credit of ex-ante offsets.

Table 11. Total net carbon benefits from forward sale, with three years until validation		
year	net carbon benefits avoided deforestation (tCO2e)	revenue (2USD/ tCO2e)
1	1,648,538	3,297,076
2	3,956,492	7,912,983
3	6,264,445	12,528,890

Table 12. Total revenue adjust for fees calculated for the first three years of the project				
year	registration fee (0.05/tCO2e)	certification fee (0.10USD/tCO2e)	net total revenue	relative
1	93,079	186,158	9,028,642	3%
2	208,476	416,953	20,222,216	3%
3	323,874	647,748	31,415,790	3%

6.2.3 Carbon Revenue Scenarios

Projected net carbon revenues are presented in table 8. They do not include transaction or implementation costs and taxes. At 5 (10) USD/tCO2 revenue is estimated at 8.2 M (16.4 M) USD in the first year from avoided deforestation; the maximum revenue from deforestation is reached in 15 years and is estimated at 153.5M (306.6M) USD and the cumulative total is 154.4M (308.8M) USD.

The net carbon revenues in case of a forward sale at a price of 2USD per tCO2e are presented in table 11. The maximum length of the forward sale is set at three years, after which validation and verification will happen and the carbon price increases from 2 to 5 USD per tCO2e. The cumulative total for the three years is 23.7 M for avoided deforestation.

Revenue of regeneration was not claimed, as it becomes marginal over the project life time. In the first year revenue from regeneration comprises 13% of the total amount, but becomes increasingly smaller over the project life time and it levels of to only 0.7%. Similarly, the registration and certification fees only marginally reduce the net carbon revenue (table 12).

6.3 Implementation & Opportunity Costs

Implementation costs
Project activities entail direct: payments (dealt with as opportunity costs), improving field productivity and improving community benefits and alternatively land title and registration.

- **Field productivity and adding value to produce – Currently, there is no NGO working** with farmers to improve this situation. Calling in expertise and organizing trainings could be done directly with the farmers or in collaboration with the National Agricultural Advisory Services (NAADS). It would costs some 220,000 USD at least to implement this activity. This activity could be funded by the USAID new program "feed the future", which mission is to increase food security in Uganda (http://www.feedthefuture.gov).

- **Land title and registration –** To transfer land title from customary to free-hold or equivalent will cost $85,333,600 in total. It is clear that the carbon revenue or donor money is not sufficient to finance this activity. Therefore, alternatives should be sought either negotiating a lower transfer cost of land title or registration at Private Forest Owners Associations (PFOA) level with agreement of the Ministry of Local Government.

The financing of these activities could either come from the carbon revenue, or donors. For instance, improving the productivity of the fields could be financed through a USAID program such as the forthcoming "feed the future" program. Likewise companies present in the region willing to improve their corporate image and responsibility could be approached to fund some of these activities.[10]

Opportunity costs
The socio-economic study has shown that the income from timber, cash crops and forest non-timber products varies greatly from the rural poor, with an annual income of only $22, to the rural rich with up to $ 41,000. The 341 household interviewed were classified according to their annual income presented in table 2. 60% of the households received less than $1500, 32% less than $3500 and 90% less than $5500.

The possibility of direct payment to compensate farmer and forest owners for the lost income from timber, cash crops and forest non-timber product is strongly determined by the carbon density of the forests and the surface area of their land. Break-even points have been calculated at an annual income of $1400/yr, $3600/yr, $5000/yr and $10,000 per year. (table 13). The annual income was transferred in tCO2e by dividing it by the carbon price of $5/tCO2e, e.g. $1400 equals 280 tCO2e. Carbon density was arbitrarily set ranging between 100 and 500 tCO2e per ha and the surface area in forest between 1 and 10 ha.

The break-even points for the opportunity costs are reached with more difficultly for high annual incomes and low forest densities. For instance, the break-even point for an annual income of $1400 was reached by a farmer with 3 ha of forest with a carbon density of 100 tCO2/ha. But for an annual income of $10,000 the break-even was not reached before a

[10] WCS is currently approaching companies in the region to assess their willingness to contribute to the conservation of the corridors and reduce their impact (Nampindo 2011).

farmer has 10 ha of a forest with a carbon density of 200 tCO_2e. The study showed that only 52% still have forest on their land, and the average farmer has 3.7 ha of forest ranging between 0.3 and 27 ha.

This means that the farmer with an annual income from the forest of $1400 need a carbon density of 100tCO_2, $3500 a carbon density of 200tCO_2e, $5000 a carbon density of 250tCO_2e and $10,000 a carbon density of 500tCO_2e.

More feasible breakeven points for the project will be reached when these short-term profits are spread over the fallow period needed for soils to recover. This income in general is not sustainable as in the business as usual scenario all forests will be cleared in 14 years after which in a few years all the old fields will lose their fertility and stop producing altogether.

6.4 Over all financial feasibility

The potential net carbon revenues are relatively modest and not enough to implement all of the above mentioned project activities. Direct payments as compensation to farmers will only partially cover the project opportunity costs for lost income from cash crops. On the other hand, this production is not sustainable and bound to reach an irreversible tipping point in 15 to 20 years. In return for security, farmers may be willing to accept a lower but stable income.

To avoid the irreversible tipping point it is important to improve the yields of the existing fields. Donor funding is more likely to be available for this project activity especially now USAID is launching their new program “feed the future”. Increasing the carbon stock by planting trees in the landscape has not been mentioned as a project activity per se. Instead of developing the “plus” component within this project it would be more feasible to scale up the existing planting scheme under Plan Vivo.

The success of this project could be reached through a combination of carbon credits from REDD, and Plan Vivo in combination of introducing a profitable cash crop like shade coffee or cocoa.

Table 13. Break-even points for direct direct payments to offset opportunity costs for annual income per household in the equivalent of tCO2e

1400 USD/yr
280 tCO2e/yr

carbon density (tCO2e)	forest per household (ha) 1	2	3	4	5	6	7	8	9	10
100	-180	-80	20	220	120	320	420	520	620	720
150	-130	20	170	320	320	470	770	920	1070	1220
200	-80	120	320	520	520	720	1120	1320	1520	1720
250	-30	220	470	720	720	970	1470	1720	1970	2220
300	20	320	620	920	920	1220	1820	2120	2420	2720
350	70	420	770	1120	1120	1470	2170	2520	2870	3220
400	120	520	920	1320	1320	1720	2520	2920	3320	3720
450	170	620	1070	1520	1520	1970	2870	3320	3770	4220
500	220	720	1220	1720	1720	2220	3220	3720	4220	4720

3500 USD/yr
700 tCO2e/yr

carbon density (tCO2e)	forest per household (ha) 1	2	3	4	5	6	7	8	9	10
100	-600	-500	-400	-300	-200	-100	0	100	200	300
150	-550	-400	-250	-100	50	200	350	500	650	800
200	-500	-300	-100	100	300	500	700	900	1100	1300
250	-450	-200	50	300	550	800	1050	1300	1550	1800
300	-400	-100	200	500	800	1100	1400	1700	2000	2300
350	-350	0	350	700	1050	1400	1750	2100	2450	2800
400	-300	100	500	900	1300	1700	2100	2500	2900	3300
450	-250	200	650	1100	1550	2000	2450	2900	3350	3800
500	-200	300	800	1300	1800	2300	2800	3300	3800	4300

5000 USD/yr
1000 tCO2e/yr

carbon density (tCO2e)	forest per household (ha) 1	2	3	4	5	6	7	8	9	10
100	-900	-800	-700	-600	-500	-400	-300	-200	-100	0
150	-850	-700	-550	-400	-250	-100	50	200	350	500
200	-800	-600	-400	-200	0	200	400	600	800	1000
250	-750	-500	-250	0	250	500	750	1000	1250	1500
300	-700	-400	-100	200	500	800	1100	1400	1700	2000
350	-650	-300	50	400	750	1100	1450	1800	2150	2500
400	-600	-200	200	600	1000	1400	1800	2200	2600	3000
450	-550	-100	350	800	1250	1700	2150	2600	3050	3500
500	-500	0	500	1000	1500	2000	2500	3000	3500	4000

10000 USD/yr
2000 tCO2e/yr

carbon density (tCO2e)	forest per household (ha) 1	2	3	4	5	6	7	8	9	10
100	-1900	-1800	-1700	-1600	-1500	-1400	-1300	-1200	-1100	-1000
150	-1850	-1700	-1550	-1400	-1250	-1100	-950	-800	-650	-500
200	-1800	-1600	-1400	-1200	-1000	-800	-600	-400	-200	0
250	-1750	-1500	-1250	-1000	-750	-500	-250	0	250	500
300	-1700	-1400	-1100	-800	-500	-200	100	400	700	1000
350	-1650	-1300	-950	-600	-250	100	450	800	1150	1500
400	-1600	-1200	-800	-400	0	400	800	1200	1600	2000
450	-1550	-1100	-650	-200	250	700	1150	1600	2050	2500
500	-1500	-1000	-500	0	500	1000	1500	2000	2500	3000

7 Next steps

The next step after this feasibility study is start with the Project Design Document (PDD). Partners already have a buyer for the future carbon credits. Depending whether these buyers act as a donor or a pre-complier will determine the priority of the project activities and the content of the PDD. Therefore, it will be important to establish whether co-benefits for communities and biodiversity are also important and whether they are willing to accept "riskier" credits.

The PDD also requires that certain aspects like agreements and MOU between project proponents and participants to be signed and the government has not objection. Additional consultations with the local central government are important in support for the project. Equally important is to acquire "free prior and informed consent" (FPIC) of project participants. Buyers on the other hand, require security for their investment and among others an accountable and traceable payment mechanism has to be developed.

Building an institutional framework
Since early 2010, the REDD+ process has become a common ground among the partners in the Murchison-Semliki Landscape. These NGOs, and national institutions have now formed an informal consortium the Albertine Rift Forest Carbon Group (ARFCG) with quarterly meetings. The main objective is to develop and implement effective conservation initiatives by seeking innovative financing mechanisms such as carbon finance (e.g. REDD+), payments for ecosystem services, and cooperation with private sector companies in the region. Currently, formal institutional coordination structure is being developed which will be formalized in a Means of Understanding (MOU).

Payment scheme
The project requires a simple, efficient and transparent payment scheme. The farmers need to receive their money and traceability and accountability is important to attract carbon buyers. Payments will be less costly and more efficient with only a few transactions between the carbon buyers and the farmers and through dealing with farmer/forest owner associations instead of individuals. The existing capacity of micro-financing banks in the region and technology of "mobile money" (receiving money on your mobile phone) allow making the transactions efficient and - equally important - traceable.

Implementing the payment scheme could be facilitated by existing organizations with their structures and networks. WWF, Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) together with Nature Harness Initiative (NAHI) and Jane Goodall Institute (JGI) have already started organizing farmer and forest owners into associations in Kibaale, Kyenjojo and Hoima districts, supporting them in acquiring (freehold) land title and paying them. WWF has initiated restoration of forest corridors through tree planting in Kibaale district, sensitization and delivery of incentives and alternatives to reduce deforestation.

NAHI, ECOTRUST and others are organizing farmers to plant trees both for timber and for potential carbon credits in Hoima and Masindi districts. CSWCT (with funding from UNEP/GEF) are developing a PES scheme to test whether payment to farmers is effective in conserving forest. Recent talks with the local governments of Kyenjojo, Kibaale and Hoima districts have been positive and constructive suggesting the development of a payment scheme using existing local taxes to ensure local government's source of revenue from the project.

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