The Kasigau Corridor REDD Project
Phase I – Rukinga Sanctuary

Project Document (PD) For Validation
Using the Voluntary Carbon Standard (VCS) 2007.1 / Sectoral Scope 14
VM0009 Methodology for Avoided Mosaic Deforestation of Tropical Forests

Version 9
January 31st, 2011

In partnership with the Landowner

Rukinga Ranching Co Ltd.

Technical Assistance Provided by

eco PARTNERS

Acknowledgements

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for field support and for making this project such a success. Wildlife Works would like to extend sincere thanks to all mentioned above, as well as the many other contributors to the project.

Asante Sana!

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Section 4 Applicability Conditions

For the Kasigau Corridor REDD Project the following conditions apply;

- The primary driver of deforestation is conversion of forest to cropland for annual crops, typically maize, as evidenced by the substantial conversion to maize in the Reference Area during the Reference Period. The primary agents of deforestation are a growing population of local Taita and Kamba people living in the Reference Area. Agriculture in the reference and leakage areas is permanent and cultivation activities do not shift.

- The land within the project area has been tropical dryland forest[1] for at least 20 years and has been a primary forest in its current state since recorded times[2]. The Project Area forest has an average canopy of 39% and mature tree height of 5-10m, and therefore has qualified as forest as defined by FAO 2010, or that of the definition of forest set by the residing designated national authority (DNA) (10% canopy, 4m height) for the project country for a minimum of 10 years prior to the project start date (VCS, 2008)

- No biomass is harvested for use in long-lived wood products in the project area under the with-project scenario. Therefore, carbon sequestered in long-lived wood products under the project during any monitoring period may be accounted for as zero.

- The project is located in a semi-arid tropical region.

- The primary agents of deforestation are local Taita and Kamba peoples, with a small minority of other tribes who moved in during the El Niño rains of the mid 1990s, when the land was still sparsely populated, or to work as herders for the former cattle operations. Tribal mobility for farm land in Kenya is very low, as Kenya's population is relatively high everywhere that leakage could potentially shift, and the population in the Reference Area outside of the Project Area, and the proposed Phase II Project Area (see map in Section 6.3) is high. There exists no opportunity for the agents of deforestation to shift their activities outside the leakage area.

- The project is not mandated by any enforced law, statute, or other regulatory framework.

- The project area does not contain organic or peat soils. (see soils Map in section 6.5 below).

- A reference area has been delineated meeting the requirements described in sections 6.3.1 and 6.3.2 of the methodology VM0009, 'Methodology for Avoided Mosaic Deforestation of Tropical Forests' (MED), including the minimum size requirement.

- As of the project start date, historic imagery in the reference region exists with sufficient coverage to meet the requirements of section 6.4.2 of the MED.

- A wide range of project activities have been implemented to mitigate deforestation by addressing the agents and drivers of deforestation as described in section 10.1 of the MED.

- The project start date and end date and crediting period are clearly defined (see Section 6.3).

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[1] UN IPCC, Good Practice Guidance for LULUCF, Table 3A.1.8;
[2] Earliest record that has been located is dated 1895 which identifies the area as forested [Hobley 1895 – Upon a Visit to Tsavo and the Taita Highlands – The Geographical Journal 1895 Vol 5 No 6 pp 545-561]

- Wildlife Works (the Project Proponent) has access to the leakage area to sample forest degradation, as evidenced by implementation of the leakage plots used to create the leakage model.
- The lag period for the cumulative leakage model was estimated after the project start date but before the end of the first monitoring period, and initial leakage plot measurements showed that no activity-shifting leakage had occurred prior to the estimation of the lag period.
- The project area does not include lands designated for legally sanctioned logging activities.

Section 5 Project Boundaries

Section 5.1 Spatial Boundaries

Kasigau Corridor Phase I - Rukinga Ranch

This Phase I Project Document covers 100% of the land known as Rukinga Sanctuary (see map below) which is all that 74,516 acres (30,168.66 ha) of land originally known as Rukinga Ranch, LR 12263, historically reduced by subdivisions 12263/1 and 12263/2 at dates prior to the start date of this project. Project lands conform to the latest VCS definition of forest, with an average canopy cover of 39%, and mature tree height at 5-10m, and have been primary forest since historic times. A GIS database with canopy measurements for Rukinga Ranch is available upon request.

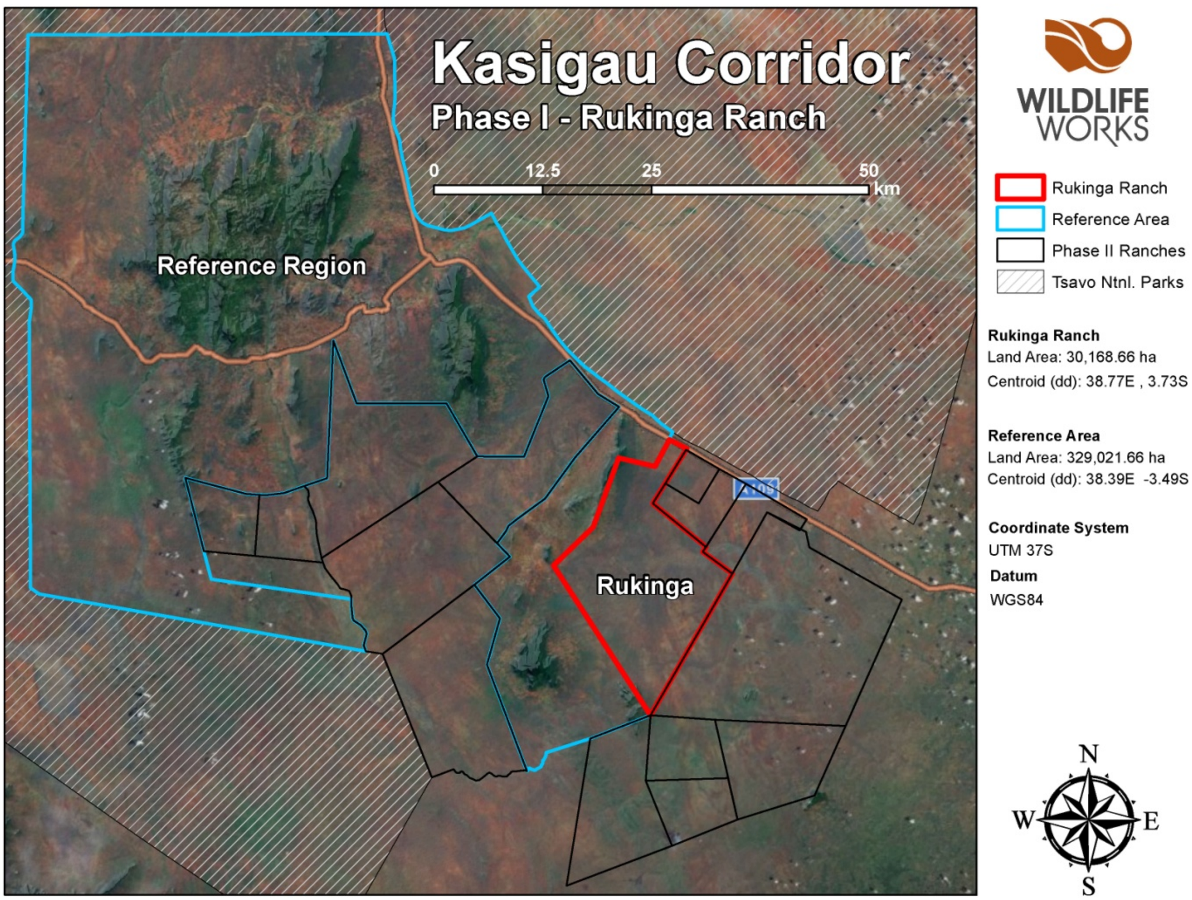


Figure 1. Rukinga Ranch REDD Project and Reference Region Spatial Boundaries

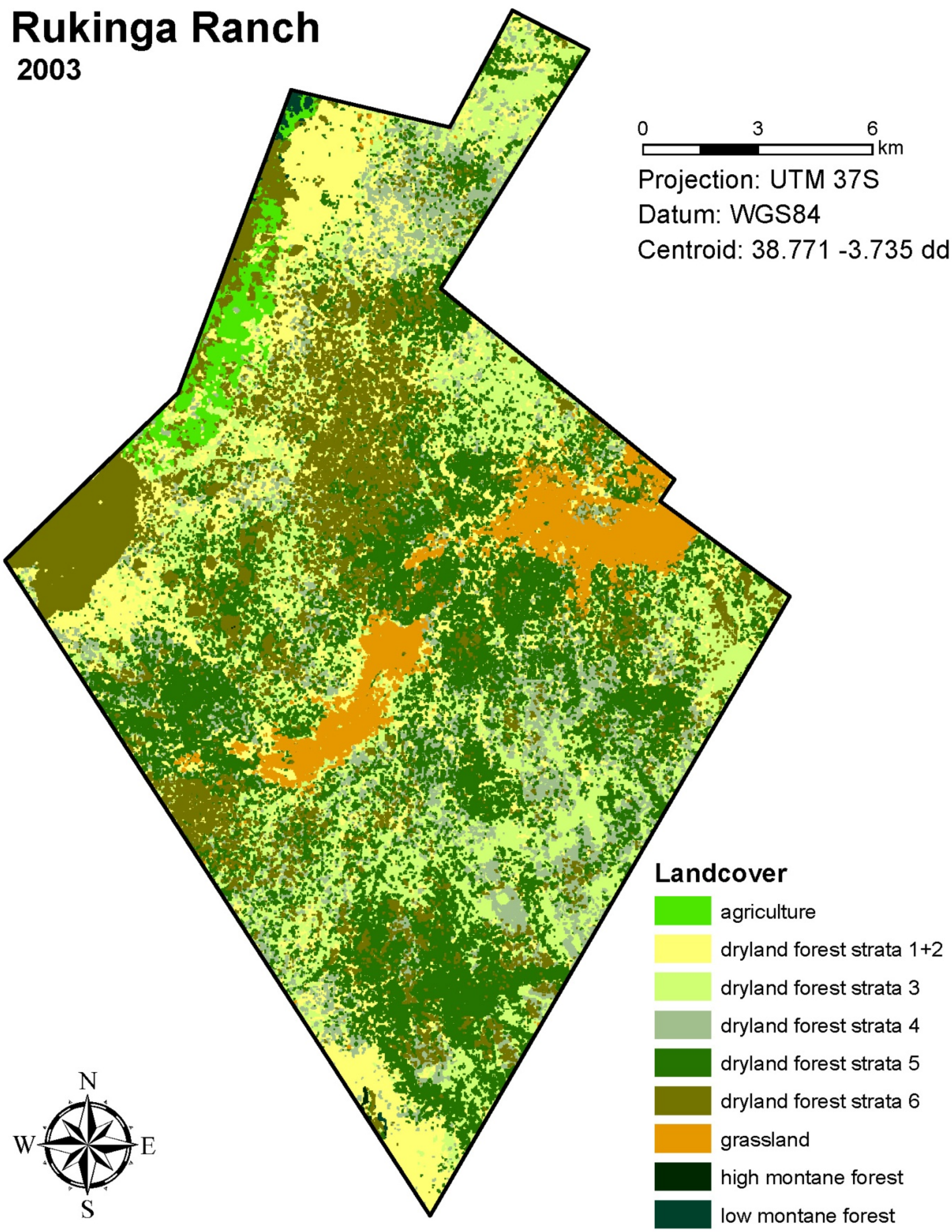


Figure 2. Rukinga Landcover Map, Classified from Landsat 7 ETM+ Acquired February , 2003

The following table shows the landcover strata for Rukinga Ranch and their respective areas. Strata sum to the total area for the Ranch, 30,168.66 ha.

Stratum	Area (ha)
ag active	713.7
dryland forest strata 1+2	6,883.6
dryland forest strata 3	5,651.1
dryland forest strata 4	2,773.4
dryland forest strata 5	8,133.4
dryland forest strata 6	4,345.5
Grassland	1,610.9
montane forest	570.6
Total area:	**30,168.7**

Table 1. Landcover Strata area for Rukinga Ranch, Febrary 2003

Using these values, forested area for the Sanctuary at project start date is calculated as:

27,844 / 30,168.7 = **93% forested 10 years prior to project start date**

Land Ownership

Rukinga Sanctuary is privately owned by Rukinga Ranching Company Ltd., the majority shareholder being Mike Korchinsky, Founder & CEO of Wildlife Works. The leasehold on the title will be due for renewal in 2038, and can then be renewed for either 33, 66 or 99 years under Kenyan law, at the leaseholder's option. Wildlife Works has had a wildlife conservation and land management operating agreement with Rukinga Ranching Company Ltd. since 2005, and more recently acquired the carbon rights from the landowner, Rukinga Ranching Company Ltd. after a process of Free Prior and Informed Consent (FPIC), through a Carbon Rights Agreement/Conservation Easement that was approved by a full vote at an AGM of the Shareholders of Rukinga Ranching Company Ltd. on February 13th 2009. At that AGM the shareholders were given a presentation - explaining in lay terms - the potential of the REDD project, a copy of which has been provided to the validator. Following the presentation, the shareholders unanimously approved the pursuit of this opportunity by the Managing Director and majority shareholder of the land. This decision was ratified again unanimously by an extraordinary general shareholder meeting of Rukinga Ranching Company Ltd. on December 9th, 2009, at the request of the CCB Validators, Scientific Certification Systems, Inc (SCS).

Section 5.2 Temporal Boundaries

The project was commenced on January 1, 2005. Since this time, Wildlife Works has been successfully protecting Rukinga Ranch from agricultural encroachment (deforestation), wildlife poaching and forest degradation. The Phase I Project is 30 years in length. The project will therefore end on December 31, 2035.

Wildlife Works took financial responsibility for all conservation activities within the Project Area as of January 1st 2005, as a result of the agreement between Wildlife Works and Rukinga Ranching Company, Ltd., the landowner, a copy of which was provided to the Validators.

Wildlife Works began conservation activities centered around our ecofactory prior to 2005, but all activities were located outside the Project Area. The figure below illustrates the relationship between the companies involved with Rukinga Sanctuary.

The VCS rule for AFOLU projects starting after Jan 1 2002 states that there is no specific time requirement for validation and verification. Language exists in the MED to clarify the type of project activities that qualify a project for a historical project start date, and Wildlife Works fully conforms to these MED requirements.

Wildlife Works will monitor the project every year, producing accurate and credible documentation for all VCS required project accounting. Wildlife Works will validate the project once every 5 years throughout the life of the project until the project end date.

Per VCS minimum requirements, a baseline revision will be performed once every 10 years, on January 1, 2016 and January 1, 2026. If the VCS standard regarding baseline revision periodicity changes in the future, Wildlife Works will commit to performing baseline revisions whenever specified by the VCSA.

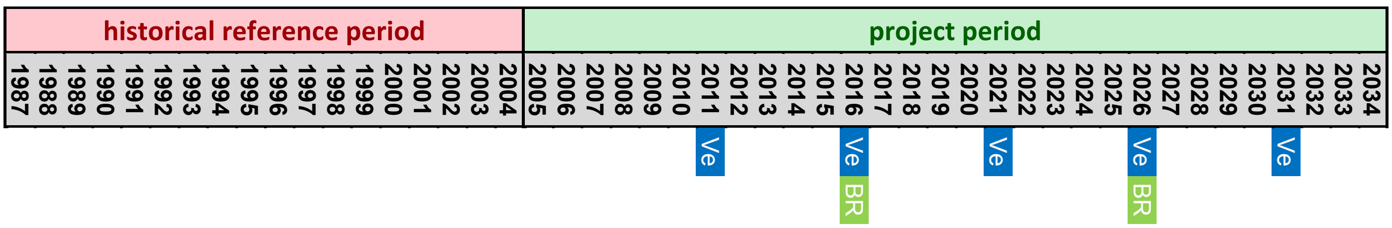
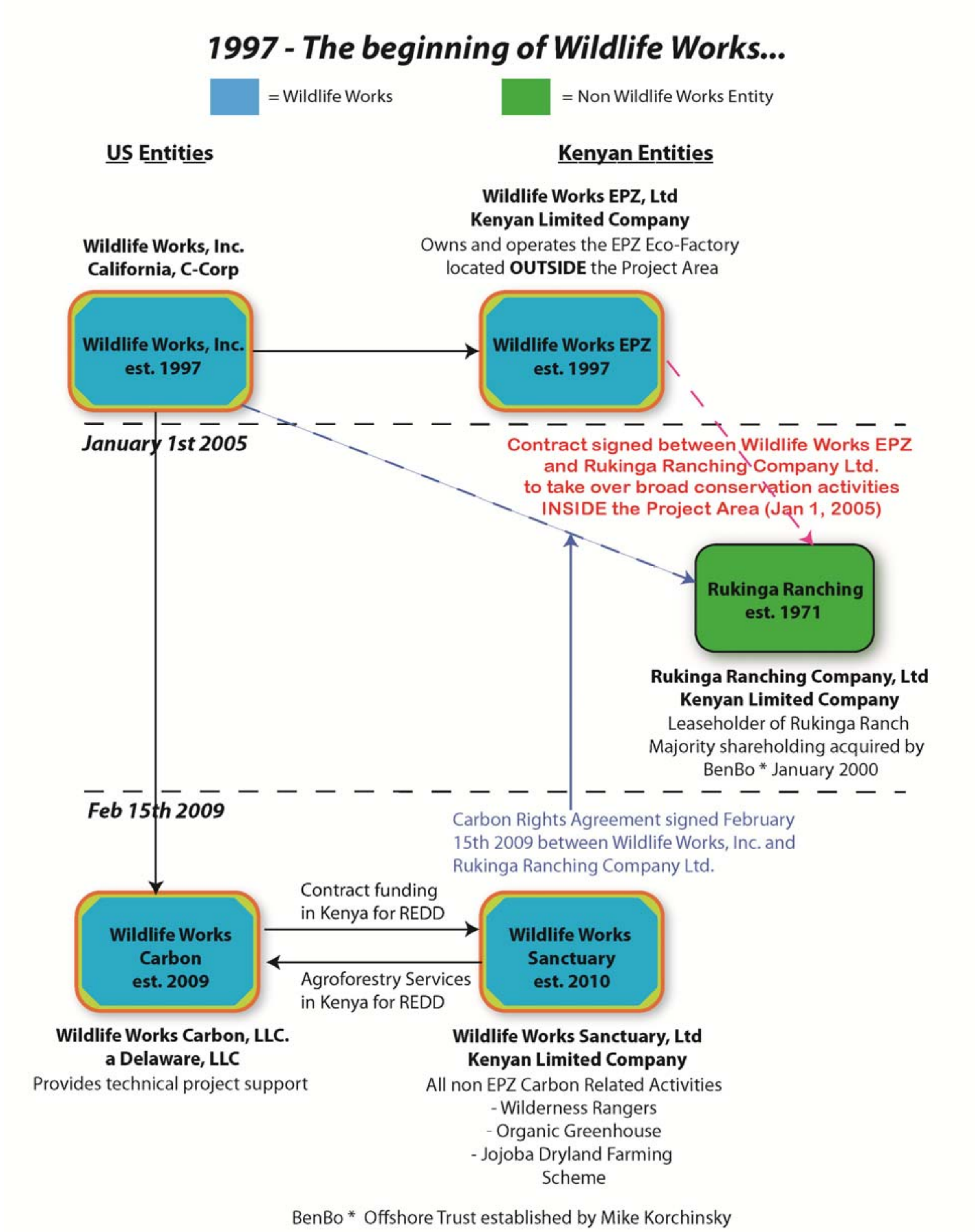


Figure 3. Project Timeline (Ve = verification year, BR = baseline re-evaluation year)

Rukinga Sanctuary is comprised of primary Acacia-Commiphora dryland forest, and therefore conforms to the minimum requirement for project land to have qualified as "forest" (10 years per VCS 2007.1). The landcover classification shown above in figure 2 was performed on ETM+ imagery acquired from the Landsat 7 satellite on February 6, 2003. As both dominant tree species in this ecosystem (Acacia and Commiphora) grow very slowly (some trees on Rukinga Ranch are estimated to be over 300 years old), we make the assumption that Rukinga ranch was in virtually the same forest state in 1996 as it was in 2003.


1997 - The beginning of Wildlife Works...
= Wildlife Works
= Non Wildlife Works Entity
US Entities
Kenyan Entities
Wildlife Works EPZ, Ltd
Kenyan Limited Company
Owns and operates the EPZ Eco-Factory
located OUTSIDE the Project Area
Wildlife Works, Inc.
California, C-Corp
Wildlife Works, Inc.
est. 1997
Wildlife Works EPZ
est. 1997
January 1st 2005
Contract signed between Wildlife Works EPZ
and Rukinga Ranching Company Ltd.
to take over broad conservation activities
INSIDE the Project Area (Jan 1, 2005)
Rukinga Ranching
est. 1971
Rukinga Ranching Company, Ltd
Kenyan Limited Company
Leaseholder of Rukinga Ranch
Majority shareholding acquired by
BenBo * January 2000
Feb 15th 2009
Carbon Rights Agreement signed February
15th 2009 between Wildlife Works, Inc. and
Rukinga Ranching Company Ltd.
Contract funding
in Kenya for REDD
Agroforestry Services
in Kenya for REDD
Wildlife Works
Carbon
est. 2009
Wildlife Works
Sanctuary
est. 2010
Wildlife Works Carbon, LLC.
a Delaware, LLC
Provides technical project support
Wildlife Works Sanctuary, Ltd
Kenyan Limited Company
All non EPZ Carbon Related Activities
- Wilderness Rangers
- Organic Greenhouse
- Jojoba Dryland Farming
Scheme
BenBo * Offshore Trust established by Mike Korchinsky

Section 5.3 Greenhouse Gases

The dominant method of deforestation in the Kasigau corridor is conversion to subsistence agriculture by slash and burn techniques. As such, only Carbon Dioxide (CO_2) was selected as a source for greenhouse gas emissions in the project. Although Methane (CH_4) and Nitrous Oxide (N_2O) are also greenhouse gases, they are conservatively excluded from this project, as neither of which are present to a significant degree in the Kasigau corridor region.

Section 5.4 Carbon Pools

The following table indicates carbon pools required for consideration under the MED, including those pools that are mandatory, optional and respective justification for selection under this project:

Pool	Required	Included in Project?	Justification
Above-ground large tree biomass	Yes	Yes	Major pool considered
Above-ground small tree biomass	Yes	Yes	Major pool considered
Above-ground non-tree biomass	Optional	Yes	Major pool considered
Below-ground large tree biomass	Optional	Yes	Major pool considered
Below-ground small tree biomass	Optional	Yes	Major pool considered
Below-ground non-tree biomass	Optional	Yes	Major pool considered
Litter	No	No	Conservatively excluded
Standing dead wood	Optional	Yes	Major pool considered
Lying dead wood	Optional	No	Conservatively excluded
Soil	Optional	Yes	Major pool considered
Long-lived wood products	Yes	Yes	May be a significant reservoir under the baseline scenario

Table 2: Carbon pools selected for inclusion in the project and respective justification

Size Class Diameter Selection and Justification

Expert knowledge of the agents of deforestation and cultural practices in the Kasigau corridor ecosystem indicate that farmers invariably burn all stumps in the process of clearing land for agriculture, We therefore do not differentiate large trees from small trees for this project, and assume that all stumps (below-ground large tree biomass) are burned during agricultural conversion. Credible evidence can be produced through farmer polling and or interviews with Wildlife Works resident community liaison, Laurian Lenjo, who has intimate knowledge of farming practices throughout the corridor, knows many farmers personally, and advises Wildlife Works regarding issues such as this.

Section 5.5 Project Grouping

The Kasigau Corridor Phase I project is not a grouped project. Therefore, no supporting evidence is supplied.

Section 6 Baseline Scenario

Section 6.1 Obvious Agents and Drivers of Deforestation

Wildlife Works staff and employees possesses an incredible depth of local knowledge regarding both the Reference and Project Areas, as a result of direct involvement and integration with this community since 1997. As such, it was considered unnecessary for us to conduct a participatory rural appraisal (PRA) to demonstrate a clear understanding of the principle driver of deforestation in the reference region. This is observed as conversion of dryland forest to annual subsistence cropland by two main groups of local agents during the historic Reference Period.

List of Obvious Agents and drivers of deforestation

- Local farmers from the Taita Tribe (approximately 95% of local population according to the 1999 Kenyan census) deforesting for cropland.
- Farmers from the Duruma Tribe (approximately 5% of local farmers – from 1999 Kenyan census) deforesting for cropland.

Both of the aforementioned populations began aggressively converting land in the 1990s prior to Wildlife Works' arrival in the area in 1997. After rendering it impossible to illegally farm private group ranch land, immigration to the area virtually ceased, and in fact many Duruma families returned to their primary farms at the Coast, while most Taita farmers remained, establishing themselves as the dominant project community.

- Illegal charcoal trade – typically first element of degradation as it generates cash to fund the clearing of the land for subsistence farming.

Large scale Tribal mobility in Kenya today for access to cropland is very restricted, as Kenya is fairly highly populated, certainly in areas of adequate rainfall for farming, and the traditional tribes in any given area typically prevent the incursion of immigrants from outside.

Narrative describing why the agents of deforestation are evident

Wildlife Works contends that the reasons for the presence of the agents of deforestation is obvious. Agricultural conversion has occurred adjacent to - and even into - the Project Area during the historical reference period just prior to Wildlife Works' arrival in the area in 1997, and continues in a heavy and visible manner in the reference region today. Standing on the boundary of the Project Area, one can see the stark contrast to the converted land outside the Project Area without effort. This makes the deforestation process extremely evident. Forest degradation is in turn conspicuous judging by the amount of charcoal sale depots alongside the main Highway (A109) that leads from the Reference Region to the closest major coastal city, Mombasa.


Looking back towards Rukinga Sanctuary from deforested area in the Reference Area.

Descriptions of agents and drivers including any useful statistics and their sources

Local Taita Farmers have traditionally farmed the fertile cloud forested hills of the Eastern Arc Mountains, Kasigau, and Taita and Sagalla Hills. As their population exceeded the carrying capacity of the montane land they relocated to the dryland Acacia-Commiphora forest that dominates the lower elevations of the district. However, their traditional farming practices did not sustain, due to extremely low average rainfall. After colonizing all available land with permanent water sources, they began to clear any available unprotected land, hoping that the unpredictable rainfall would bless them with a crop. The larger blocks of remaining land in the area outside of communally owned land protected by local administrations were privately held group ranches - designated as cattle carrying areas - for the communities of the hills in the 1970s. However, due to the remoteness of these areas and a lack of permanent water sources, these areas were never been developed as cattle ranches, and remained as natural forest over the years until the mid 1990s, when rainfall patterns initiated a population boom in the area. This boom was also facilitated by the improvement of the main Mombasa highway (A109) and a local arterial road that runs along the edge of the Rukinga project area.

Duruma farmers, originally from the Kenyan Coast, came to the area in the mid 1990s due to anomalous El Niño rains, when there was still a very small Taita population living in the Dryland forested areas that now comprise the reference region. In many cases these Duruma families were lead by second wives of a man whose primary family was at the Coast, and who farmed this area on squatter land, sending the produce home to the primary family at the Coast. Because both of these agents of deforestation did not possess legal land tenure, they never invested in the land, and chose to simply farm with no inputs until the soil was depleted. They subsequently cleared more forest and began engaging in an annual depletion cycle. Wildlife Works addressed this issue by creating a land cooperative, providing farmland for those landless farmers who were deforesting the area[3].

List of Project Activities designed to mitigate deforestation

The Project Activities designed to mitigate deforestation include (in order of importance);

Wildlife Works Sustainable Development Initiatives

Wildlife Works has implemented a wide range of sustainable development initiatives at Rukinga over the past ten years, and is committing to continue with a new range of innovative co-benefits for the communities that are in the Project Zone once the funding for the REDD project begins. These initiatives collectively form the basis of Wildlife Works' deforestation mitigation strategy. An implementation schedule for these Project Activities, complete with timelines and budgets, was shared with the Project Validator.

Organic clothing factory

[3] Local history obtained through multiple conversations with community members over a period of 12 years.

Wildlife Works' core project has been the construction of an Ecofactory. We employed over 150 people from the local community during construction, and now trained and employ young women from the community to sew organic cotton clothing, which we export to the US and Europe for sale on the internet and in fashion boutiques. First and foremost, we plan to continue the level of investment we have been making for the past ten years in this Ecofactory.

In addition, going forward we have several new Project Activities in this area;

- Adding capacity – we plan to immediately rehire ten women previously trained by Wildlife Works but let go due to lack of funding
- Factory Expansion – we plan to complete a second production cell, capable of dyeing and screen printing fabric so that we can manufacture finished goods completely within our complex without having to send out for dye and print. We believe this will make our production capability much more attractive to a wider range of customers, and reduce our production costs. The walls for this production cell were built back when the first sewing cell was built, but it needs roofing, flooring, electrification and importation of the dye and screen print equipment acquired by Wildlife Works in the US. A full budget for this factory expansion was provided to the Validator.
- Increase Fabric Inventory and Produce 2010 Collection – we have been unable to produce a new fashion collection from Rukinga for the past two years due to lack of funding, so we plan to initiate a new Collection immediately in 2010, once carbon funding is received. This new collection will be sold online and will relaunch our brand into the international marketplace, now with 100% of production being done in Rukinga. This is critical to our long term strategy to wean local people away from agricultural employment that conflicts with wildlife, and to introduce elements of sustainability to our model for post carbon finance in 20 years.

Organic Greenhouse

Widlife Works established an organic greenhouse to grow citrus trees, which we sell at a discount to local farmers so that they may plant a tree for shade that has the added benefit of earning them income. We use the funds from the citrus sales to fund the growth and distribution of free agroforestry species such as Neem and Moringa Oliefera to local farmers, to meet their medicinal, nutrition and fuelwood needs. With the financing from the Carbon project, we plan to initiate a number of new Project Activities in this area;

Wildlife Works Organic Greenhouse

- Expansion of our core greenhouse at Rukinga HQ to add a second shade house, doubling our capacity by adding two additional greenhouse workers from the local community. A full budget for this activity has been provided to the Validator.

- Establishment of 5 nurseries in the villages surrounding the Eastern and Southern boundary of the Project Area and Kasigau Wildlife Corridor: Maungu, Itinyi, Sasenyi, Buguta, Makwasinyi. Each nursery will utilize the same template and budget as for our own shade house (see above), and each nursery will employ an additional 2 members of the local community, totaling 10 new employees. Each nursery will be responsible for working with their immediate community to plan and implement a cash crop and implement fuelwood and construction pole strategy for that community. They will plant the same combination of tree species currently being grown in our own greenhouse. Once again, for the foreseeable future, the nurseries will provide agroforestry species and native hardwood seedlings for free, while the sale of cash crop trees will contribute to the budget. We will provide training in organic agroforestry and our organic Project Team Leader, Joseph Mwanganda, will manage these new nurseries.

- We will continue a project activity through which we provide relatively small amounts of elephant dung from the Rukinga Sanctuary to a local women's group called the Imani Women's Group. Periodically and at their request, they can use the dung as a growing medium for their commercial mushroom farm, which is housed in a small shed within the women's group compound and provides a good income to the group, with little to no negative impact on biodiversity or land use.

- We will restart a 3 year reforestation project on the slopes of Mt. Kasigau, working closely with the Kasigau Conservation Trust (KCT) to plant 20,000 indigenous hardwood trees over the next three years in one of the Project Zone's High Conservation Value (HCV) areas. This project aims to replace trees taken out for charcoal or construction over the past years. We will be using the nursery built at Makwasinyi and Sasenyi (see above) as the base for propagating the seedlings of the indigenous trees in the first year, until Phase II of this project, at which time we plan to add an additional 4 nurseries on the South and East sides of Mt. Kasigau. We will be providing financial rewards to community members who plant those trees and protect them through two full years. We are confident that this project will go a long way in restoring the habitat and conserving the endemic species in this region. Its model might hopefully be emulated in other parts of the country so as to stop the loss of forests in Kenya. We have involved the community in all facets of the project, from the formulation of this proposal, the monitoring and as indicated in its implementation. This has ensured that the community has taken it up as its own initiative and will see it through even in the absence of Wildlife Works, thus ensuring sustainability.

Dryland Farming scheme

Our most recent project involves working with the Kenyan Agricultural Research Institute (KARI) to cultivate a climate appropriate plant called Jojoba (Simmondsia chinensis) that provides a cash crop through its seeds and is also extremely drought tolerant, non invasive and has the added critically important benefit that it is not eaten by any wildlife, birds or even insects. It is therefore viewed as the ultimate non-conflict crop. Wildlife Works is currently studying the impact of various levels of plant maintenance and irrigation on plant seed and oil productivity, with the idea that we can provide local farmers root stock to establish their own plants. They can then determine how much they can likely make if they are willing to put a certain level of effort into the plant maintenance. There are three specific Project Activities associated with this scheme;

- Complete our involvement in Phase I of the joint Research Project, taking place on the Jojoba fields at our HQ which will end in 2010
- Develop a full business plan on how to create a self sustaining venture to outplant jojoba in the surrounding community farmland, providing the local farmers with a drought tolerant and non-conflict crop.
- Source private funding to implement the Jojoba outplanting business plan, either from donors, private investors, Government of Kenya, or some combination thereof.

Wildlife Works REDD Forest and Biodiversity monitoring

There are a number of specific Project Activities in the Kasigau area that Wildlife Works will complete throughout the project lifetime;

- Continue daily ranger patrols to monitor of the health and vitality of the Project area – we have been performing daily patrols for almost fourteen years, and our rangers are very skilled at identifying potential threats to the forest and biodiversity of the Rukinga Sanctuary.
- Using Carbon finance, we have added a new permanent Ranger Station at the SoutEast end of the Project area, furthest from our headquarters. This supports the addition of a full new section of 8 Wildlife Works Rangers, recruited and trained from the local community, along with a new Team Leader promoted from within our existing force. This is primarily to prevent incursions of illegal cattle from that direction, to make patrolling the far boundary easier, and to develop closer working relationships with the Makwasinyi community.
- We have made a significant investment in modernizing our patrol fleet, by purchasing three new Toyota Land Cruisers, to reduce the carbon emissions from our patrol vehicles, and to reduce the cost of operating and maintaining them. Perhaps most importantly, we wish to ensure that we have a reliable fleet to support constant patrol activities. We have thus retired our oldest patrol vehicle, a 1980 Toyota Land Cruiser – HJ45 Diesel.
- We will improve our ability to monitor the HCV species in Rukinga by adding a dedicated Ranger Patrol, the HCV Ranger Team, which will be responsible for constant tracking and monitoring of the HCV species. Unlike the general ranger teams that are patrolling geographic sectors of the Project area, this dedicated team will be recruited from the existing ranger Patrols based on tracking ability and biodiversity knowledge, and the 4 members of the patrol will be backfilled in the geographic Ranger teams by hiring new rangers from within the community.

Wildlife Works ranger force team members

- Additionally, to improve our monitoring of HCV species, we plan to establish a GIS center of excellence at Rukinga HQ, for which we have hired one full time Kenyan GIS expert, and set up a state of the art GIS computer station. This individual is responsible for liaising closely with the HCV Ranger Team, with the Ecotourism partner in the Project Zone, and with all Wildlife Works ranger patrols to maintain daily sighting logs of the HCV species. They will also be responsible for monitoring those other species of ecotourism value, such as Elephant, Buffalo, Giraffe and Common Zebra. A biodiversity database is being collected with recordings made from standard daily ranger patrol sheets.
- We will begin annual monitoring of our carbon inventory by revisiting 20% of our permanent fixed plots each year to resample the trees, shrubs and grasses, looking for degradation or improvement in existing stocks. In addition we plan to acquire remote sensed imagery to prove the absence of large scale deforestation or boundary incursion. Wildlife Works subsidized the purchase of a gyrocopter by our VP African Operations, Rob Dodson, which he will use to perform periodic aerial monitoring of the project area and reference region.
- We will investing in third auditors to verify project carbon inventories and project progress every five years.

Ecotourism

Wildlife Works has located an ecotourism provider who now operates a safari camp in the center of the Rukinga Sanctuary. This provides employment for safari guides and other service jobs, as well a market for local produce. In the absence of REDD funding, and our continued protection of the biodiversity in the project area, this business would likely lose its support.

Ecotourism Center at Rukinga - "Camp Tsavo"

The primary ecotourism tenant, called Camp Kenya, brings groups of young people to the camp from the UK who stay at the camp, but spend their days in the communities of the project area implementing community projects, providing a significant benefit to the communities. Wildlife Works has negotiated for a second partner, called EcoTraining, to come to Rukinga. They are a South African safari guide training company, and have agreed to support the placement of local youth into their program, on a space available basis, to be trained as Safari Guides at a very high quality level. As a project activity, we plan to provide funding for two local youth per year to go through their program and be trained as safari guides.

Finally we plan to explore a second high end ecotourism retreat on Rukinga, to bring more jobs and income to the Project. This effort will be self funded by outside investment partners, and represents a significant capital expenditure.

School Construction and Bursary Scheme

When Wildlife Works arrived in the area, there were almost no schoolrooms, no books and no desks. None of the necessary infrastructure for children to have a hope of a decent education exisited. We began with a school building program, and over the years we have partnered with the community and various identified donors to build 18 classrooms throughout the district. We also build desks, and our original Kenyan manager Alice Ndiga launched a school bursary program, which she administers, called the Kelimu Trust, that has sent over 65 local children through private high school, and several on to college.

Old Kale School – no floor, no desks, one mud room New School block built by Wildlife Works

Once the Project Carbon funds start to come in we plan on two specific Project Activities in this scheme, as outlined in the Project Implementation Schedule provided to the Validator;

- Provide Wildlife Works direct funding to send 5 new students through four year secondary schools program and on to three or four year College/University should they qualify – this is an annual commitment of $2000 in the first four years of Secondary School fees and between $5000 and $10000 a year in college/university fees.
- Establish a Wildlife Works School Construction and Maintenance fund, by hiring a dedicated staff person to manage the fund with project management skills and ability to write grant proposals, and provide $10,000 per year in Wildlife Works funding above and beyond the compensation of the fund manager to seed school construction and maintenance projects in the Project Zone. The Fund Manager will work closely with the local District Education Officer, and the existing school boards in the area to determine which projects should receive funding each year.

Please note that this document outlines minimum levels of financial commitment to project activities, and funding levels will be revisited as project financing becomes more clear based on carbon credit sales each year.

A List of External Drivers of Deforestation (Covariates) Used in the Deforestation Model

We explored the most obvious covariate - population - and found that it did not significantly affect the deforestation baseline rate. We ultimately decided to not use any covariates, basing deforestation on historical information alone.

Section 6.2 Participatory Rural Appraisal

As a result of Wildlife Works extensive knowledge of the Reference Region and Project Area, we are intimately familiar with the agents and drivers of deforestation and therefore we found it unnecessary to perform a Participatory Rural Appraisal.

Analysis of Agents of Deforestation

This section is Not Applicable.

Analysis of Drivers of Deforestation

This section is Not Applicable.

Section 6.3 The Reference Region

Delineation of the Reference Area

The Reference Region for the Kasigau Corridor Phase I project was chosen to specifically address the behavior of the local agents of deforestation as well as the drivers of deforestation for the ecoysystem. Specifically, the area is comprised almost entirely of local inhabitants engaging in subsistence farming practices. In the area that are not zoned for group ranch ownership, local agents practice slash and burn agriculture. This type of deforestation is prevalent and exclusive, as the dominant species (Acacia / Commiphora) are not commercially viable. For this reason, the main agents of deforestation, as described in section 6.2.1 consist of local community members, and the primary driver, as will be tested in section 6.4, the Cumulative Deforestation Model, is population.

Narrative describing the rationale for selection of the reference region boundaries

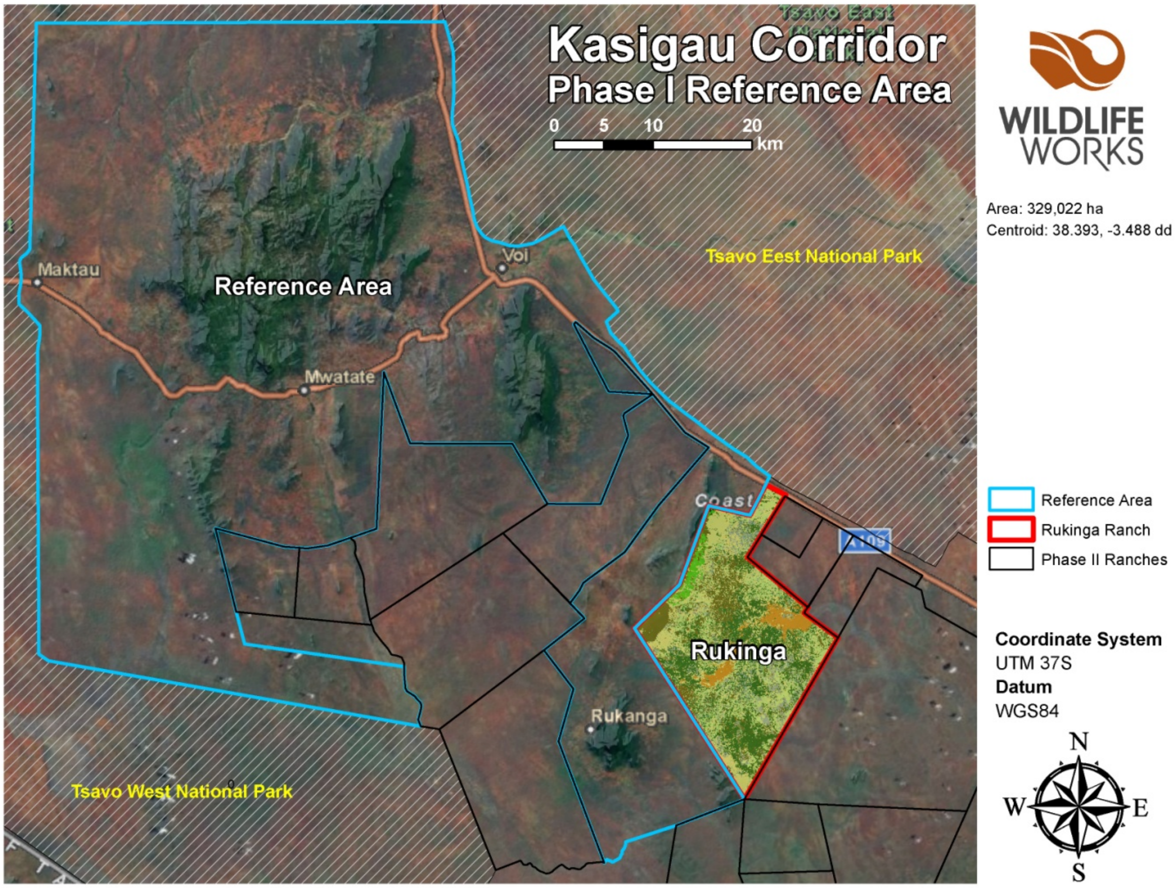
The Reference region boundaries were chosen to address the behavior of the agents of drivers of deforestation in the Kasigau Corridor. The reference area is bounded by Tsavo West national park to the west, Tsavo East national park to the Northeast, and group-owned ranches on all other boundaries. The area is therefore bound on all sides by either protected areas or tracts owned by groups under agreement with Wildlife Works for Kasigau Corridor Phase II Project. As such, unplanned deforestation will necessarily occur within the delineated reference area.

The region was specifically chosen to embody a region that has seen deforestation of a nature typical for this ecosystem. In fact, the area forms a corridor between the two aforementioned national parks, with virtually no extraneous space. As such, Wildlife Works is confident that by studying the area delineated as the reference region for this project, the culture and behavior of the agents and drivers of deforestation will be completely captured.

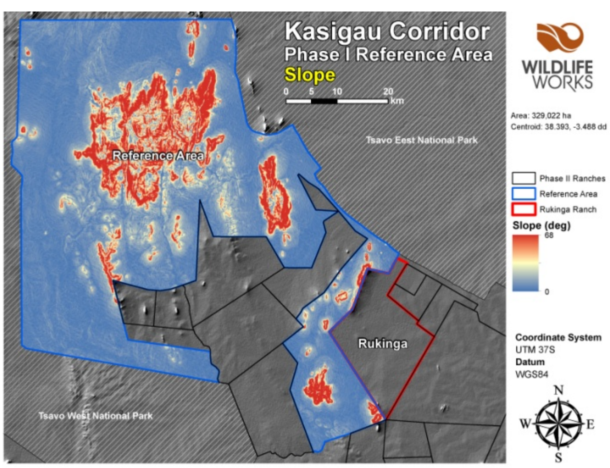
Additionally the geographic qualities of the reference region are similar to those of Rukinga Ranch. Forest type, soils, river density, and infrastructure are similar. The reference region does encompass the Taita Hills area; Wildlife Works feels that it is not only appropriate, but necessary to include these hills in the reference area, as they have been subject to subsistence conversion to agriculture as much, if not to a greater extent, than the surrounding lowlands. It would be inappropriate to omit the hills simply due to their elevation. The reference region was also chosen such that the agents of deforestation would, and are perfectly able, to act within its boundaries as an alternative to deforesting within Rukinga Ranch itself.

The following maps demonstrate the geographic features of the reference area that render it appropriate for evaluating the baseline scenario for this project.

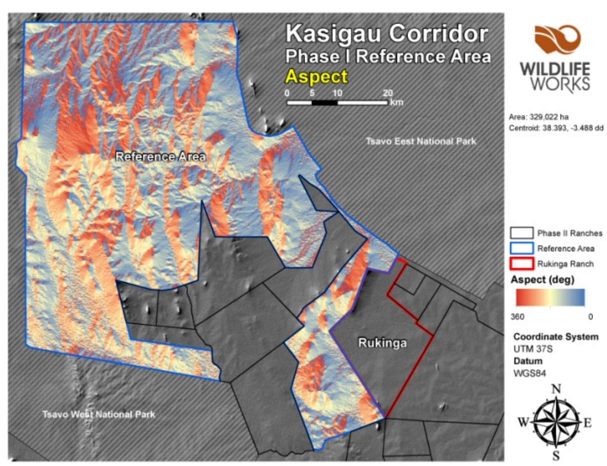
Delineated boundaries



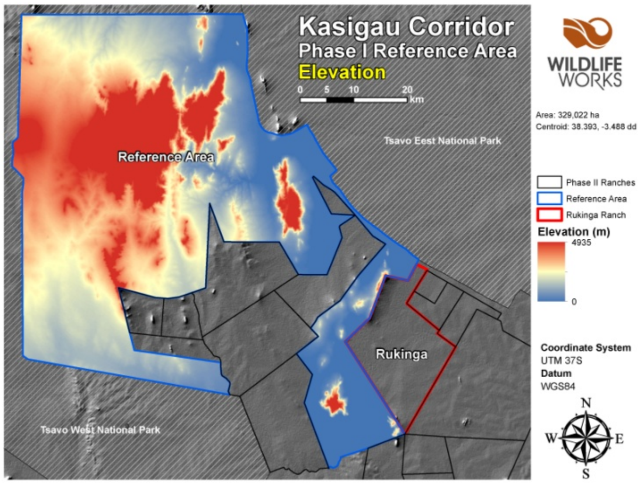
Reference Area and Land Tenure Boundaries, Roads and Major Markets



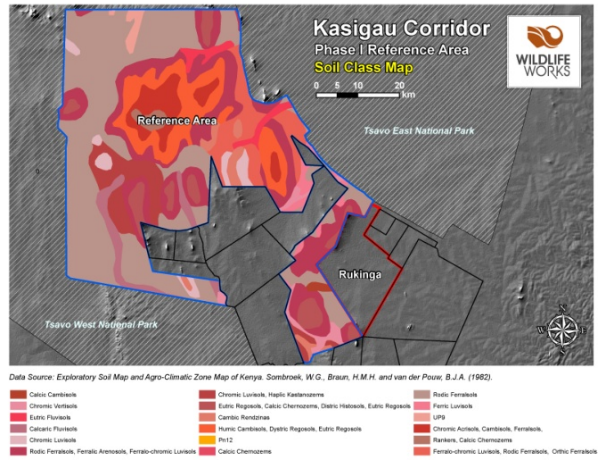
Reference Area Slope



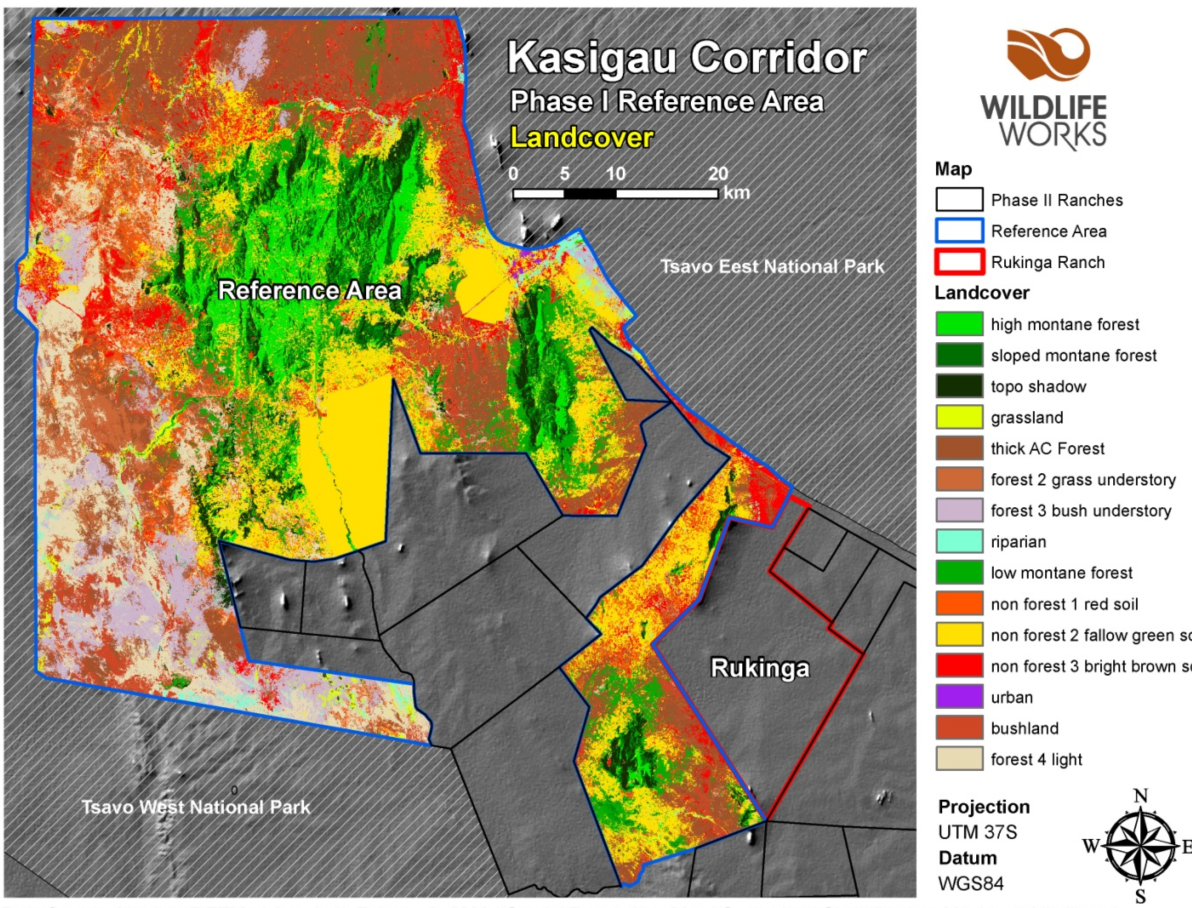
Reference Area Aspect



Reference Area Elevation



Reference Area Soil Classes



Data Source: Landsat 7 ETM+ | Acquired: Febrary 6, 2003 | Spatial Resolution: 30m | Supervised Classification: Maximum Likelihood

Reference Area Thematic Landcover

Infrastructure (roads, major markets, land tenure)

These characteristics are shown on the main maps of the reference region.

Defining the Reference Period

The reference period is defined by the following historic events;

- Population in the Taita Hills began to exceed the carrying capacity of the fertile hill top lands in the late 1980s, and families began to move down into the dryland forested areas.
- Local lore has it that the Coastal Duruma first came to the Reference Area adjacent to the Project Area in the early 1990s when they were promised land by a local Taita politician who had taken a Duruma wife in return for their votes in local elections. The only problem was he promised them land he did not own that falls within the Reference Area for this project. The Duruma are polygamists, and therefore the common practice was for a husband to bring his second or third wives to the Project area to establish agricultural plots. The husband would leave them in the bush with their small children and return to the Coast where they would spend most of the time with the family of the first wife. The husband would then return at harvest and claim a large portion of the crop should there actually have been a crop, and would take it back to the Coast family. These single parent families were rarely successful at agriculture, but continued to clear land aggressively hoping they would find the perfect location where the tragically localized rainfall patterns would find their land. In the interim, the teenage males would snare animals for food, the Duruma being much more comfortable in the bush than Taita farmers.
- El Niño Rains in the mid 1990s caused more landless families from both Taita and Coastal Duruma communities to move to the area, as they could get successful maize harvests, and the land was still relatively under populated.
- The main Nairobi - Mombasa highway that passes through the Reference Area (A109) fell into horrible disrepair in the late 1990s, so the high volume of trucks that travel up and down the highway from the main port of Mombasa to the interior of Kenya and beyond (as far as Zambia) was forced to make frequent maintenance stops. As a result, small towns such as Maungu, which is the town directly adjacent to Rukinga, sprang up along the highway.
- There are no significant economic factors involved in selection of the Reference Period, as the local population consists primarily of subsistence farmers, producing for their own consumption.
- These factors lead to a reference period beginning in February, 1987, before which there was very little population and very low deforestation, and extending to the Project sart date, January 1st, 2005. Wildlife Works then located historical imagery covering as much of the reference area as possible, both on a spatial and temporal basis. The following were found and used in building the cumulative deforestation model (CDM).

Kasigau Corridor Phase I Imagery

	Image Number	Image Year	plot line height	Imagery date	Satellite/sensor	Tile / record	Notes
Historical Reference Period	1	1987	10	2/18/1987	Landsat 5 - TM	167/62 167/63	
	2	1994	-12	11/20/1994	Landsat 5 - TM	167/62 167/63	
	3	1995	10	1/7/1995	Landsat 5 - TM	167/62 167/63	
	4	1995	20	2/8/1995	Landsat 5 - TM	167/62 167/63	
	5	1995	30	3/28/1995	Landsat 5 - TM	167/62 167/63	
	6	1999	10	10/25/1999	Landsat 7 - ETM+	167/62 167/63	
	7	2001	-12	3/4/2001	Landsat 7 - ETM+	167/62 167/63	
	8	2003	15	2/6/2003	Landsat 7 - ETM+	167/62 167/63	
	9	2003	30	10/1/2003	Quickbird-2 (Multi-spectral)		
	10	2004	10	9/4/2004	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	11	2005	-20	2/11/2005	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	12	2006	-12	1/29/2006	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	13	2008	30	1/3/2008	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	14	2008	20	9/7/2008	Landsat 5 - TM	167/62 167/63	
	15	2008	10	10/1/2008	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	16	2009	-12	2/22/2009	Landsat 7 - ETM+	167/62 167/63	SLC-OFF
	17	2009	-20	10/4/2009	Landsat 7 - ETM+	167/62 167/63	SLC-OFF

Figure 4. Historical imagery used for the Cumulative Deforestation Model (CDM).

It should be noted that the MED makes use of the post 2003 Landsat SLC-OFF imagery, that was in turn accessible and useful in the deforestation analysis.

Section 6.4 The Cumulative Deforestation Model

Historic Imagery Used to Build the Cumulative Deforestation Model

The imagery located for the reference period provided 100% “double coverage” over the reference area. Upon request, the valdiator will be shown a double coverage map to demonstrate this point. All images were registered to within 10% RMSE. The line plot of the historic images confirms stationarity.

Historical Reference Period Image Line Plot

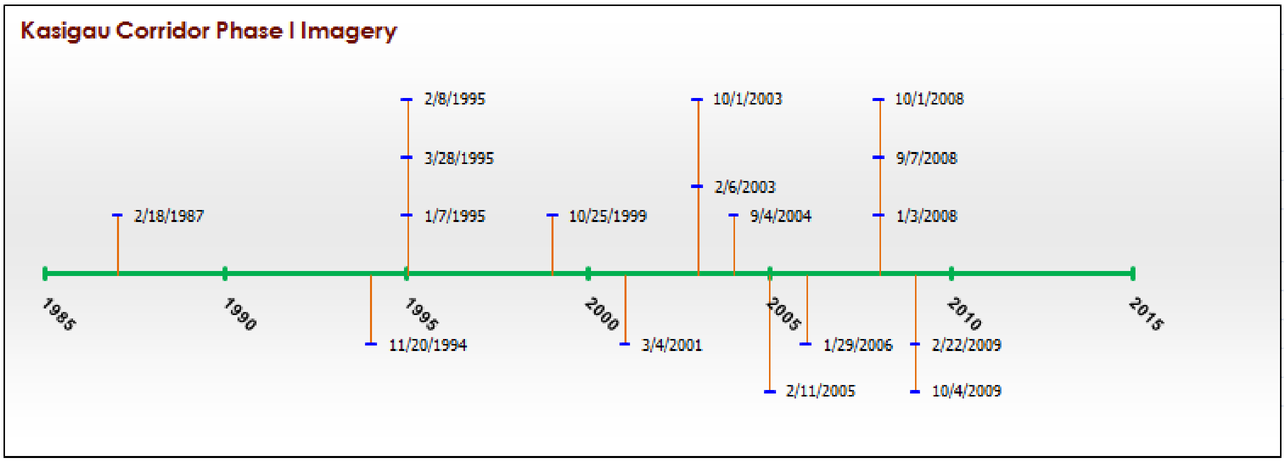


Figure 5. Line plot of historic images demonstrating stationarity.

Sampling Deforestation to Build the Cumulative Deforestation Model

Variance from the pilot sample (100 points) was collected and input to equation 6 to determine total sample size for the CDM:

$$\hat{\sigma}_{DF} = 0.3126$$

$$\hat{m}_{DF} \geq \frac{1}{2}\left(\frac{\hat{\sigma}_{DF}1.96}{0.01}\right)^2$$

$$\hat{m}_{DF} \geq \frac{1}{2}\left(\frac{(0.3126)1.96}{0.01}\right)^2$$

$$\hat{m}_{DF} \geq \mathbf{1877}$$

We chose to use an even 2000 samples, as it is conservatively greater than 1877. To support the collection of data for the CDM, Wildlife Works developed an image classification protocol, and a grid classification tool, which generates the dot grid overlaid on the historic imagery, and supports the analyst in performing the deforestation analysis of each of the grid values over time. An excerpt of the image classification protocol is provided below, and the full document was provided to the Validator.

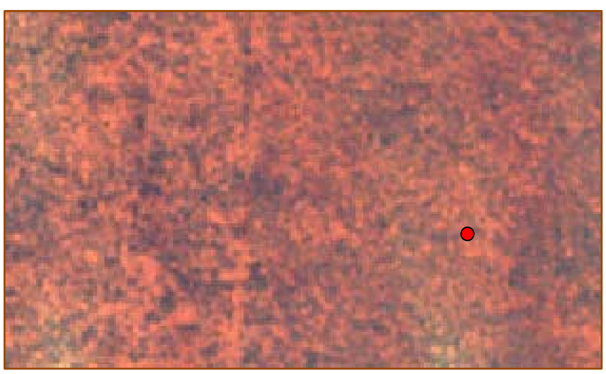
Evaluating points

When classifying the points in the grids it is very important to evaluate the area around each point to get a clear understanding of the land cover features and classification type, not just the area directly under the point. Points will often land in transition areas so a thorough review must be done to evaluate the relative proximity to the various land covers. The follow examples examine a range of land covers and features in the images and how to classify them correctly.

<u>Example 1: Forests</u>

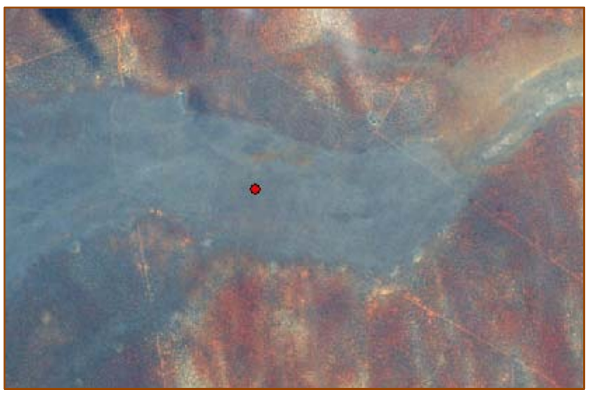
A. **High density** – This point is in the center of a forest. This forest is consistently deep green and very little to no soil is visible.

B. **Low density** – This point is on a low density forest where a lot of soil can be seen. The dark spots in the image are trees and the red area is soil visible between the trees.



C. **Low density –** This is another example of a low density forest.

D. **Shrub/grass land/naturally low vegetation** – This point is on a non-forest area; however this area has not been deforested. This is a very important distinction to be aware of; even though this area may not be forested it should still be classified as forest because the lack of forest was not caused by anthropogenic activities.



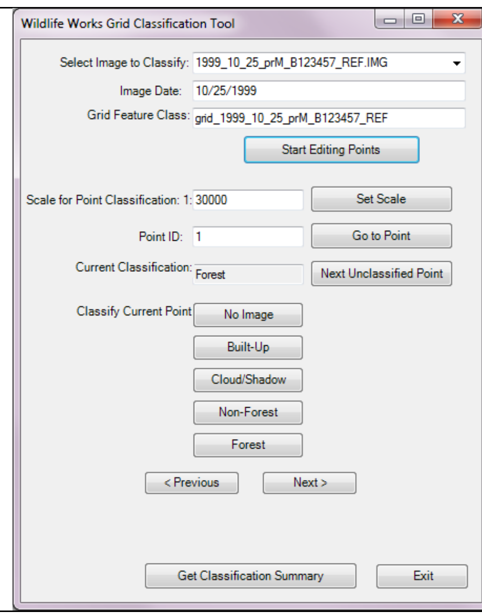
<u>Example 2: Anthropogenic deforestation</u>

The key to identifying anthropogenic deforestation versus land that is naturally non-forested or low density forest is the identification of unnatural patterns in the landscape. These patterns look very unnatural and include agricultural fields, mosaic deforestation and clear-cut area.

A. **Agricultural fields** – This point is in an agricultural field. The distinct lines and structure of the fields are common landscape characteristics of land that is used for agricultural activities.

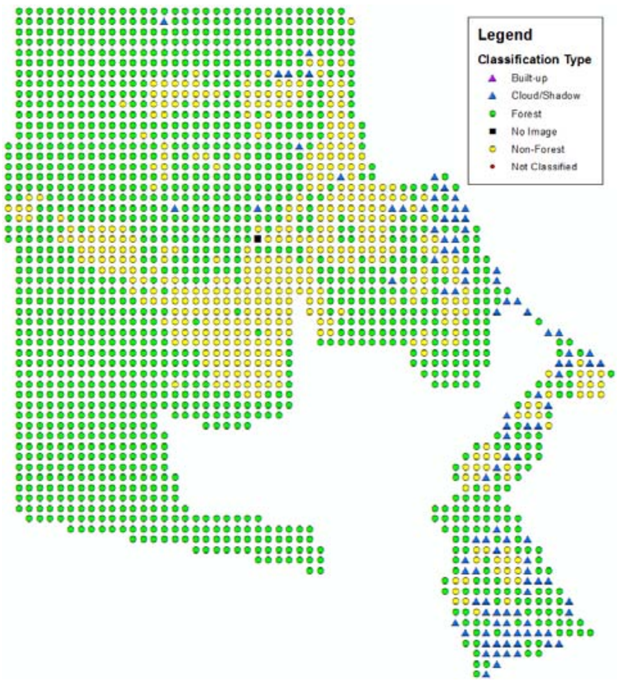
B. **Mosaic Deforestation** – This point is on a mosaic patch of deforestation. A common characteristic of mosaic deforestation is random patches of cleared areas that usually start in a dense area and become less dense and scattered as it spreads out.

The points in the grid can be classified to the appropriate land cover type using the Grid Classification tool. For more information about the Grid Classification tool see: **Grid Classification Tool User Manual**.

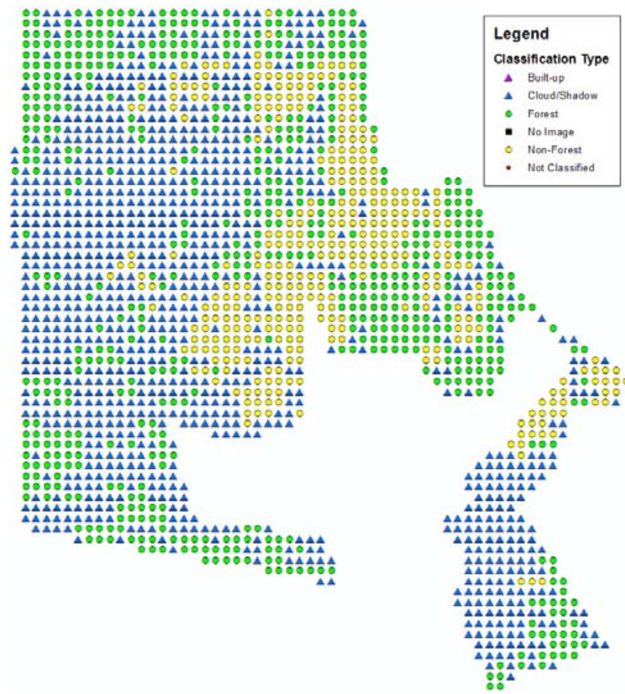


Excerpt from image classification protocol

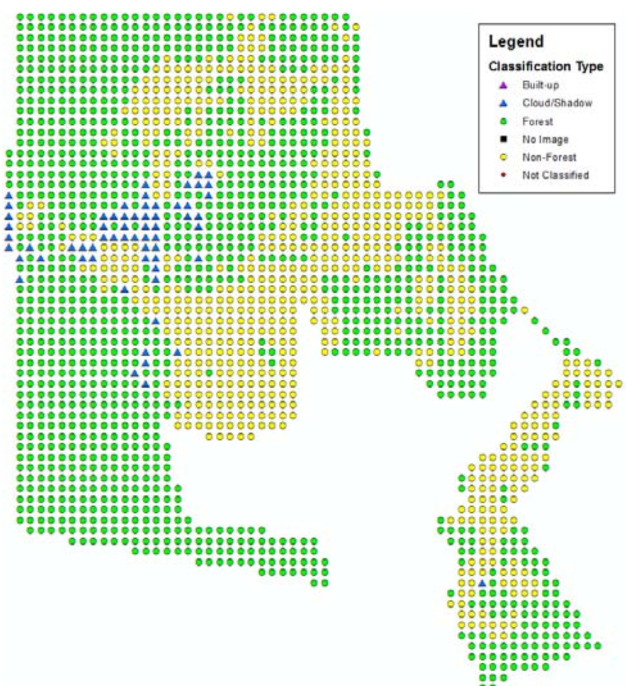
The grid data was collected according to the procedure described in the MED and using the Grid Classification Tool (shown above). The result of this data collection analysis for the Reference Area for all time periods follows;



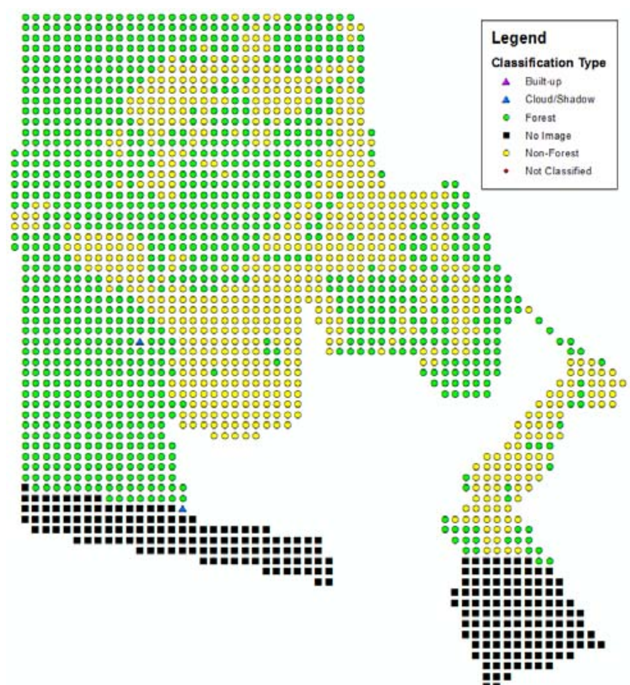
1987



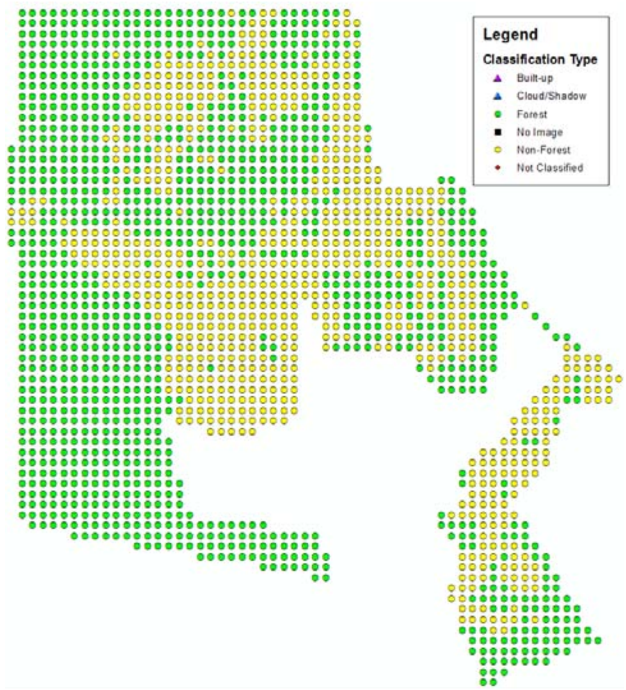
1994



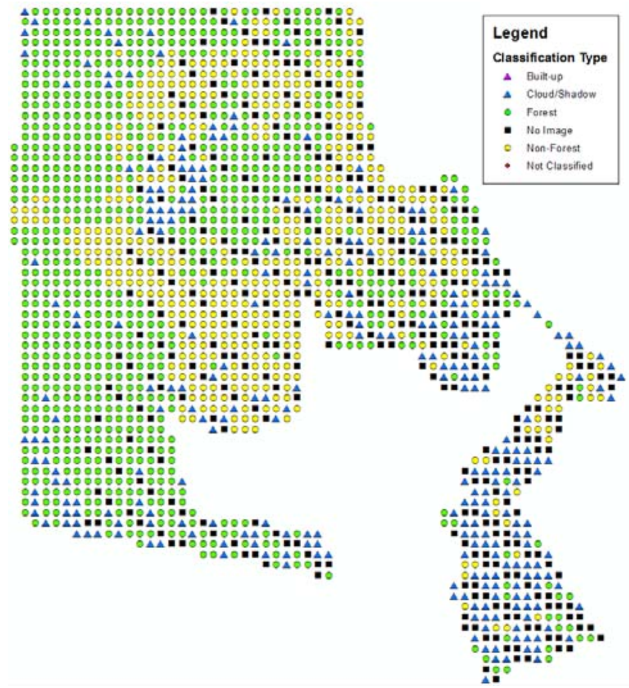
1999



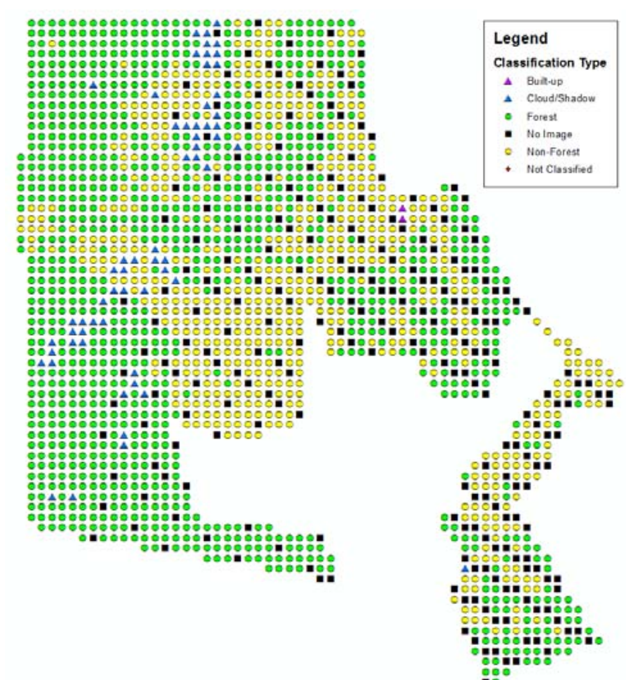
2001



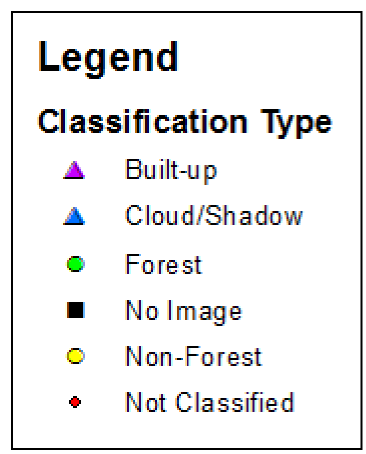
2003



2004



2005



Classification Legend

Figure 6. Data collected over the historical reference period used to fit the CDM

Minimizing Uncertainty in the Cumulative Deforestation Model

To minimize interpretation errors while evaluating forest state in the images used to develop the CDM, an image interpretation protocol was developed and followed by all interpreters. This protocol includes the following information;

- Instructions in how to interpret images using a grid of points overlaid on each image.
- A description of the set of thematic landcover classes used to interpret the points.
- Common (typically encountered) types of land cover patterns and features, and instructions as to how to recognize thematic classes using context.
- How to interpret the forest state of an image, including potential pitfalls to be cognizant of.

After forest state interpretation was completed for all the images within in the historical reference period, the data was independently checked for inconsistencies and systematic misinterpretation. This was accomplished by using an algorithm that flagged any points that had an unlikely forest state transition over the reference period (an example being a transition from non-forest to forest in less than 5 years). These points were then re-evaluated by examining all images at each point (the temporal span) in order to accurately identify and rectify any misinterpretations.

A total of 164 points out of 2000 were flagged for inconsistencies. A spreadsheet was used to evaluate and track the forest state change over the reference period. The images were then re-interpreted for each point and the errors were documented. After the points were reclassified, the check algorithm was run again to ensure that all flagged forest state transitions had been corrected.

The following documents were made available to the validator:

Image Classification Protocol: Image Evaluation Protocol, 01/12/2011

List of flagged and rectified forest state transition: Grid Data RefArea flaggedPointsv2, 01/12/2011

Fitting the Cumulative Deforestation Model

Observations of forest state from the reference region and applicable covariate data sets were used to fit the cumulative deforestation model using the free statistical program R. Population census data were considered as covariates to deforestation throughout time, and these data were obtained for two census districts near the project area – Sagalla and Kasigau – from the Kenya Census for 1989, 1999 and 2009. A linear interpolation was used to estimate population between 10-year census dates. However, these covariates did not inform the model when compared to the model evaluated using only historical observations of deforestation. Four models were evaluated using AIC and their linear predictors, and are presented in the table below.

Model	AIC
Forest State = Alpha + Time	4
Forest State = Alpha + Time + Sagalla	6
Forest State = Alpha + Time + Kasigau	6
Forest State = Aplha + Time + (Sagalla + Kasigau)	12

Table 3. Linear predictors considered and AICs.

The selected linear predictor, per equation 7 is

$$\hat{\eta} = -1.0804558 + 0.0003792x$$

where x is the number of days since the project start date. This predictor was selected because it gave the model with the lowest AIC. A graph of the selected model based on this linear predictor is given below.

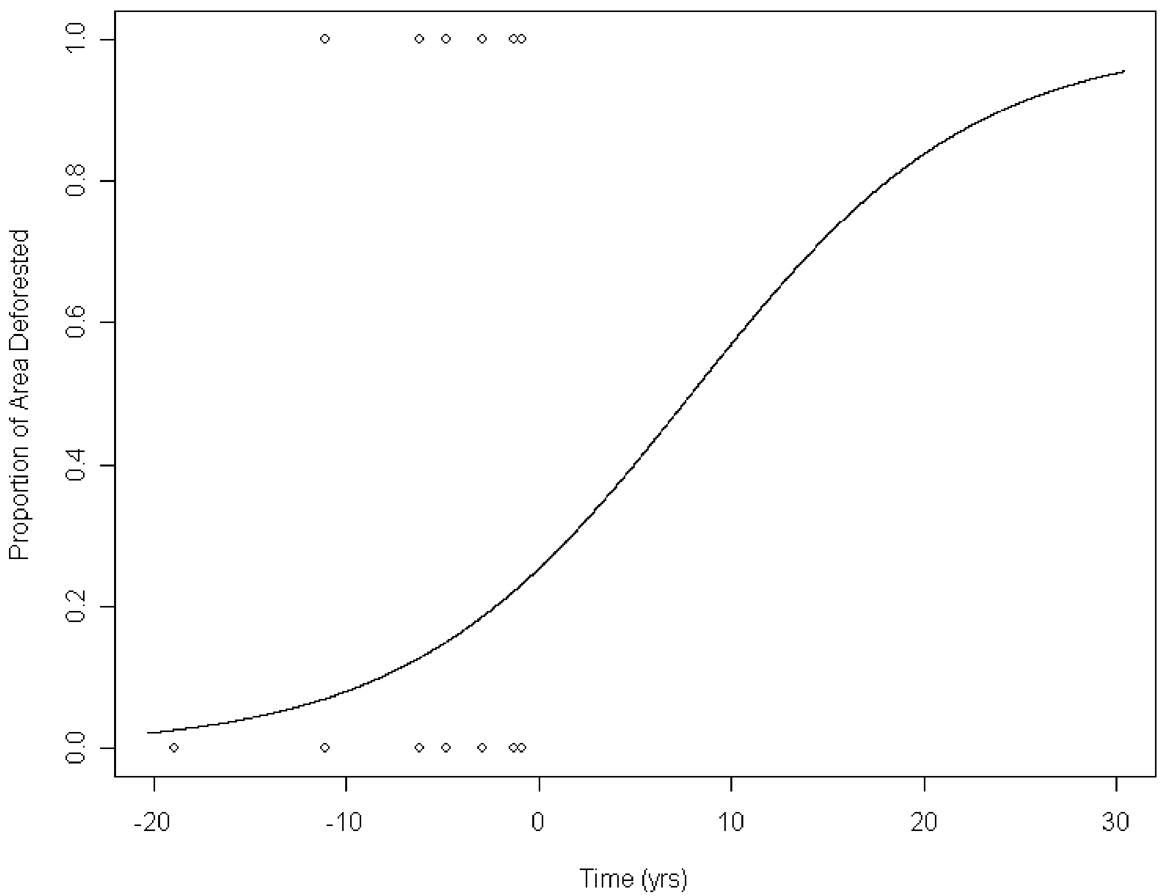


Figure 7. A plot of the selected logistical cumulative deforestation model.

Linear Prediction of Deforestation

A linear rate was selected to predict the cumulative deforestation for project accounting purposes. According to the notation of equation 7, the selected rate is

$$y = 0.031649x$$

where x is the number of days since the project start date, and y is proportion of area deforested. This linear rate is conservative because it predicts less baseline deforestation than the cumulative deforestation model, does not cross the CDM, and is at least 20 years in length. For the end date of this monitoring period, the projected proportion of cumulative deforestation by the cumulative deforestation model is 0.404, while the linear model is 0.1898, less than that predicted by the logistical cumulative deforestation model.

The following lists the proportion of cumulative deforestation for all monitoring periods to-date based on this selected linear rate.

Monitoring Period	Year Ending	Cumulative Deforestation
1	2010	0.1898

Table 4. List of cumulative deforestation by monitoring period.

A graph of the selected linear rate compared to the cumulative deforestation model from the project start date to end date is presented below to illustrate that the linear rate is conservative.

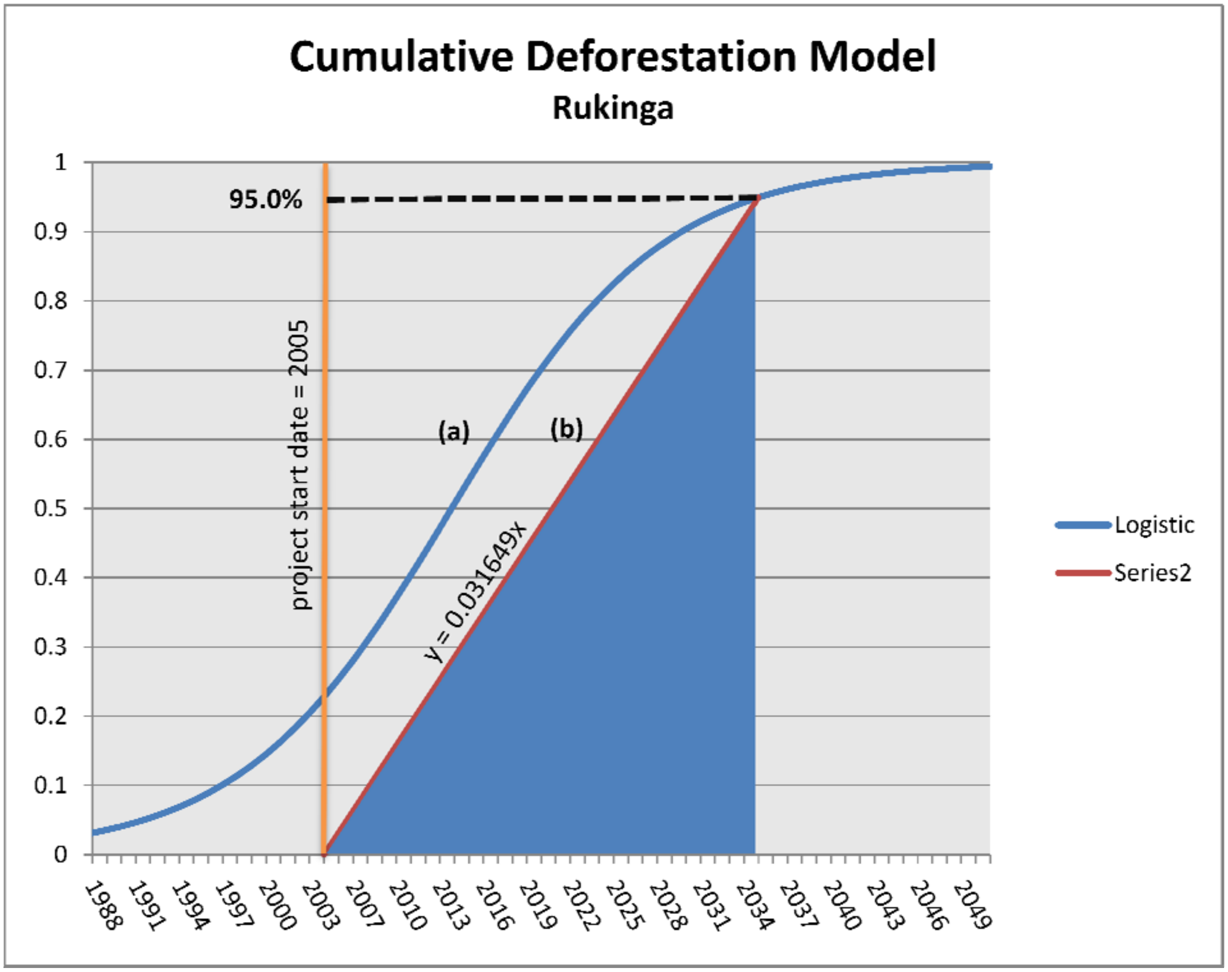


Figure 8. A plot of the logistical cumulative deforestation model (a) and the selected linear rate (b).

Estimating Uncertainty in the Cumulative Deforestation Model

Uncertainty in the cumulative deforestation model was quantified using equation 15 and 17. Equation 17 is calculated as

$$\hat{\sigma}_{DF} = \sqrt{\left[\sum_{i \in \mathcal{J}} w_i o_i\right]\left[1 - \sum_{i \in \mathcal{J}} w_i o_i\right]}$$

$$0.3126732 = \sqrt{0.1098263(1 - 0.1098263)}$$

where 0.1098263 is equal to $\sum_{i \in J} w_i o_i$.

Equation 15, the uncertainty in the deforestation model, is then calculated as

$$U_{DF} = \frac{1.96\hat{\sigma}_{DF}}{\sqrt{n_{DF}} \times \sum_{i \in \mathcal{J}} w_i o_i}$$

$$U_{DF} = \frac{1.96 \times 0.3126732}{\sqrt{8821} \times 0.1098263}$$

where 8821 is the number of state observations made to fit the cumulative deforestation model. The uncertainty in the deforestation model is

$$\boldsymbol{U_{DF} = 0.05941298}$$

Section 6.5 Soil Carbon Loss Model

Sampling Soil Carbon Loss

Soil carbon was determined to be an important pool for this project and was measured using purposive samples of farms in the reference area, most closely correlated to the original dryland forest conditions on Rukinga Ranch. This was possible because Wildlife Works primary shareholders, and of course all employees were in the region prior to the Project start date, so we were able to determine which farms were converted from dryland forest conditions most similarly matching those inside the Project area, as well as when they were converted.

We selected 25 soil sample locations outside of Rukinga's boundary in farms(shambas), all at least 10 years since conversion to farm land with conversion as recently as 10 years and as distant as 40 years ago. We also randomly selected 25 locations inside Rukinga in intact dryland forest.

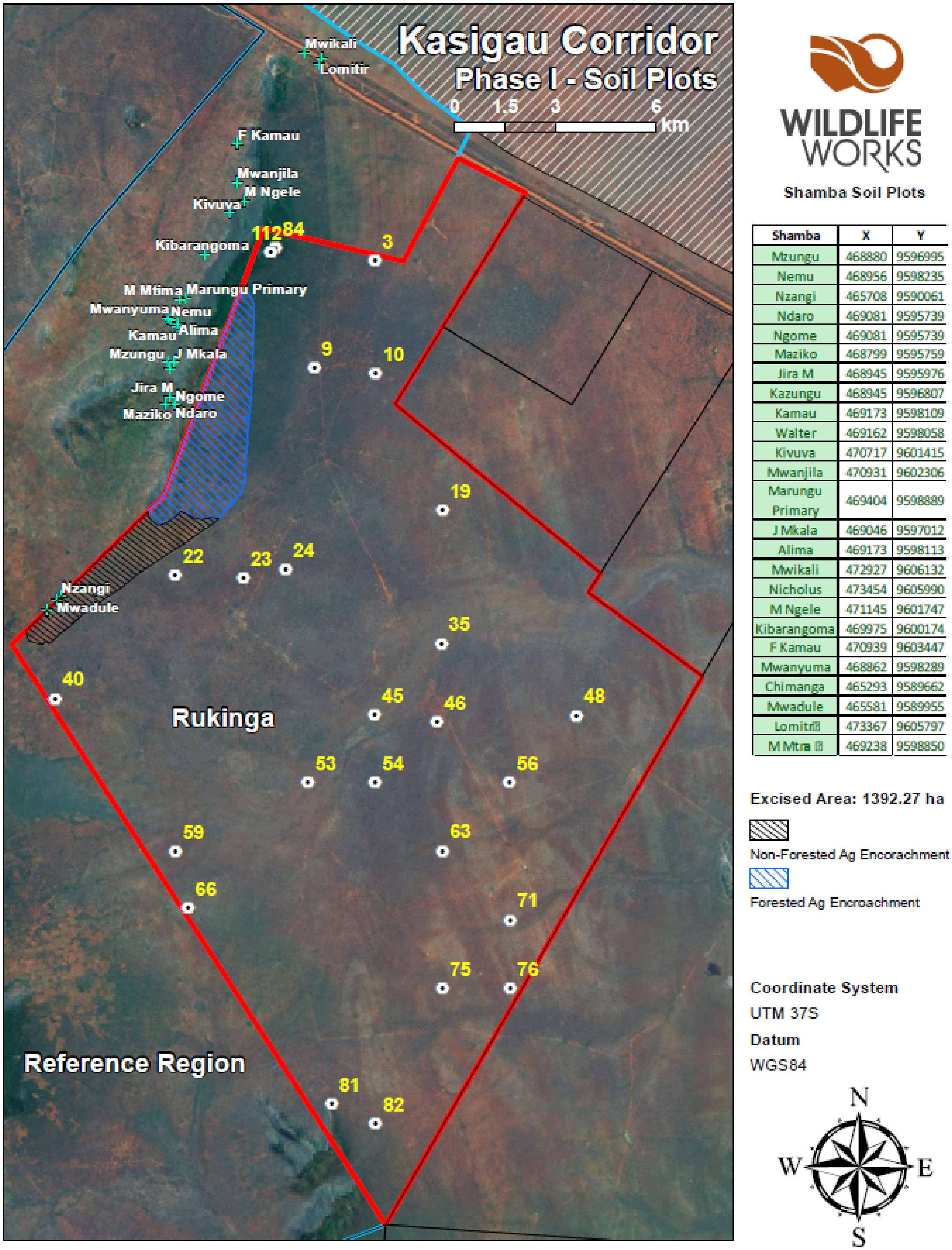
This following is a table of the shambas that were sampled:

Name	Location	Plot Description	Sample Depth (cm)
Mzungu	Sasenyi	Farm cleared 28 yrs ago. Crops grown are maize and green peas	100
Nemu	Marungu	Farm cleared 10 yrs ago. Crops grown are maize & green peas	100
Nzangi	Kulikila	Farm cleared 17 yrs ago. Crops grown are maize & green peas	100

Ndaro	Sasenyi	Farm cleared 35 yrs ago. Crops grown are maize & green peas	100
Ngome	Sasenyi	Farm cleared 37 yrs ago. Crops grown are maize & green peas	100
Maziko	Sasenyi	Farm cleared 26 yrs ago. Crops grown are maize & green peas	100
Jira M	Sasenyi	Farm cleared 40 yrs ago. Crops grown are maize & green peas	100
Kazungu	Sasenyi	Farm cleared 30 yrs ago. Crops grown are maize & green peas	100
Kamau	Itinyi	Farm cleared 12 yrs ago. Crops grown are maize & green peas	100
Walter	Marungu	Farm cleared 10 yrs ago. Crops grown are maize & green peas	100
Kivuva	Itinyi	Farm cleared 20 yrs ago. Crops grown are maize & green peas	100
Mwanjila	Itinyi	Farm cleared 10 yrs ago. Crops grown are maize & green peas	100
Marungu primary	Marungu	Farm cleared 40 yrs ago. Crops grown are maize & green peas	100
J. Mkala	Sasenyi	Farm cleared 40 yrs ago. Crops grown are maize & green peas	100
Alima	Marungu	Farm cleared 10 yrs ago. Crops grown are maize & green peas	100
Mwikali	Lokichigio	Farm cleared 20 yrs ago. Crops grown are maize & green peas	100
Nicholus	Lokichigio	Farm cleared 10 yrs ago. Crops grown are maize & green peas	100
M. Ngele	Itinyi	Farm cleared 13 yrs ago. Crops grown are maize & green peas	100
Kibarangoma	Marungu	Farm cleared 13 yrs ago. Crops grown are maize & green peas	100
F. Kamau	Itinyi	Farm cleared 16 yrs ago. Crops grown are maize & green peas	100
Mwanyuma	Marungu	Farm cleared 14 yrs ago. Crops grown are maize & green peas	100
Chimanga	Mwagwede	Farm cleared 17 yrs ago. Crops grown are maize & green peas	100
Mwadule	Mwagwede	Farm cleared 17 yrs ago. Crops grown are maize & green peas	100
Lomitir	Lokichogio	Farm cleared 18 yrs ago. Crops grown are maize & green peas	100
M. Mtima	Marungu	Farm cleared 17 yrs ago. Crops grown are maize & green peas	100

Table 4. List of soil samples in the reference region.

The location of all the soil samples taken is shown below in a map of Rukinga Sanctuary and the immediately surrounding reference area.



Shamba	X	Y
Mzungu	468880	9596995
Nemu	468956	9598235
Nzangi	465708	9590061
Ndaro	469081	9595739
Ngome	469081	9595739
Maziko	468799	9595759
Jira M	468945	9595976
Kazungu	468945	9596807
Kamau	469173	9598109
Walter	469162	9598058
Kivuva	470717	9601415
Mwanjila	470931	9602306
Marungu Primary	469404	9598889
J Mkala	469046	9597012
Alima	469173	9598113
Mwikali	472927	9606132
Nicholus	473454	9605990
M Ngele	471145	9601747
Kibarangoma	469975	9600174
F Kamau	470939	9603447
Mwanyuma	468862	9598289
Chimanga	465293	9589662
Mwadule	465581	9589955
Lomitir	473367	9605797
M Mtra	469238	9598850

Figure 9. Soil samples in Rukinga and shambas in the reference region

For each plot location, soil was sampled to a consistent depth of 1m. We selected this depth due to the results of a pilot study using a few test pits. Analysis showed that soil carbon loss was still significant down to 1m. Farmers typically disturb the top 30cms with their ploughs, or with any farming practices they might use to improve or deteriorate soil condition, but we had surmised that the deep root systems of the dryland forest would lead to high soil carbon at lower depths over time, and we thus chose to sample to a 1m depth.

Each sample was performed in two “lifts”, the first representing the top 30cm (Top Soil), the second from 31-100cm (Sub Soil), by digging a 1m square pit and thoroughly mixing the soil removed from the pit in each “lift” before extracting a sample in a bag for sending of to the independent Soil Laboratory in Nairobi. Wildlife Works has been using the same soil sampling laboratory - in fact using the same analyst - for several years. The laboratory analyst / manager has agreed to speak with the Validator should they require any/all of the following:

- calibration records
- certification documents
- a description as to how soil carbon is analyzed

All laboratory reports, depicting bulk density and soil carbon, have been provided to the Validator. The process for soil sampling is illustrated in a soil sampling protocol standard operating procedure , which serves as a training guide for the field sampling teams, and has also been provided to the Validator.

The following tables list soil data collected inside the project area and in the immediately surrounding reference area:

Reference area samples

Sample	Farm	Soil Depth	Comments	Bulk Density (g/cm^3)	Carbon (%)
CW019SA0290	Mzungu	Top Soil	Sasenyi - X0468880,Y9596995	1.57	0.64
CW019SA0291	Mzungu	Sub Soil	Sasenyi - X0468880,Y9596995	1.42	0.52
CW019SA0292	Nemu	Top Soil	Marungu- X0468956,Y9598235	1.43	0.80
CW019SA0293	Nemu	Sub Soil	Marungu- X0468956,Y9598235	1.36	0.55
CW019SA0294	Nzangi	Top Soil	Kulikila- X0465708,Y9590061	1.31	1.34
CW019SA0295	Nzangi	Sub Soil	Kulikila- X0465708,Y9590061	1.29	0.64
CW019SA0296	Ndaro	Top Soil	Sasenyi- X0469081,Y9595739	1.53	0.51
CW019SA0297	Ndaro	Sub Soil	Sasenyi- X0469081,Y9595739	1.38	0.17
CW019SA0298	Ngome	Top Soil	Sasenyi- X0469081,Y9595739	1.57	0.32
CW019SA0299	Ngome	Sub Soil	Sasenyi- X0469081,Y9595739	1.36	0.27

CW019SA0300	Maziko	Top Soil	Sasenyi-X0468799,Y9595759	1.45	0.36
CW019SA0301	Maziko	Sub Soil	Sasenyi-X0468799,Y9595759	1.41	0.22
CW019SA0302	Jira M	Top Soil	Sasenyi-X0468945,Y9595976	1.43	0.62
CW019SA0303	Jira M	Sub Soil	Sasenyi-X0468945,Y9595976	1.38	0.19
CW019SA0304	Kazungu	Top Soil	Sasenyi-X0468945,Y9596807	1.43	0.81
CW019SA0305	Kazungu	Sub Soil	Sasenyi-X0468945,Y9596807	1.31	0.62
CW019SA0306	Kamau	Top Soil	Itinyi-X0469173,Y9598109	1.69	0.20
CW019SA0307	Kamau	Sub Soil	Itinyi-X0469173,Y9598109	1.52	0.34
CW019SA0308	Walter	Top Soil	Marungu-X0469162,Y9598058	1.5	0.41
CW019SA0309	Walter	Sub Soil	Marungu-X0469162,Y9598058	1.47	0.37
CW019SA0310	Kivuva	Top Soil	Itinyi-X04770177,Y9601415	1.51	0.40
CW019SA0311	Kivuva	Sub Soil	Itinyi-X04770177,Y9601415	1.37	0.25
CW019SA0312	Mwanjila	Top Soil	Itinyi-X0470931,Y9602306	1.5	0.78
CW019SA0313	Mwanjila	Sub Soil	Itinyi-X0470931,Y9602306	1.43	0.30
CW019SA0314	Marungu Primary	Top Soil	Marungu-X0469404,Y95988891	1.52	0.26
CW019SA0315	Marungu Primary	Sub Soil	Marungu-X0469404,Y95988891	1.42	0.19
CW019SA0316	J Mkala	Top Soil	Sasenyi-X0469046,Y9597012	1.58	0.24
CW019SA0317	J Mkala	Sub Soil	Sasenyi-X0469046,Y9597012	1.46	0.35
CW019SA0318	Alima	Top Soil	Marungu-X0469173,Y9598113	1.48	0.64
CW019SA0319	Alima	Sub Soil	Marungu-X0469173,Y9598113	1.42	0.51
CW019SA0320	Mwikali	Top Soil	Lokichiqio-X0472927,Y9606132	1.53	0.69
CW019SA0321	Mwikali	Sub Soil	Lokichiqio-X0472927,Y9606132	1.39	0.34
CW019SA0322	Nicholus	Top Soil	Lokichiqio-X0473454,Y9605990	1.56	0.50
CW019SA0323	Nicholus	Sub Soil	Lokichiqio-	1.41	0.38

			X0473454,Y9605990		
CW019SA0324	M Ngele	Top Soil	Itinyi-X0471145,Y9601747	1.33	0.47
CW019SA0325	M Ngele	Sub Soil	Itinyi-X0471145,Y9601747	1.57	0.15
CW019SA0326	Kibarangoma	Top Soil	Marungu-X0469975,Y9600174	1.57	0.56
CW019SA0327	Kibarangoma	Sub Soil	Marungu-X0469975,Y9600174	1.5	0.28
CW019SA0328	F Kamau	Top Soil	Itinyi-X0470939,Y9603447	1.59	0.51
CW019SA0329	F Kamau	Sub Soil	Itinyi-X0470939,Y9603447	1.5	0.26
CW019SA0330	Mwanyuma	Top Soil	Marungu-X0468862,Y9598289	1.54	0.42
CW019SA0331	Mwanyuma	Sub Soil	Marungu-X0468862,Y9598289	1.29	0.51
CW019SA0332	Chimanga	Top Soil	Mwaqwede-X0465293,Y9589662	1.56	0.52
CW019SA0333	Chimanga	Sub Soil	Mwaqwede-X0465293,Y9589662	1.38	0.55
CW019SA0334	Mwadule	Top Soil	Mwaqwede-X0465633,Y9589944	1.34	0.91
CW019SA0335	Mwadule	Sub Soil	Mwaqwede-X0465633,Y9589944	1.28	0.76
CW019SA0336	Lomitir	Top Soil	Lokichogio-X0473367,Y9605797	1.51	0.44
CW019SA0337	Lomitir	Sub Soil	Lokichogio-X0473367,Y9605797	1.45	0.35
CW019SA0338	M Mtima	Top Soil	Marungu-X0469238,Y9598850	1.55	0.43
CW019SA0339	M Mtima	Sub Soil	Marungu-X0469238,Y9598850	1.44	0.35

Sample Number	Farm	Field	Comments	Bulk Density	Carbon
CW019SA0239	Rukinga Ranch	Rukinga 75	0-30cm-X0477067, Y9578494	1.38	0.59
CW019SA0240	Rukinga Ranch	Rukinga 75	31-100cm- X0477067, Y9578494	1.21	1.70
CW019SA0241	Rukinga Ranch	Rukinga 53	0-30cm- X473061, Y9584563	1.23	1.47
CW019SA0242	Rukinga Ranch	Rukinga 53	31-100cm- X0473061, Y9584563	1.33	0.74
CW019SA0243	Rukinga Ranch	Rukinga 40	0-30cm- X0465557, Y9587046	1.34	1.09
CW019SA0244	Rukinga Ranch	Rukinga 40	31-100cm- Xx0465557, Y9587046	1.13	1.90
CW019SA0245	Rukinga Ranch	Rukinga 45	0-30cm- X0475045, Y9586570	1.22	1.49
CW019SA0246	Rukinga Ranch	Rukinga 45	31-100cm- X0475045, Y9586570	1.35	0.69
CW019SA0247	Rukinga Ranch	Rukinga 54	0-30cm- X0475063, Y9584564	1.3	0.59
CW019SA0248	Rukinga Ranch	Rukinga 54	31-100cm- X0475063, Y9584564	1.33	0.83
CW019SA0249	Rukinga Ranch	Rukinga 81	0-30cm- X0473772, Y9575089	1.39	0.61
CW019SA0250	Rukinga Ranch	Rukinga 81	31-100cm- X0473772, Y9575089	1.38	1.10
CW019SA0251	Rukinga Ranch	Rukinga 63	0-30cm- X0477066, Y9582559	1.39	0.38
CW019SA0252	Rukinga Ranch	Rukinga 63	31-100cm- X0477066, Y9582559	1.25	0.72
CW019SA0253	Rukinga Ranch	Rukinga 71	0-31cm- X0479067, Y9580518	1.2	0.52
CW019SA0254	Rukinga Ranch	Rukinga 71	31-100cm- X0479067, Y9580518	1.36	0.60
CW019SA0255	Rukinga Ranch	Rukinga 19	0-30cm- X0477062, Y9592623	1.38	0.44
CW019SA0256	Rukinga Ranch	Rukinga 19	31-100cm- X0477062, Y9592623	1.4	0.80
CW019SA0257	Rukinga Ranch	Rukinga 3	0-30cm-X0475059, Y9599984	1.33	0.40
CW019SA0258	Rukinga Ranch	Rukinga 3	31-100cm- X0475059, Y9599984	1.42	0.85
CW019SA0259	Rukinga Ranch	Rukinga 56	0-30cm- X0479048, Y9584582	1.37	0.65
CW019SA0260	Rukinga Ranch	Rukinga 56	31-100cm- X0479048, Y9584582	1.21	1.28
CW019SA0261	Rukinga Ranch	Rukinga 23	0-30cm- X0471146, Y9590615	1.3	0.65
CW019SA0262	Rukinga Ranch	Rukinga 23	31-100cm- X0471146, Y9590615	1.25	1.05
CW019SA0263	Rukinga Ranch	Rukinga 24	0-30cm- X0472402, Y9590858	1.25	0.69
CW019SA0264	Rukinga Ranch	Rukinga 24	31-100cm- X0472402, Y9590858	1.35	0.98
CW019SA0265	Rukinga Ranch	Rukinga 10	0-30cm- X0475077, Y9596669	1.34	0.52
CW019SA0266	Rukinga Ranch	Rukinga 10	31-100cm- X0475077, Y9596669	1.4	0.72
CW019SA0267	Rukinga Ranch	Rukinga 48	0-30cm- X481050, Y9586554	1.31	0.87

CW019SA0268	Rukinga Ranch	Rukinga 48	31-100cm- X481050, Y9586554	1.34	0.65
CW019SA0269	Rukinga Ranch	Rukinga 22	0-30cm- X0469113, Y9590709	1.38	1.13
CW019SA0270	Rukinga Ranch	Rukinga 22	31-100cm- X0469113, Y9590709	1.52	0.55
CW019SA0271	Rukinga Ranch	Rukinga 112	0-30cm- X0471958, Y9600245	1.44	0.35
CW019SA0272	Rukinga Ranch	Rukinga 112	31-100cm- X0471958, Y9600245	1.33	0.78
CW019SA0273	Rukinga Ranch	Rukinga 76	0-30cm- X0479067, Y9578494	1.22	0.54
CW019SA0274	Rukinga Ranch	Rukinga 76	31-100cm- X0479067, Y958494	1.26	1.39
CW019SA0275	Rukinga Ranch	Rukinga 35	0-30cm-X0477031, Y9588676	1.21	1.19
CW019SA0276	Rukinga Ranch	Rukinga 35	31-100cm- X0477031, Y9588576	1.29	1.12
CW019SA0277	Rukinga Ranch	Rukinga 82	0-30cm- X0475085, y9574499	1.34	0.54
CW019SA0278	Rukinga Ranch	Rukinga 82	31-100cm- X0475085, Y9574499	1.45	0.73
CW019SA0279	Rukinga Ranch	Rukinga 66	0-30cm- X0469494, Y9580862	1.3	0.67
CW019SA0280	Rukinga Ranch	Rukinga 66	31-100cm- X0469494, Y9580862	1.59	0.59
CW019SA0281	Rukinga Ranch	Rukinga 59	0-30cm- X046129, Y9582521	1.5	0.48
CW019SA0282	Rukinga Ranch	Rukinga 59	31-100cm- X0469129, Y9582521	1.36	1.07
CW019SA0283	Rukinga Ranch	Rukinga 9	0-30cm- X0473253, Y9596819	1.39	0.62
CW019SA0284	Rukinga Ranch	Rukinga 9	31-100cm- X0473253, Y9596819	1.45	0.47
CW019SA0285	Rukinga Ranch	Rukinga 84	0-30cm- X0472093. Y9600367	1.36	0.44
CW019SA0286	Rukinga Ranch	Rukinga 84	31-100cm- X0472093, Y9600367	1.28	0.81
CW019SA0287	Rukinga Ranch	Rukinga 63	0-30cm- X0476903, Y9586364	1.24	0.51
CW019SA0288	Rukinga Ranch	Rukinga 46	31-100cm- X0476903, Y9586364	1.26	0.98

Description of Soil Types

The dominant soil type within the Project Area is Red Laterite typical of this region of Kenya. There are small bands of black cotton soil that occur randomly within the project area but account for a tiny - and we believe insignificant - element from the standpoint of the Project soil carbon pool. There are also areas within the Project Boundary where Gneiss Islands, or rocky outcrops penetrate the soils to form small rocky hills. These outcrops also represent a tiny and we believe insignificant portion of the land and therefore were ignored from the standpoint of the Project soil carbon pool. A soil classification map was obtained for the whole of Kenya[4] from which the soil classification map for the Reference Area, and the supporting data below, was produced:

[4] Sombroek, W.G., Braun, H.M.H. and van der Pouw, B.J.A. (1982). Exploratory Soil Map and Agro-Climatic Zone Map of Kenya, 1980. Scale: 1:1,000,000. Exploratory Soil Survey Report No. E1. Kenya Soil Survey Ministry of Agriculture - National Agricultural Laboratories, Nairobi, Kenya.

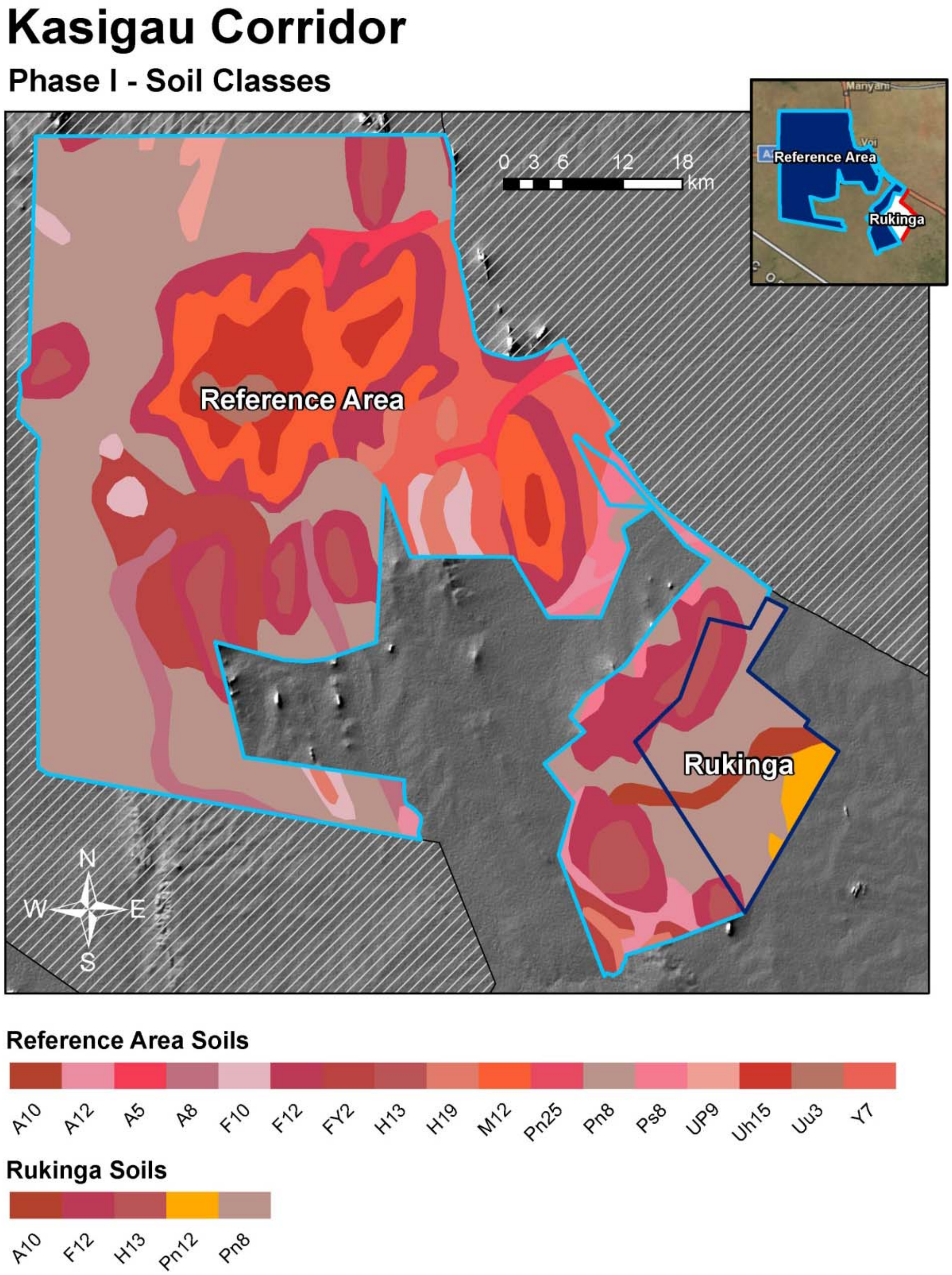


Figure 10. Soil classes in the reference and project areas.

2 Soil Classes:

Reference	Area (ha)	Contib area (ha)	Soil Unit(s)	Soil Sub Type	Soil Type	contrib (%)	Lithology	Area (ha)	Contib area (ha)	Rukinga
A10	1,174	1,174	BK	Calcic Cambis	Cambisols	100	I	3,198	3,198	A10
A12	5,722	5,722	VC	Chromic Vert	Vertisols	100	UE			
A5	5,934	5,934	JE	Eutric Fluvisc	Fluvisols	100	UF			
A8	10,101	10,101	JC	Calcaric Fluvi	Fluvisols	100	SC2			
F10	6,848	6,848	LC	Chromic Luvi	Luvisols	100	SO1			
F12	61,367	30,684	FR	Rodic Ferrals	Ferralsols	50	MA2	3,571	1,786	F12
		18,410	QF	Ferralic Aren	Arenosols	30			1,071	
		12,273	LIC	Ferralo-chror	Luvisols	20			714	
FY2	18,239	10,944	LC	Chromic Luvi	Luvisols	60	MA2			
		7,296	KH	Haplic Kastar	Kastanozems	40				
H13	14,083	8,450	RE	Eutric Regosc	Regosols	60	IA1	1,919	1,151	H13
		1,408	DK	Calcic Chernc	Chernozems	10			192	
		1,408	OK	Distric Histos	Histosols	10			192	
		2,817	ROCK	Eutric Regosc	Regosols	20			384	
H19	6,272	6,272	EC	Cambic Rend	Rendzinas	100	SC3			
M12	30,348	21,244	BH	Humic Cambi	Cambisols	70	MA			
		6,070	RD	Dystric Regos	Regosols	20				
		3,035	ROCK	Eutric Regosc	Regosols	10				
Pn25	37	37	DC	Calcic Chernc	Chernozems	100	SO1			
Pn8	122,681	122,681	FR	Rodic Ferrals	Ferralsols	100	MA2	18,522	18,522	Pn8
Ps8	6,036	6,036	LF	Ferric Luvisol	Luvisols	100	MB3			
UP9	2,914	2,914			Other	100				
Uh15	14,188	8,513	AC	Chromic Acri	Acrisols	60	MA2			
		2,838	B	Cambisols	Cambisols	20				
		2,838	F	Ferralsols	Ferralsols	20				
Uu3	2,893	1,447	U	Rankers	Rankers	50	MA			
		1,447	DH	Calcic Chernc	Chernozems	50				
Y7	20,184	20,184	LIC	Ferralo-chror	Luvisols	100				
			FR	Rodic Ferrals	Ferralsols	50	MA2	2,958	1,479	Pn12
			FO	Orthic Ferral	Ferralsols	50			1,479	
total:		329,021							30,168	

	Reference	Rukinga
Cambisols	7.68%	10.60%
Vertisols	1.74%	0.00%
Fluvisols	4.87%	0.00%
Regosols	6.19%	5.09%
Ferralsols	47.47%	77.12%
Chernozem	0.88%	0.64%
Histosols	0.43%	0.64%
Luvisols	17.11%	2.37%
Kastanozem	2.22%	0.00%
Acrisols	2.59%	0.00%
Rankers	0.44%	0.00%
Rendzinas	1.91%	0.00%
Arenosols	5.60%	3.55%
Other	0.89%	0.00%
total:	100.00%	100.00%

Figure 11. Soil type comparison between Rukinga and the reference area

Minimizing Uncertainty

Wildlife Works has developed a field protocol for sampling soil carbon and that document "Standard Operating Procedure – Soils" was provided to the Validator.

The same team has been collecting soil samples for over one year in the project area and has collected well over 100 soil samples during that time. Our VP African Field Operations, Rob Dodson, trained the teams in the proper procedures and conducts periodic audits. Wildlife Works has the utmost confidence in our soil sampling team, and they have produce consistently accurate results. Ultimately, provided accuracy in field measurements, soil carbon uncertainty lies in the variance between plots and the quality of the soil laboratory used to determine soil organic carbon levels. Wildlife Works has, and will continue to use, Crop Nutritional Services in Nairobi. "Cropnuts" is run by Jeremy Cordingley, who has extensive training and experience in soil science and laboratory procedures. Jeremy conducts periodic calibration exercises with his equipment, and has offered to speak to the Validators should the so desire.

Fitting the Soil Carbon Loss Model

The soil carbon loss model was fit by first estimating the asymptotic proportion of soil carbon loss. Per equation 12 of the MED, the estimated asymptotic proportion is

$$\hat{\ell}_{max} = 1 - \left[\frac{C_{SOIL}^{[0]}}{a_{project}}\right]^{-1} \times \frac{1}{\#(\mathcal{A})}\sum_{i\in\mathcal{A}} y_i$$

$$\hat{\ell}_{max} = 1 - \frac{224.01}{411.53}$$

$$\hat{\ell}_{max} = \mathbf{0.456}$$

where 224.01 is the estimated mean carbon stock (tonnes CO2e/ha) of shambas in the reference area and 411.53 is the same for the project area. The default of 20% was selected for the mean rate of soil carbon loss (based on a conservative value derived from Davidson and Ackerman, 1993). A mean rate of 20% decay is achieved by $\lambda = 0.55$, and the final model is

$$S(t_1, t_2, \lambda, \ell_{max}) = \ell_{max}[G(t_2, \lambda) - G(t_1, \lambda)]$$

$$= \ell_{max}[1 - \exp(-\lambda t_2) - 1 - \exp(-\lambda t_1)]$$

$$\boldsymbol{S(t_1, t_2, \lambda, \ell_{max}) = 0.456\{[1 - \exp(-0.55t_2)] - [1 - \exp(-0.55t_1)]\}}$$

Predicting Soil Carbon Loss

The final soil model is displayed by equations 11 and 13 below. These equations show that upon deforestation in the project area, soil carbon gradually decays from the stocks in the deforested areas. Most soil carbon is lost in the 5 years after deforestation and the proportion of soil carbon lost asymptotes at 0.456.

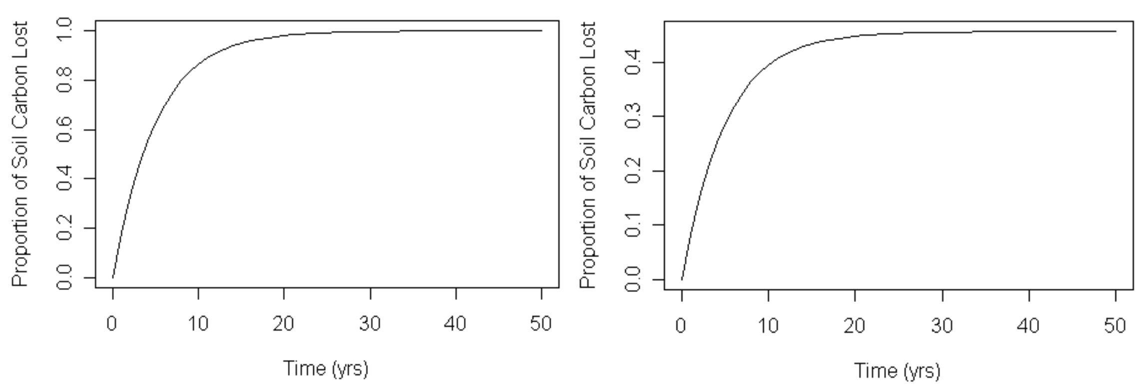


Figure 12. Equation 11 (general soil loss form) and Equation 13 (general carbon loss form applied at Rukinga)

Estimating Uncertainty in the Soil Carbon Loss Model

Per equation 19, the total estimated uncertainty in the soil carbon loss model is

$$U_{SCL} = 1.96 \times \hat{\sigma}_{SCL} \times \left[\sqrt{n_{SCL}} \times \frac{1}{n_{SCL}} \sum_{i \in \mathcal{A}} y_i \right]^{-1}$$

$$U_{SCL} = 1.96 \times 79.48 \times \left[\sqrt{25} \times 224.01 \right]^{-1}$$

$$\boldsymbol{U_{SCL} = 0.1391}$$

where 79.48 is the estimated standard deviation of soil carbon stocks (tonnes CO2e/ha) from the sampled shambas, 25 is the sample size and 224.01 is the estimated sample mean (tonnes CO2e/ha).

Section 6.6 Baseline Scenario for Selected Carbon Pools

Selecting the Proportion of Below Ground Biomass Removed from Large Trees

The Kasigau Corridor is semi-arid, and due to very low average annual rain fall, the Dryland Forest on Rukinga Ranch and in the surrounding reference region is characterized by small to medium sized trees, mostly Acacia ssp and Commiphora ssp. When farmers clear the forest for agriculture, stumps are always removed if the cleared land is to be used for growing crops such as maize. This is because the land is usually tilled by ox-plough and stumps can present an impediment. Commiphora stumps rot away quite quickly after the tree has been cut down but the acacia are often too hard to be cut with an axe or panga, so the farmers fell them by making a fire around the base of the tree. This eventually topples the tree and the fire smolders into the stump and burns it down to below the surface of the soil. Stumps are correspondingly not visible from the cleared farm.

Our site management team and the majority shareholder of Rukinga Ranching Company Ltd, Mike Korchinsky, have been in the area for almost 15 years and have not seen a single stump in a maize farm. As a result we contend that it is common practice in this region to burn the stumps out, and therefore we select 100% as the Proportion of below ground biomass removed from large trees.

Selecting the Proportion of Wood Products

There is no harvest of commercial timber from the project area in the Baseline, nor for wood carving, furniture etc. The only potential harvest of wood products under the baseline would be for building materials for local village huts, e.g. the farmer might cut one or two trees for poles to build his home prior to slash and burn of the remaining biomass for cropland preparation. There are approximately 200-300 trees per hectare in the dryland forest, and a typical small farm or “shamba” is 5 acres or 2.5 hectares, representing 500-750 trees, so the one or two poles taken for hut construction per farm represent a deminimus amount of the above ground biomass of less than .5%. As not all farmers use locally harvested poles for hut construction, and even for those that do, the poles represent a tiny amount of biomass as the huts are very small and grass thatched, we feel it is reasonable to ignore the sequestration of carbon in long lived wood products in the baseline scenario, and therefore suggest the proportion of baseline emissions that are stored in long-lived wood products can be zero.

Figure 13. Local farmers house - Rukinga boundary

Section 6.7 Baseline Reevaluation

This PD was written at the time of initial validation and first monitoring period at the beginning of the project. This section is not yet applicable. Wildlife Works understands that under certain circumstances in the future as specified in VCS 2008a there may be reason to perform a Baseline Reevaluation before the mandatory time frame of 10 years.

Section 7 Additionality

Within the Project Area, none of the proposed Project activities violate any law.

1. Identification of alternative land use scenarios

    a. Continuation of the pre-project land use as private wildlife sanctuary:

    Prior to the implementation of the REDD project on Rukinga, the Project proponents had spent a significant and unsustainable amount of money over the last ten years financing activities to attempt to protect the forest from destruction. Those activities provided no significant sources of income from the land to offset the land protection costs, and therefore this project would eventually have failed financially if carbon funding were not made available.

    b. Uses a in the ten years prior to Project start date:

    Cattle Ranching - When the current majority landowners acquired their interest in Rukinga Sanctuary in 2000, the previous owners were operating a financially unsuccessful cattle ranching operation on the land. The area is too dry with no permanent water for successful cattle ranching, and there was predation by lions on the cattle at a rate that lead to the financial failure of the operation, and eventual sale of the land to the majority shareholder of Wildlife Works.

    Ecotourism - The prior owners also had an ecotourism facility on the Project area, but as evidence that these activities were not financially viable on the land, the slash and burn clearing had reached within 200 meters of the ecotourism facility, causing it to fail and move away.

    c. Slash and Burn Agriculture by subsistence farmers:

    Prior to the Project Proponent taking over management of the land in 2005, local people had begun to clear part of the Project area, and have systematically cleared the dryland forest from a majority of the Reference area in order to provide land for annual crops. This is evidently the most likely Baseline scenario, as it had been carried out routinely throughout the Reference region, in clear violation of land laws.

2. Consistency of credible land uses with enforced mandatory laws and regulations:

    All of the alternative land use scenarios above represent legal land uses, with the exception of slash and burn agriculture, which essentially consists of squatting on privately owned land; illegal under Kenyan law. However, there is overwhelming evidence that this law had been systematically unenforced, as greater than 30% of the area of the administrative unit that encompasses the project area had been deforested in the ten years prior to the Project start date. Thus, all the land uses above are credible.

3. Investment Analysis – Simple Cost Analysis:

    Physical protection of the Project area, and provision of deforestation mitigation activities, such as school building, scholarships, ranger patrols, reforestation of deforested indigenous forests etc. for the community cost the Project Proponent approximately $300-400,000 per year in the years prior to implementation of the VCS AFOLU project. There exists no significant income to offset these costs. In the absence of active protection, both physical and that created by partnering with the communities to create economic alternatives, it is clear the land in the Project area would be cleared aggressively for subsistence agriculture, as that was in fact what was already happening prior to our arrival. Slash and burn agriculture faces no economic barriers, and is therefore once again the most likely Baseline scenario.

4. Common Practice Analysis

   It is common practice to protect wilderness in Africa, and to provide sustainable development support for rural African communities, but that common practice is typically funded by governments or donor agencies, and not by financial return from the project activities. It is NOT common practice for private companies that are not donor funded, such as the Project proponent to protect forested wilderness in Africa for financial return, in the absence of AFOLU revenues. The Project proponent's Rukinga Sanctuary project is the first AFOLU Project Activity of its type in Kenya, and one of the very first in Africa.

Summary of Additionality Test

In summary;

- the Kasigau Corridor REDD project is not the only credible alternative land use consistent with enforced mandatory applicable laws,
- one of those alternative land uses, that of Slash and Burn Agriculture is by far the most likely baseline land use,
- the Kasigau Corridor project passes the Investment Analysis Test as it is not a financially viable land use without the AFOLU VCS project revenues
- and the project activities are NOT common practice.

therefore it is additional under the rules of VT0001 Tool for the Demonstration of Additionality in VCS AFOLU Project Activities.

Section 8 Baseline Emissions

Baseline emissions are calculated as the carbon pools measured in the project area, which are applied to the cumulative deforestation model (determined by sampling historical imagery). The estimated emissions (tonnes CO2e) for each selected carbon pool in the project area for each year since the project start date are shown in the following table. The total estimated baseline emissions for the first monitoring period are 1,450,329 tonnes CO2e. These emissions are based on the selected linear predictor of cumulative deforestation. It should be noted that it is not mandatory to measure ex-ante carbon stocks in the project area according to VCS standards. However, Wildlife Works chose to verify the project at the same time as project validation, and therefore performed a full ex-ante carbon inventory. The spreadsheet 'NER Analysis v4, 01/25/2011' provides complete GHG emission analysis for the entire project crediting period, and was provided to the Validator.

	2005	2006	2007	2008	2009	2010
Linear Model (%)	3.16%	6.33%	9.49%	12.66%	15.82%	18.99%
AGLT	50,776	50,776	50,776	50,776	50,776	50,776
BGLT	20,310	20,310	20,310	20,310	20,310	20,310
AGST	0	0	0	0	0	0
BGST	0	0	0	0	0	0
AGNT	8,556	8,556	8,556	8,556	8,556	8,556
BGNT	3,422	3,422	3,422	3,422	3,422	3,422
SDW	0	0	0	0	0	0
LDW	0	0	0	0	0	0
WP	0	0	0	0	0	0
SOIL	119,709	155,515	166,225	169,429	170,387	170,674
Total Emissions	**202,774**	**238,580**	**249,290**	**252,494**	**253,452**	**253,739**

Table 5. Baseline emissions by carbon pool and year.

8.1 Estimating Emissions from Above Ground Large Tree Biomass

See above summary table.

8.2 Estimating Emissions from Above Ground Small Tree Biomass

See above summary table – no distinction is made in this project between large and small trees; small tree biomass is therefore included in the large tree pool.

8.3 Estimating Emissions from Above Ground Non-Tree Biomass

See above summary table – non-tree includes shrubs and grasses.

8.4 Estimating Emissions from Below Ground Large Tree Biomass

See above summary table.

8.5 Estimating Emissions from Below Ground Small Tree Biomass

See above summary table – no distinction is made in this project between large and small trees; small tree biomass is therefore included in the large tree pool.

8.6 Estimating Emissions from Below Ground Non-Tree Biomass

See above summary table – non-tree includes shrubs and grasses.

8.7 Estimating Emissions from Standing Dead Wood

See above summary table – standing dead wood was included in the large tree numbers. Lying dead wood was conservatively ignored (see below)

8.8 Estimating Emissions from Lying Dead Wood

While there are many lying dead trees in the ecosystem, termites are very active in this ecosystem. To provide a conservative estimate of total aboveground biomass from trees, we have excluded this pool, although in some plots the weight of lying dead wood is significant as a result of elephant damage.

8.9 Estimating Emissions from Soil

See above summary table

8.10 Estimating Emissions from Wood Products

The proportion of long lived wood products defined in section 6.6.10 was zero. Therefore, there are no measured negative emissions (sequestration) from this pool.

Section 9 Project Emissions

9.0 Forest Fires

There have been no significant forest fires in the Project area during the first monitoring period. The Project proponent understands that should significant forest fires occur in the future during the Project crediting period, that we would be required to produce a map of the boundaries of the fire prior to the subsequent monitoring period.

9.1 Emissions from Burning

There have been no events of woody biomass burning within the Project area. Wildlife Works' sustainable charcoal project activity uses fingerling wood, sustainably harvested from indigenous trees outside the Project Area.

Section 10 Leakage

Section 10.1 Leakage Mitigation Strategies

- Providing economic alternatives to the slash and burn agricultural practices that have devastated so much of sub-saharan Africa:

  a) we built a factory on the edge of our project area where we train the local women how to sew. We have employed many local people over the years, producing organic cotton fashion which we sell locally and internationally. A pact with the community exists: if they value the jobs, they agree to stop clearing the forest and damaging biodiversity, or we will not be able to sell products, and they will lose their jobs. Our factory uses a small amount of electricity generated from the National Grid, which in Kenya is 40% hydroelectric. We believe the emissions created by this power use are more than offset by the reduction in emissions gained from our greenhouse and tree nurseries and replanting schemes discussed below.

  b) we established an organic greenhouse and nursery program to grow a variety of trees, providing fuelwood, cash crops and medicinal/agroforestry species to the community. Increasing agricultural productivity on existing farmland is viewed as the best way to stop additional conversion. We plan to expand this activity to sponsor nurseries in each of the main villages surrounding our project upon receipt of carbon revenue from this project. We havfe already initiated a reforestation activity with native hardwoods grown in our nursery, and outplanted into previously deforested areas on community lands. We are claiming no additional carbon emissions credits for this activity; it is simply an element of our leakage mitigation strategy.

  c) we have been working with the Kenyan Agricultural Research Institute (KARI) to explore the potential of growing jojoba as a dryland cash crop that can withstand drought and poor agricultural practices and still generate a cash crop on a high value per hectare basis, again to improve food security by increasing agricultural productivity on existing ag lands to reduce conversion pressure. We have completed a two year study and are ready to roll out a farmer outreach model.

- Providing planned Farm land

  The local population's need for additional farm land was addressed by the establishment of a land cooperative on 5000 acres of what was still at that time Rukinga Ranch. This Sasenyi Valley land cooperative on land that had been cleared of forest prior to our arrival gave the community area to expand into without needing to clear more forest. They were able to receive legal title for their farms, a first in this area of Kenya. This program has been fully implemented.

- Expansion of our ranger patrols and implementation of community ranger groups to patrol the leakage area

  Unlike most REDD projects, Wildlife Works directly employs its own rangers to protect the forest from illegal incursion, deforestation and even damage to biodiversity. We have a 10 year track record of physically protecting the land from all potential deforestation agents. Our success, where many other projects have failed in this regard, is due to our providing economic alternatives to the community, preventing the requirement to clear more forest for agriculture. This has created a partnering relationship with the community, and increased the effectiveness of our rangers, even though they are not armed. They can draw heavily on support from the influential members of the local community. We believe that our presence in daily protection of the forest has significantly reduced, if not completely eliminated, the threat of immigrant populations from non forested areas of the Coast province in Kenya coming to the area in search of unprotected land for slash and burn agriculture. Therefore, in addition to stopping the specific deforestation of the project area, the project activities have reduced the population pressure that would have been seen under the baseline / without project scenario. We have more than doubled our ranger force since the beginning of the REDD project.

- Phase II:

  We plan to implement a second phase of the Kasigau Corridor project, in which we will extend our monitoring and protection to ALL of the remaining dryland forest in this region of Kenya, nearly 500,000 acres, to prevent slash and burn agriculture from moving into any of the adjacent forested lands privately owned by members of the community. We have entered into Carbon Rights Agreements / Easements with the neighboring community land owners to execute this component of the strategy, and have already begun protection of their forests with additional rangers and ranger posts. This program has been fully implemented.

- Fuelwood and sustainable charcoal:

  a) We are establishing 5 organic greenhouse extensions within the Project area to produce fuelwood and other agriforestry species for the local community. We aim to assist them in becoming self-sufficient in fuelwood, without having to extract from any of the Project area or other private dryland forest in the region. This activity is currently being established.

  b) A study carried out by Matthew Owen of the University of North Carolina, “Adaptation to Rural Domestic Fuelwood Scarcity in Embu District, Kenya" showed that when fuelwood is an abundant and free resource, it is used at a level far above necessity, and that when it becomes a constrained resource, consumption can drop by as much as 50% without loss of function to the community. This indicates that the amount of wood being harvested for fuelwood from Rukinga can probably be replaced with far less fuelwood grown in woodlots and community farms.

  c) We have been developing a sustainable charcoal alternative to destructive bush charcoal. We currently employ 12 people in the production of charcoal briquettes from fingerling charcoal harvested from indigenous trees and shrubs, and using a cassava flour binder. We believe we can substitute this carbon neutral charcoal into the local economy with minimal subsidy to provide for the community’s fuel needs, with zero leakage. Production testing has been completed for this activity. Sales tests are ongoing.

  d) Our baseline analysis shows that the without project scenario would have seen the Project area eventually cleared completely for farm land. As such, wood resources the community may have extracted from the Project area would have been transient at best.

Section 10.2 Delineation of the Leakage Area

The leakage area, depicted in the map in section 10.3.2 below, was selected from forested areas as close as possible to the Project area which are subject to the same agents and drivers of deforestation as the project area, and that exhibit similar geographic characteristics (such as elevation, proximity to villages or towns, forest type etc.) The MED requires that the leakage area be forested at the project start date. Tsavo National Parks were excluded, as they fall under a different legal protection status. The most obvious area with a high potential for leakage are the group-owned ranches with identical land ownership system to the Project area. They are immediately adjacent to the project area, but were not selected for inclusion in the leakage area, as they are now being protected by Wildlife Works under Phase II of the Kasigau Corridor REDD. The second criteria was accessibility by the agents of deforestation, as some of the remaining forested land in the reference region is very remote and unlikely to suffer leakage. Soil fertility or rainfall were not considered, as they are fairly constant across the Reference area.

Section 10.3 The Leakage Model

Sampling Deforestation and Degradation to Build the Leakage Model

Per the requirements of the MED, the leakage area was sampled prior to the first monitoring period, to estimate the lag period for the leakage model.

Equation [10], dependent on the standard deviation of the forested state observations, was used to calculate the number of sample point locations required, and yielded a result of 38 locations within the leakage area

$$\hat{m}_{LE} \geq \left(\frac{\hat{\sigma}_{DF}1.96}{0.1}\right)^2$$

$$\hat{m}_{LE} \geq \left(\frac{(.3126)(1.96)}{0.1}\right)^2$$

$$\hat{m}_{LE} \geq \mathbf{38}$$

38 equal sized 2 hectare square plots were then randomly located within the Leakage area, and coordinates of the NE corner of each Leakage plot was given to the leakage plot sampling team. A number of extra plots were generated to allow for inaccessibility in the field of certain plots. The rationale behind the extra plots is that in this ecosystem, inaccessibility is limited to thick bush, where vehicles cannot approach to a safe distance for the sampling teams to reach the location on foot to perform the sampling exercise. At Wildlife Works, safety for our employees is of primary concern, and if sampling teams walk too far in thick bush, they run the risk of encountering elephant or buffalo. As inaccessibility always corresponds with thick primary vegetation, it can be assumed that the exclusion of the inaccessible points is a conservative measure of leakage, as they would undoubtedly have a factor of 0. Note that the field leakage sampling done by Wildlife Works personnel was done prior to the MED being finally validated, and at the time the Leakage Plot samples were taken, a 0% leakage factor was not encountered; the lowest factor was 0-20%. Again, we believe this leads to a conservative measure of average leakage factor, and a conservative leakage lag period. Maps of the leakage area, showing the permanent Leakage plots are shown below.

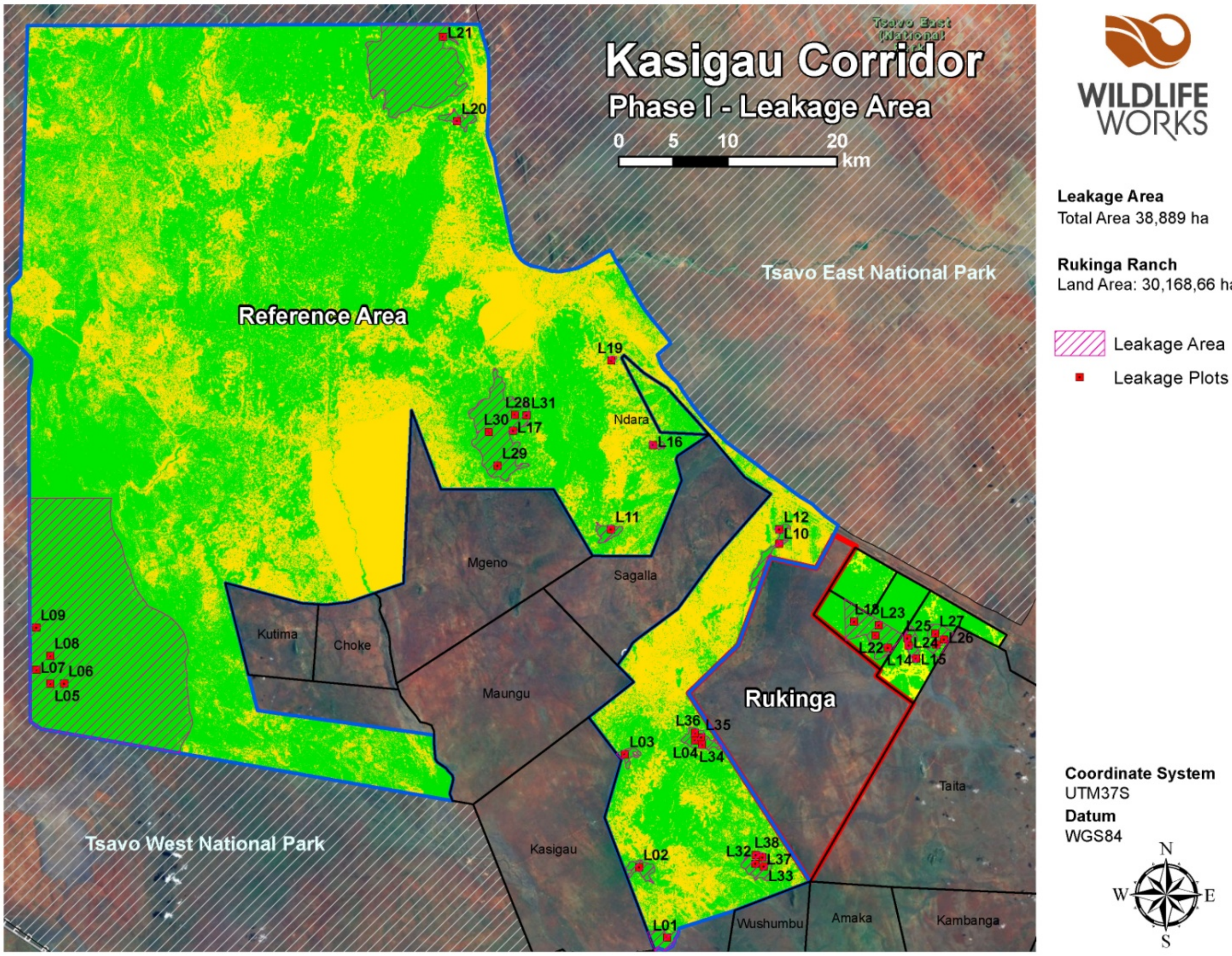
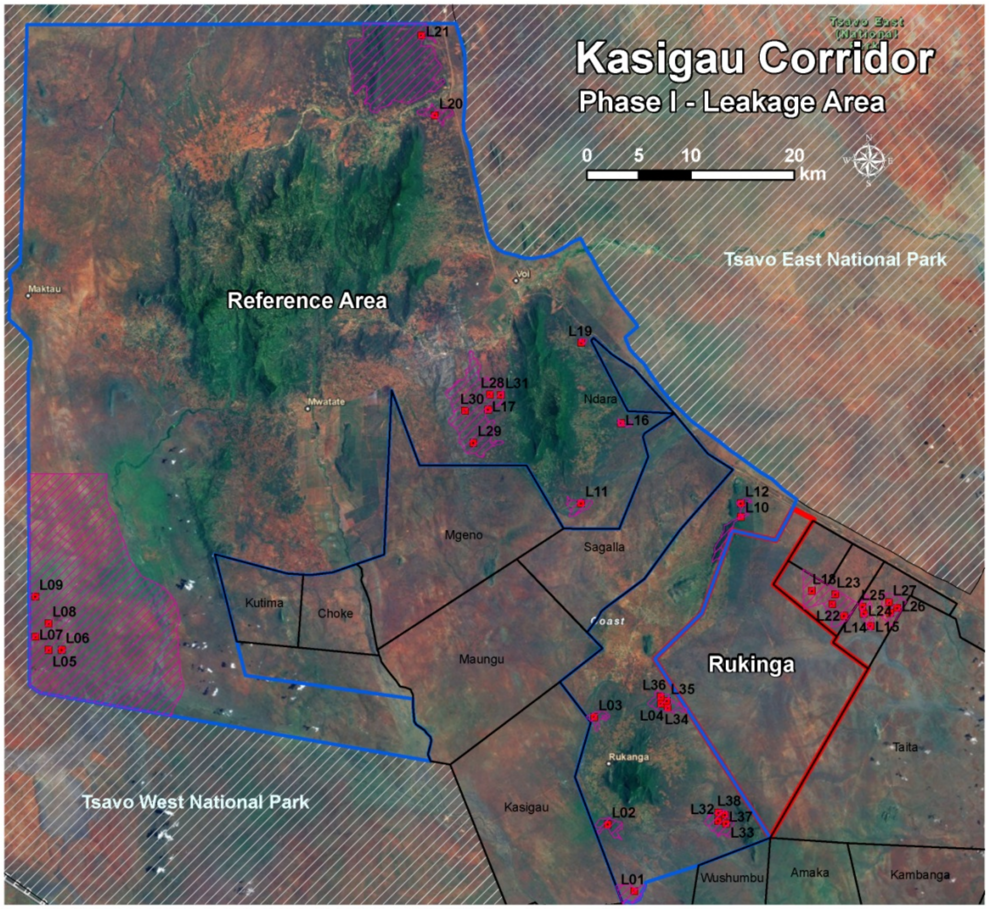


Figure 14. Leakage plots overlaid on a forest/non-forest map



Leakage Plot Coordinates

Plots	Point X	Point Y
L01	462290.6	9566407.4
L02	459730.6	9572807.4
L03	458450.6	9583047.4
L04	464850.6	9584327.4
L05	405970.6	9589447.4
L06	407250.6	9589447.4
L07	404690.6	9590727.4
L08	405970.6	9592007.4
L09	404690.6	9594567.4
L10	472530.6	9602247.4
L11	457170.6	9603527.4
L12	472530.6	9603527.4
L13	486859.7	9593065.8
L14	482453.6	9592769.8
L15	485034.1	9591786.5
L16	461010.6	9611207.4
L17	448210.6	9612487.4
L18	479344.8	9595139.2
L19	457170.6	9618887.4
L20	443090.6	9640647.4
L21	441810.6	9648327.4
L22	481307.2	9593867.3
L23	481598.5	9594812.8
L24	484344.9	9592969.2
L25	484231.9	9593633.8
L26	487579.8	9593521.9
L27	486771.0	9594064.8
L28	448401.6	9613947.0
L29	446810.4	9609307.4
L30	446012.1	9612379.7
L31	449457.4	9613888.1
L32	470359.3	9573125.2
L33	471130.8	9572882.0
L34	465491.1	9583961.7
L35	465407.2	9584618.5
L36	464821.6	9585006.8
L37	470989.6	9573694.4
L38	470380.8	9573910.4

Figure 15. Leakage plots and corresponding coordinates

The Leakage Sampling team performed estimates of deforestation and degradation according to 'Standard Operating Procedure Leakage', a copy of which was provided for the Validator. They made no permanent marking of plots, and will simply return to the same NE corner coordinate each monitoring period, and repeat the procedure in each subsequent period. Sampling results are summarized in the table below. Leakage sampling was lead by Operations Manager Jamie Hendriksen, and supervised by Rob Dodson, VP African Field Operations, our two most experienced staff members, as this was our first ever leakage area plot sampling effort. They will now be responsible for training other members of our field plot sampling team to perform this activity each required monitoring period, and for performing QA on a selected sample of the Leakage Plots each monitoring period to ensure consistency in their evaluation of degradation for this first monitoring period.

Leakage Plot Coordinates				
Plots	**Point X**	**Point Y**	**Degradation % Dec, 2010**	**value**
L01	462290.6	9566407.4	0-20	1
L02	459730.6	9572807.4	41-60	3
L03	458450.6	9583047.4	21-40	2
L04	464850.6	9584327.4	0	0
L05	405970.6	9589447.4	0-20	1
L06	407250.6	9589447.4	0-20	1
L07	404690.6	9590727.4	0-20	1
L08	405970.6	9592007.4	21-40	2
L09	404690.6	9594567.4	21-40	2
L10	472530.6	9602247.4	0-20	1
L11	457170.6	9603527.4	61-80	4
L12	472530.6	9603527.4	0-20	1
L13	486859.7	9593065.8	0-20	1
L14	482453.6	9592769.8	21-40	2
L15	485034.1	9591786.5	41-60	3
L16	461010.6	9611207.4	41-60	3
L17	448210.6	9612487.4	21-40	2
L18	479344.8	9595139.2	20-40	2
L19	457170.6	9618887.4	0-20	1
L20	443090.6	9640647.4	0	0
L21	441810.6	9648327.4	0	0
L22	481307.2	9593867.3	0-20	1
L23	481598.5	9594812.8	21-40	2
L24	484344.9	9592969.2	0-20	1
L25	484231.9	9593633.8	21-40	2
L26	487579.8	9593521.9	0-20	1
L27	486771.0	9594064.8	0-20	1
L28	448401.6	9613947.0	61-80	4
L29	446810.4	9609307.4	61-80	4
L30	446012.1	9612379.7	41-60	3
L31	449457.4	9613888.1	21-40	2
L32	470359.3	9573125.2	61-80	4
L33	471130.8	9572882.0	41-60	3
L34	465491.1	9583961.7	21-40	2
L35	465407.2	9584618.5	21-40	2
L36	464821.6	9585006.8	0-20	1
L37	470989.6	9573694.4	41-60	3
L38	470380.8	9573910.4	21-40	2

Leakage Area Polygons	
perimeter (m)	**area (m^2)**
10394.51227	2622654.416
2046.461795	221164.6479
4547.836483	522040.3724
7837.745452	2487550.251
17675.17905	3713644.272
8279.920827	1626170.571
10307.97126	3942253.055
9726.982167	2795240.98
18021.21369	13467407.77
7857.944337	2567239.308
8822.613995	4934017.422
68042.63615	255753249.1
32587.05298	29928113.67
38283.42394	56169524.54
8619.378165	3420972.65
9174.509654	4721327.05
Total Leakage area (ha)	**38,889**
Rukinga forested area (ha)	**27,844**

deg	value
0	0
0-20	1
21-40	2
41-60	3
61-80	4
81-100	5

Table 6. Leakage plot evaluation results

Fitting the Leakage Model

The leakage model was fit by first computing the proportion of cumulative deforestation and degradation in the leakage area as the average of observed factors. This proportion $\hat{d}_0$ is 0.3789, applied to equation 9 to compute the lag period as

$$\hat{\delta}_{LE} = \log(\hat{d}_t) + \log(1 - \hat{d}_t) + \hat{\alpha} + \hat{\boldsymbol{\theta}}\boldsymbol{x}^T$$

$$\hat{\delta}_{LE} = \log(0.3737) + \log(1 - 0.3737) + 1.08804558$$

$$\hat{\delta}_{LE} = \mathbf{0.4498}$$

And the final leakage model per equation 8 is then

$$F_{LE}(t, \hat{\eta}, \hat{\delta}_{LE}) = \frac{1}{1 + \exp(-(-1.08804558 + 0.0003792x) - 0.4498)}$$

The following is a plot of the leakage model for the leakage area compared to the cumulative deforestation model.

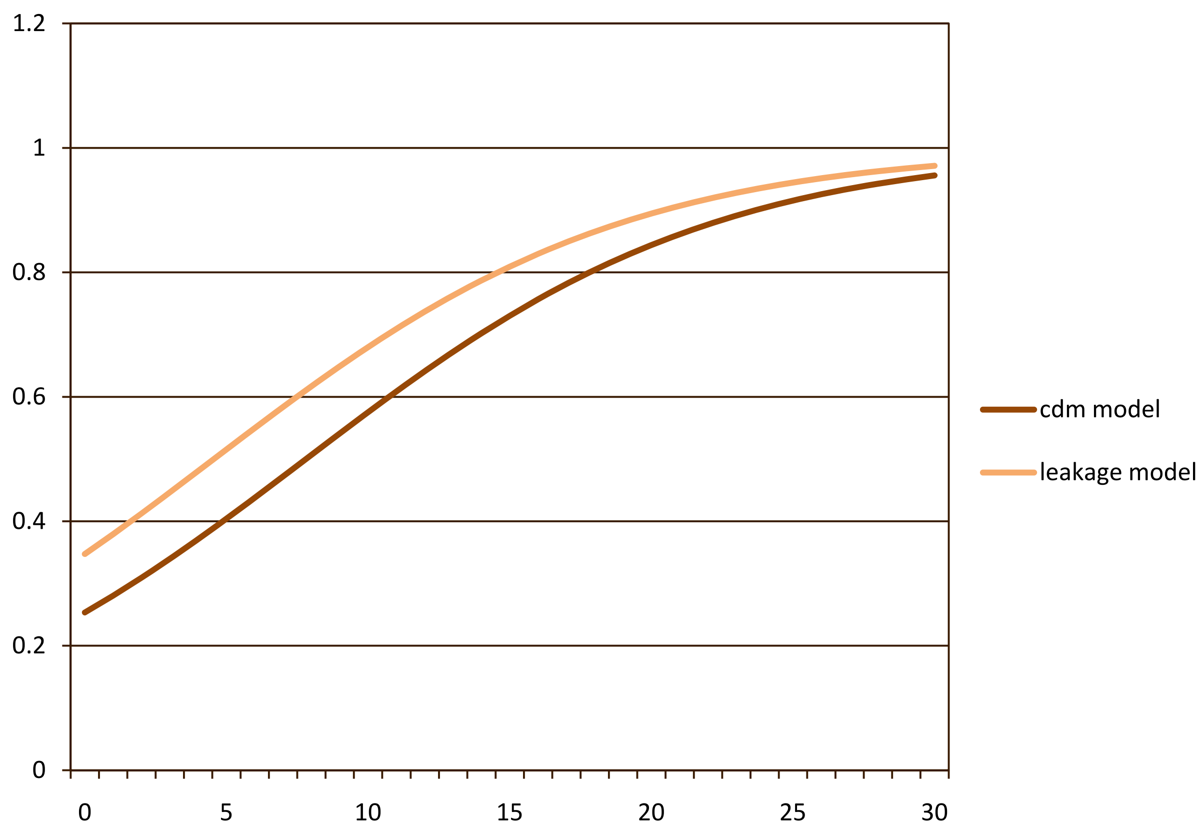


Figure 16. Plot of the leakage model compared to the cumulative deforestation model over time (years).

Section 10.4 Estimating the Leakage Factor and Emissions from Leakage

The estimated cumulative degradation and deforestation predicted by the leakage model is 0.343 which necessarily matches that observed in the leakage area for the first monitoring period. Since this is the first monitoring period and the leakage model was parameterized after the project start date, the leakage factor is zero. Likewise, for this monitoring period, the estimated emissions from leakage are zero.

During subsequent monitoring periods, the Leakage Plot Sampling teams will revisit the 38 two-square hectare plots and perform the same SOP to determine the Leakage Factor evident at that time, and that will be used to determine whether or not Leakage has occurred during that monitoring period, per the requirements of the MED.Leakage measured for each monitoring period will be applied to net emission reduction figures for that same period (i.e. adjustment for leakage is applied at the point of each verification event following the first, which is used to only determine the leakage lag factor).

Section 11 Quantification of NERs

Net Emissions Reductions (NERs) to date are quantified from the following components (tonnes CO2e) with 290,066 and 1,160,263 tonnes CO2e to buffer pool and issuance, respectively.

Component	Value
Estimated Baseline Emissions	1,450,329
Uncertainty Deduction	0
Project Emissions	0
Emissions from Leakage	0
Gross Total NERs	1,450,329
NERs to Buffer Pool (20%)	290,066
Net Total NERs	**1,160,263**

Table 7. Components of NER calculations, allocation to buffer pool and total NERs to date.

Section 11.1 Determining Deductions for Uncertainty

Given the calculated, weighted quadratic average using equation 36, no confidence deduction is applied, as total uncertainty falls below 0.15. The weighted quadratic average of quantified uncertainty, per equation 36, is

$$U^{[m]} = \sqrt{\left[C_{TOTAL}^{[1]} U_{DF}^{2} + C_{TOTAL}^{[1]} \left(U_{TOTAL}^{[1]}\right)^{2} + C_{SOIL}^{[1]} U_{SCL}^{2}\right] \left(2C_{TOTAL}^{[1]} + C_{SOIL}^{[1]}\right)^{-1}}$$

$$U^{[m]} = \sqrt{\frac{[2624568.9 \cdot 0.05941298^{2} + 2624568.9 \cdot 0.0851^{2} + 11842347.78 \cdot 0.1391^{2}]}{(2 \cdot 2624568.9) + 11842347.78}}$$

$$\boldsymbol{U^{[m]} = 0.124}$$

where the inputs are presented below.

Variable	Description	Value
$\boldsymbol{C_{TOTAL}^{[1]}}$	Total forest carbon stock at monitoring period [1]	2,624,568.9
$\boldsymbol{C_{SOIL}^{[1]}}$	Soil carbon stock within the project area at monitoring period [1]	1,1842,347.8
$\boldsymbol{U_{DF}}$	Estimated uncertainty in the CDM at monitoring period [1]	0.05941298
$\boldsymbol{U_{TOTAL}^{[1]}}$	Estimated uncertainty of total carbon stocks at monitoring period [1]	0.0851
$\boldsymbol{U_{SCL}}$	Estimated uncertainty in the soil carbon model at monitoring period [1]	0.1391

Table 8. Variables and values used to calculate the weighted quadratic average of uncertainty.

Section 11.3 Ex-Ante Estimation of NERs

Baseline emissions were projected over the life of the project to estimate net carbon benefit. An ex-ante estimate of the total *gross* NERs generated by the project is 7,542,945 tonnes CO2e.

The project activities described in detail in Section 10 Leakage and Section 6.1 Baseline Scenario Overview, were specifically designed to mitigate deforestation and human-wildlife conflict, and therefore by default serve to mitigate leakage and uphold project permanence. Wildlife Works is of the opinion that the project will suffer little to no leakage, due to our exceptional attention to leakage mitigation. However, in the absence of precedent for estimating ex-ante leakage emissions, Wildlife Works chose to use a conservative value of 20%. Applying this factor to gross NERs yields an estimate of total gross NERs over the project lifetime of:

$$\text{GROSS ex} - \text{ante NERs} = 7{,}542{,}945 - (7{,}542{,}945 * 0.20)$$

$$\text{GROSS ex} - \text{ante NERs} = 6{,}034{,}356$$

This analysis is available as a spreadsheet and accounts for an estimate of 20% leakage from 2011 onwards, according to the MED. It includes project emissions and a total confidence deduction. A chart of the projected NERs over the life of the project is presented below. Actual leakage values will be measured empirically at each monitoring period, and will vary from these conservative ex-ante estimates.

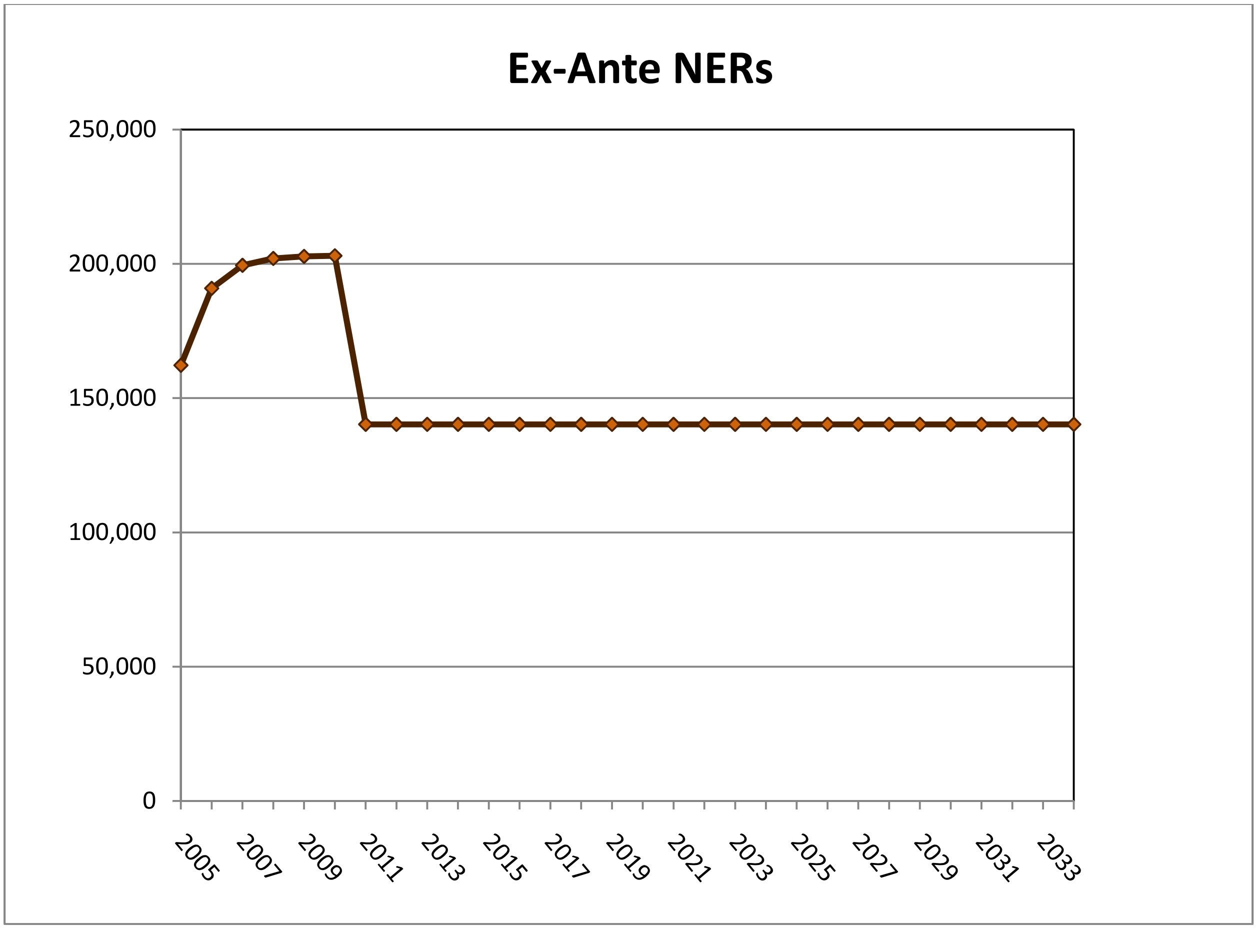


Figure 17. Ex-Ante Calculation of NERs for the Project lifetime.

Section 13 Monitoring

Please also refer to the document entitled 'Section 13 Monitoring' (01/14/2011)

Section 13.14 Monitoring of Carbon Stocks in the Project Area

Summary of sampling procedures

(See Standard Operating Procedure Biomass, 1/10/2011 and Standard Operating Procedure Soils, 1/1/2011 provided to the Validator for detailed procedures)

Rukinga Sanctuary is 30,169 hectares of varying density Acacia-Commiphora woodland/forest located in the SE of Kenya. Altitudes on the sanctuary range from approximately 450m to 1,000m and the ecosystem encompasses montane forest on the slopes of the higher elevations, through Acacia-Commiphora dryland forest at mid elevations and down to grassland dominated savannah at the lowest elevations. In order to most accurately estimate the biomass of the sanctuary, with reasonable time and expense, we divided the sanctuary into three major strata based on ecosystem type, as there is a high perceived variation in average biomass across the three strata pools, with larger trees in high density in the montane forest strata, medium to large trees and lots of shrubs in the dryland forest strata and scattered trees, very few shrubs and heavy grass cover in the savannah grassland strata. Overall, we used 9 strata, summing to the total land area, to depict landcover in Rukinga.

In order to most accurately estimate biomass in the sanctuary, with reasonable time and expense, we divided the sanctuary into three major ecosystem types, as there is a high perceived variation in average biomass across these pools, with larger trees in high density in the montane forest strata, medium to large trees and lots of shrubs in the dryland forest strata and scattered trees, very few shrubs and heavy grass cover in the savannah grassland areas. We ultimately used 9 strata, summing to the total land area, to depict homogeneous patches of landcover in Rukinga.

It should be noted that our ex-ante monitoring was conducted in February and March 2009, the dry season in this area. We believe this will yield an extremely conservative biomass estimates, as the dominant tree species enter into estervation to preserve moisture. During this season, the trees lose all leaf mass, and the perennial grasses senesce. Wildlife Works executive management supervised the data collection teams at the initial plots, to ensure proper adherence to procedure.

It was determined that a systematic random plot sampling technique would best capture variability in landcover, due to the high degree of perceived variation of type and density of trees and shrubs. A systematic sampling method was used to overlay a 2km x 2km grid over the sanctuary and select sample plot centers at the center point of each square (see figure 18 below). The upper left corner of the grid was randomly positioned within its UTM 1km x 1km grid.

To sample soil, coordinates were provided to the soil plot sampling teams by our GIS team, at random forest plot locations, and they sampled using the method illustrated in the 'Standard Operating Procedure Soils' document provided to the validator. The following is an excerpt from the soil sampling procedure:

Step1 For a plot inside Rukinga, coordinates are provided to the soil plot sampling teams by our GIS team, at random plot locations. The plot teams use their GPS to find the plot center.

Step 2. A one meter square is marked out on the ground, and digging commences.

Step 3. The soil from the top 30cms is piled together and the larger lumps are smashed with the back of a hoe.

Step 4. Whilst the soil is being dug from the sample pit, the tailings are thoroughly mixed so that the various layers are interspersed.

Step 5. The lower layer taken from 31cm-100cm is then piled on the other side of the pit and it too is mixed thoroughly.

Step 6. A sample is then taken from each of the mixed piles, bagged, and sent to the independent testing lab – CROP NUTRITION SERVICES, Nairobi Kenya.

If outside Rukinga, the location and name of the farm and any comments are recorded on the bag and in the sampling notes, and Top Soil(0-30) and Sub Soil(31-100) are recorded for the respective samples. Care should be taken not to include any large rocks or roots or other obvious organic matter in the samples; mineral soil only.

Crop Nutrition Services performs standard bulk density and organic matter analysis of the soil samples and returns the results in excel spreadsheets. The Bulk Density method used by the outside laboratory (Crop Nutrition Services) that performed the soil testing for the PD is an official FAO methodology for measuring Bulk Density of disturbed soil samples. A copy of the FAO approved protocol was provided to the Validators.

Field training

Field training was conducted in February, 2009 for the first tree plot sampling team. This team consisted of;

- a local tree expert who was able to identify all the different acacia and commiphora species encountered in the sampling - Joel Mwandiga
- Mike Korchinsky – CEO Wildlife Works
- Rob Dodson – VP African Field Operations
- Mwololo Muasa a Wildlife Works employee who would be the permanent team lead and data recorder
- Three casuals to assist with carrying equipment into the field and marking the plots
- A driver
- A ranger for security

The Standard Operating Procedures for Biomass and Soils were produced following refinement of the field techniques by this initial team and two other teams have been trained using the procedure and by accompanying our permanent team on their work, to ensure consistency in method.

Documentation of data quality assessment such as the results from a check cruise

Quality Control (QC) for Biomass plots was conducting using the following protocol;

1. An independent QC team not involved in the original plot sampling of each plot is given coordinates for the plot centers for 5% of the original plots. The Independent QC team is also given blank plot data recording sheets, plot radius for each carbon pool, a copy of the plot sampling “Standard Operating Procedure – Biomass”, dbh tape, compass and long tape, and sent out to measure the plots as though they were doing it for the first time.

2. The QC team returns to headquarters with data sheets which are given to a third party analyst, who are neither on the original nor the QC plot team, for comparison against the original plot data sheets.

3. Any discrepancies are noted, and when all sheets have been compared, the two plot teams are brought together with the VP African Field Operations or his deputy the Operations Manager to discuss and explain any significant variances (±15%)

4. The monitoring team lead is informed if more than 1 QC plot contains significant discrepancies from the original data sheets, and further QC plots may be required to establish the extent of the quality errors.

5. The Monitoring Team Lead and/or senior carbon staff makes a determination as to whether a plot needs to be revisited:

   For a given plot, the number of trees that fall outside the ±15% threshold for change since original measurement is counted. If greater than 10% of trees in that plot fall outside the threshold, and QC has been performed on the plot within 1 year from original measurement, the plot must be re-measured. If QC has been performed on a plot greater than 1 year after original measurement, the threshold described above shall be relaxed to 15%.

Map Showing Strata Boundaries and Plot Locations

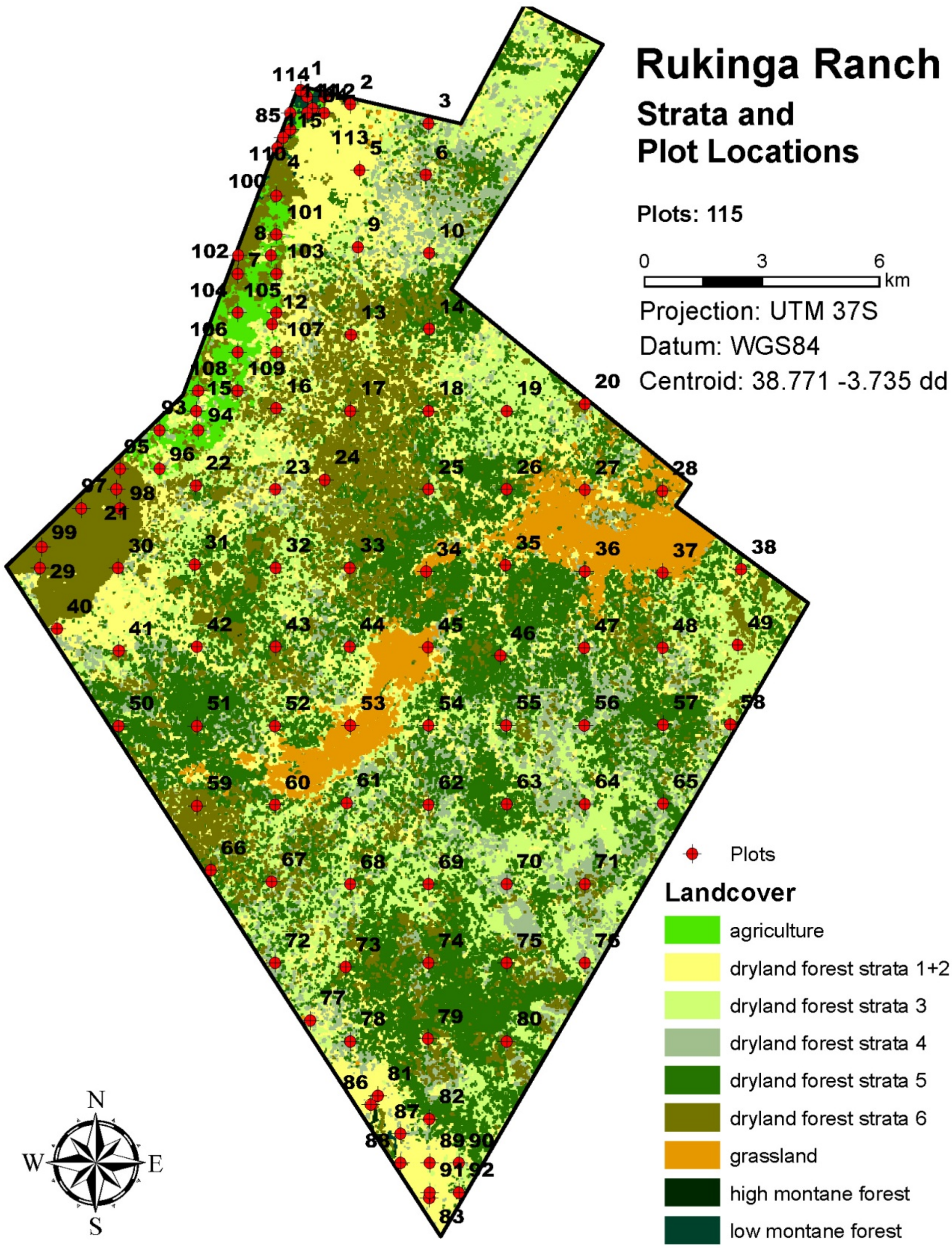
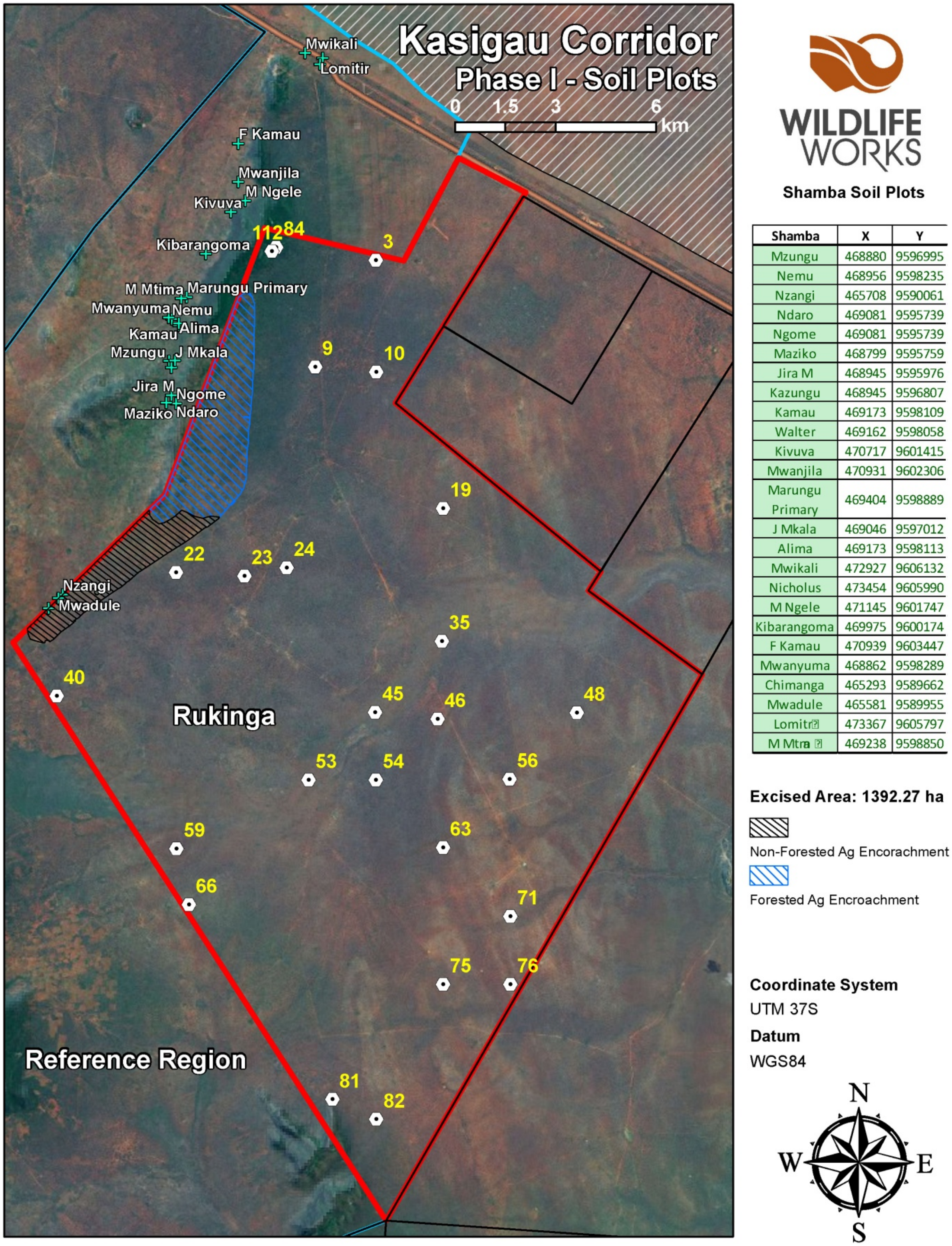


Figure 18. Stratification of the project area and carbon inventory plots



Shamba	X	Y
Mzungu	468880	9596995
Nemu	468956	9598235
Nzangi	465708	9590061
Ndaro	469081	9595739
Ngome	469081	9595739
Maziko	468799	9595759
Jira M	468945	9595976
Kazungu	468945	9596807
Kamau	469173	9598109
Walter	469162	9598058
Kivuva	470717	9601415
Mwanjila	470931	9602306
Marungu Primary	469404	9598889
J Mkala	469046	9597012
Alima	469173	9598113
Mwikali	472927	9606132
Nicholus	473454	9605990
M Ngele	471145	9601747
Kibarangoma	469975	9600174
F Kamau	470939	9603447
Mwanyuma	468862	9598289
Chimanga	465293	9589662
Mwadule	465581	9589955
Lomitr	473367	9605797
M Mtm	469238	9598850

Figure 18. Stratification of the project area and carbon inventory plots

List of Plot Coordinates

A list of plots and corresponding coordinates was provided to Validator, as it was determined to be inappropriately large for this document.

Description of Plot size

The following describe the biomass plots on Rukinga;

- 25m radius circle for large and small trees in Dryland Forest
- 8m radius circle for large and small trees in Montane Forest
- 15m radius circle for shrubs in Dryland forest
- 4m radius circle for shrubs in Montane Forest
- 1m x 1m x 4 square plots at each tree plot location for grasses

Documentation of Allometry

Living Trees

As this is the first project we have encountered calculating aboveground biomass for the species of tree found in Acacia-Commiphora woodland, there exist no allometric equations available for calculating ABB from DBH. As a result we were forced to develop our own method to determine appropriate allometry.

Select trees from dominant species found in repeated plots were harvested from test areas outside of the Project area, and cut into pieces and weighed, for a range of dbh equating to the dominant ranges of dbh found within the project area. This provided a wet weight total aboveground biomass for a range of tree sizes from 10cm to 50cm dbh. A green to dry weight ratio was used to convert to dry weights.

A graph of dbh vs. wet weight was then plotted, as described in the spreadsheet 'AllometricFormulasPower, 01/14/2011 ' provided to the validator.

Shrubs

For dominant shrub species a test plot was created from which two separate methods were produced;

For shrubs/small trees that can become very large, e.g. Cordia, Acacia ruficiens where the shrub is multi stemmed from the ground, with between 2 and 15 stems, average stem diameter was calculated for a range of shrub sizes, by measuring all the stem diameters on the shrub and dividing by number of stems, and then harvesting, bundling and weighing one representative stem of the average diameter from each size class. These classes are small, medium, and large, providing a standard stem weight by shrub size class. The number of stems and size class for each shrub in the sample plot were then recorded, and a shrub total aboveground biomass determined from multiplying the number of stems by the stem weight for that class.

For Grewia, and others where the shrub has many stems, and is non-uniform in distribution of biomass per stem, conservative weight averages were obtained for each size class through destructive harvesting, which was then applied to live sample plots without destructive harvesting requirements. A green to dry weight ratio was then used to convert to dry weights.

Shrub Species	Size Class (S/M/L)	Crown Diameter Range	Crown Height Range	Average Stem Diameter (cm)	Standard Weight/Weight/stem (kg)
Cordia sinensis	S				3
Cordia sinensis	M				15
Cordia sinensis	L				33
Grewia sp.	S	<1m	<1m		1.5
Grewia sp.	M	>1m <2m	>1m <2m		4.3
Grewia sp.	L	>2m	>2m		9
Acacia ruficiens	S			5	23
Acacia ruficiens	M			9	43
Acacia ruficiens	L			12	131

Table 9. List of dominant shrub species and standard weights

Development of Allometry

The allometric equations for the project area, based on the aforementioned, field-collected destructive harvest data, were produced for Wildlife Works by Ryan Anderson of EcoPartners. These equations predict green weight(kg) as a function of DBH(cm), based on the data provided by Wildlife Works in the "AllometricFormulasEXP" spreadsheet. All equations have the form :

$$Biomass = a[DBH]^b$$

The evaluation of goodness of fit is based on a cross-validation statistic, not R^2. We reporting R^2 as well because people are used to seeing it, but we believe the cross validation statistic is a better indicator of fit.

Destructive harvest in a wildlife conservation area is philosophically problematic, especially for trees of large diameter which are many decades if not hundreds of years old. As a result we harvested only a few trees at large diameter. A consequence of this sample size is a tendency for the few large trees we sampled to have an overly large influence on the shape of the regression curve. When only one or two large trees are sampled, and they exhibit biomass much larger than the smaller trees, regression fit by least squares tends to be highly influenced by those trees. This tends to lead to over estimation of biomass for the smaller trees. For model fitting reasons, it is additionally problematic because (a) the uncertainty in measuring the mass of a large tree is larger than a small, easily weighed tree, and (b) the diameter-biomass relationship for large trees is inherently more variable than it is for small trees. The consequence is that the model is heavily influenced by a few points whose response variable values are known with little certainty.

To deal with the highly influential large points that have large variance, we used a weighted regression. A discussion of this technique should be in any regression text, but we used "Applied Regression Including Computing and Graphics" (Cook and Weisber g 1999, Wiley and Sons). The idea is that higher weight in fitting the model should be given to those points that are known with greater certainty. We evaluated weights individually for each model, and only used them in cases where the model residuals demonstrated strong trends in variance. Weights were assumed to be proportional to either 1/BA or $1/BA^2$, where BA is basal area. In one unusual case (*Lannea alata*), the variance appeared higher for small trees than large trees, so we weighted this regression with weights proportional to DBH. We note that the weighting considerably reduced the cross-validated estimate of bias ($\bar{E}$).

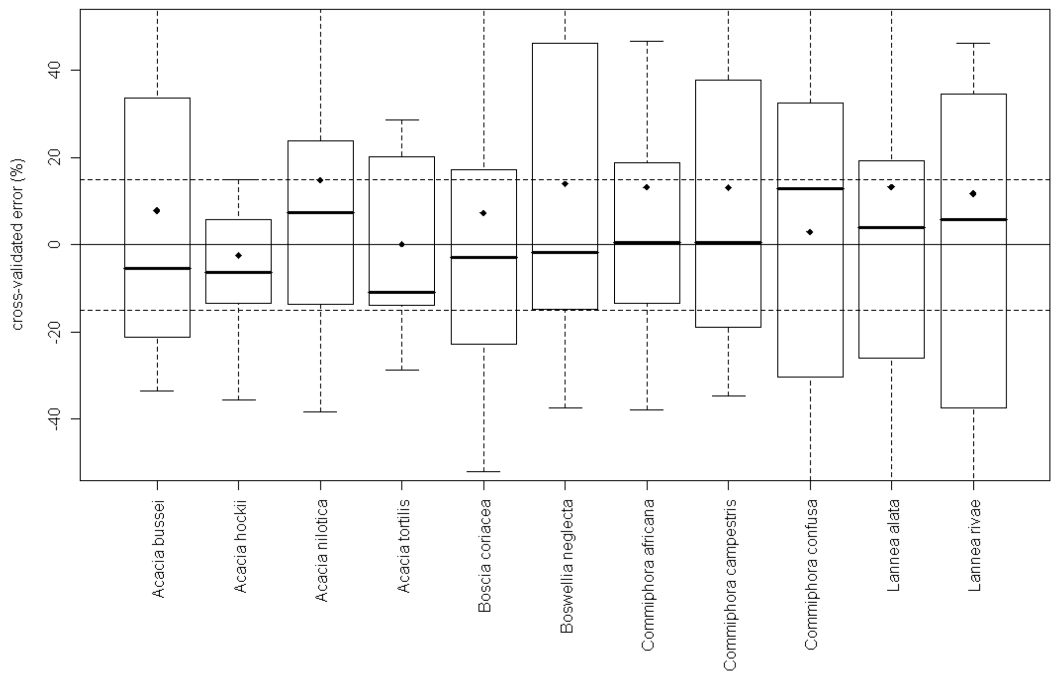
Coefficients for each equation are below:

Species	Weight Type	a	b	N	Max DBH	R^2	$\bar{E}$
Acacia bussei	None	3.3796	1.6416	8	18	.80	7.82
Acacia hockii	None	0.6850	2.1820	17	23	.93	-2.46
Acacia nilotica	None	1.3615	1.9513	10	23	.86	14.83
Acacia tortilis	None	2.6060	1.6175	9	20	.85	0.13
Boscia coriacea	1/BA	0.2033	2.3647	15	34.2	.77	7.30
Boswellia neglecta	$1/BA^2$	1.3025	1.8332	18	37	.40	13.87
Commiphora africana	$1/BA^2$	0.6293	1.9456	17	24	.75	13.17
Commiphora campestris	$1/BA^2$	0.06774	2.8156	17	40	.83	13.072
Commiphora confusa	None	0.1147	2.6634	18	23	.77	2.912
Lannea alata	DBH	0.5603	2.1027	17	17	.85	13.216
Lannea rivae	None	0.1488	2.6421	22	16	.54	11.7
Acacia sp.	None	1.1421	1.9954	44	23	.85	1.99
Boscia sp.	1/BA	0.2033	2.3647	15	34.2	.77	7.30
Boswellia sp.	$1/BA^2$	1.3025	1.8332	18	37	.40	13.87
Commiphora sp.	1/BA	0.10527	2.66544	52	40	.87	11.26
Lannea sp.	None	0.3288	2.3233	39	17	.62	11.18
All species (<35 cm DBH)	None	0.3411	2.3016	166	34.2	.74	9.50

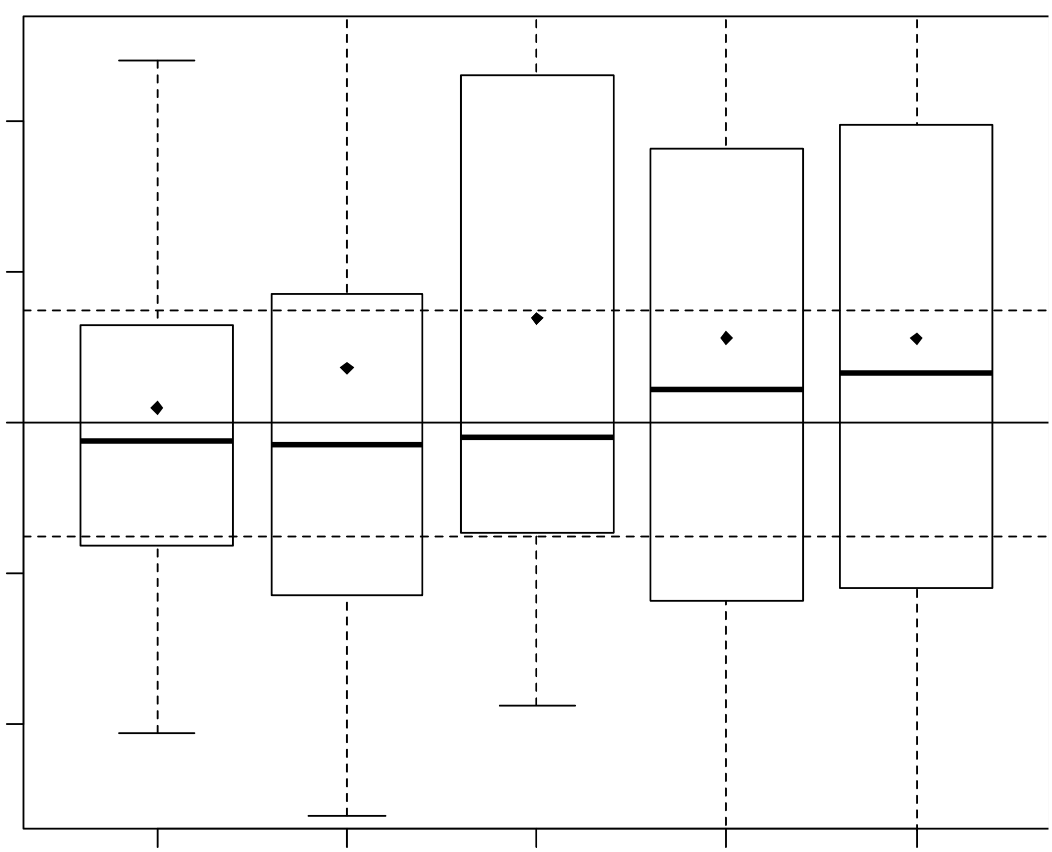
Table 10. Accuracy allometry coefficients for dominant species in Rukinga.

A summary of the cross validation statistics for species appears below. The black diamond is the mean cross validated residual, expressed as a percent. The boxplots show the quartiles (.25, median, .75), and maximum of the cross-validated residuals. The dashed lines indicate +/- 15%, the bias threshold allowed by the MED.

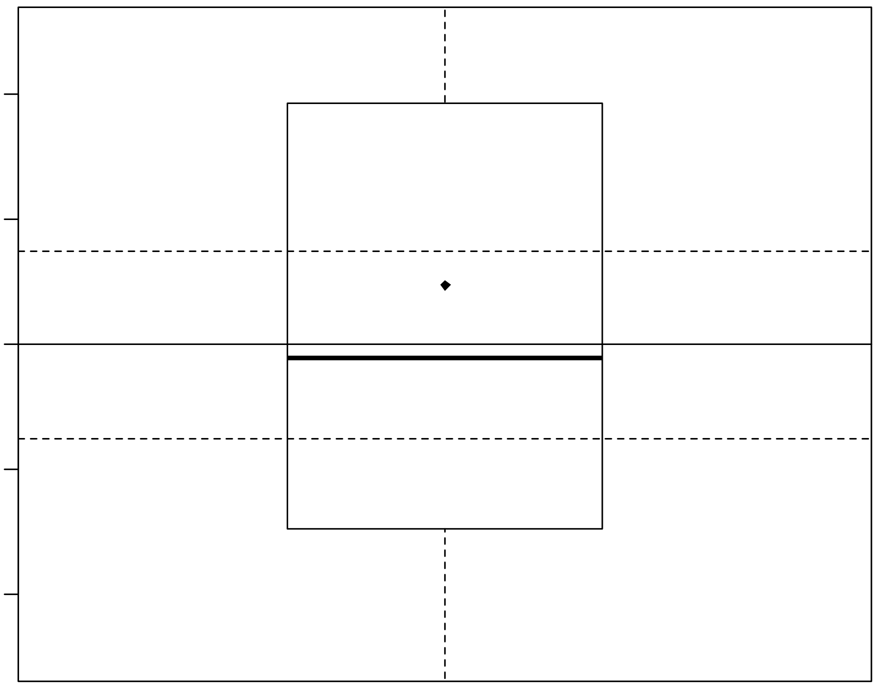
Species level:



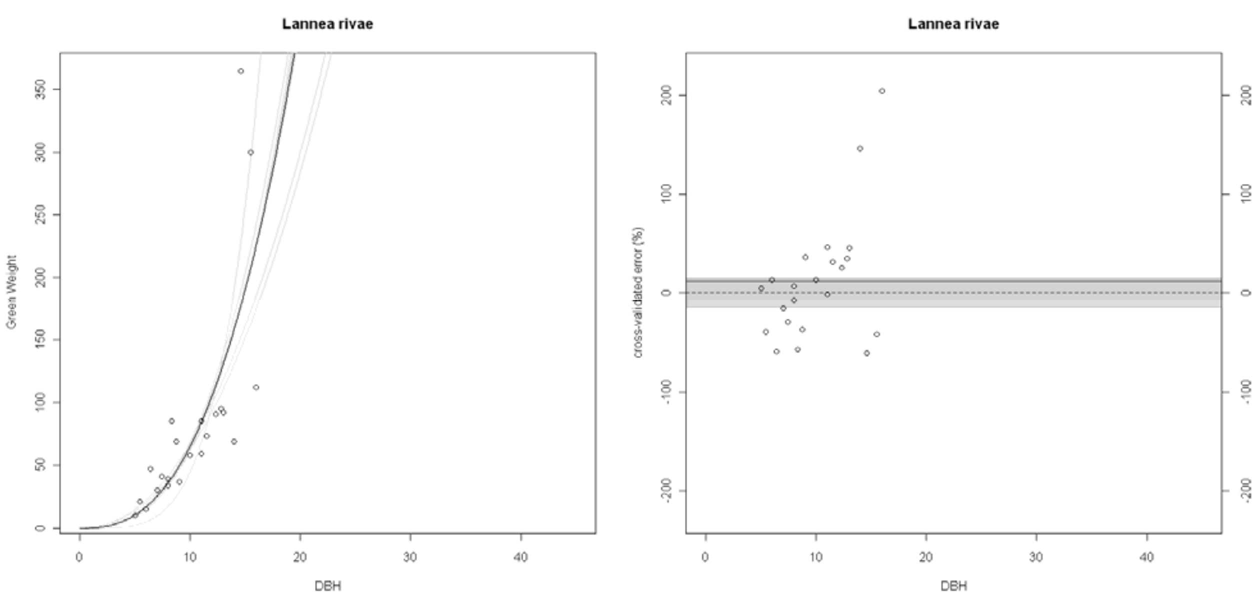
Genus Level:

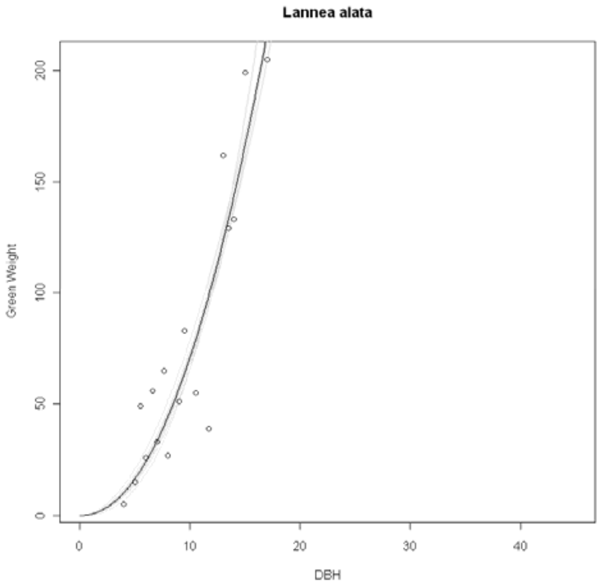


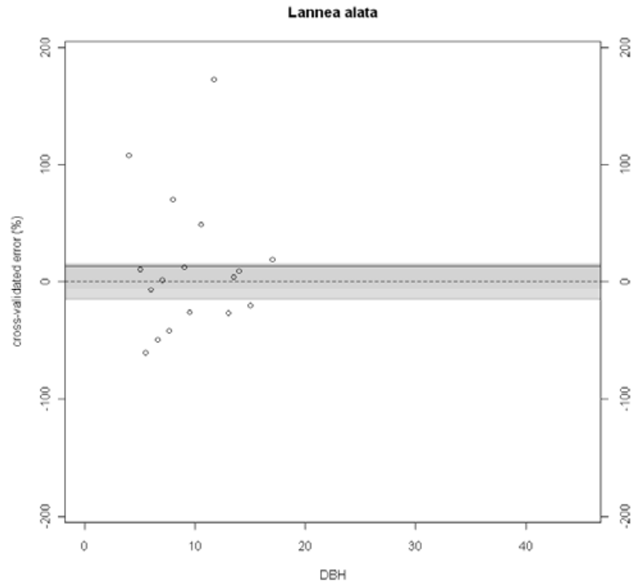
All species combined (<35 cm):

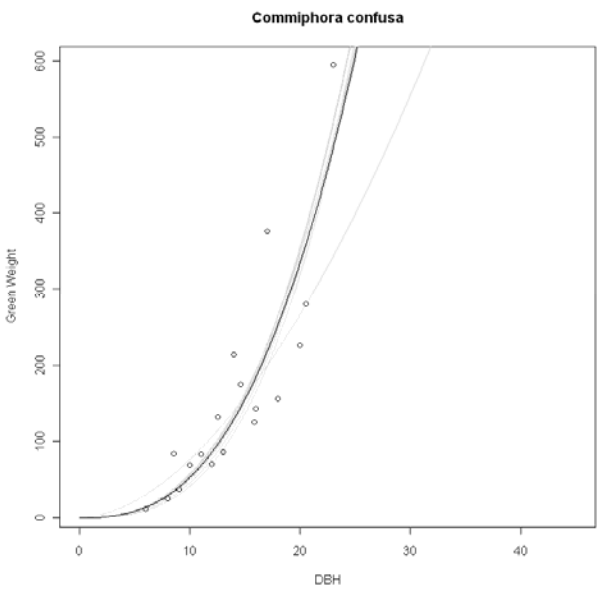


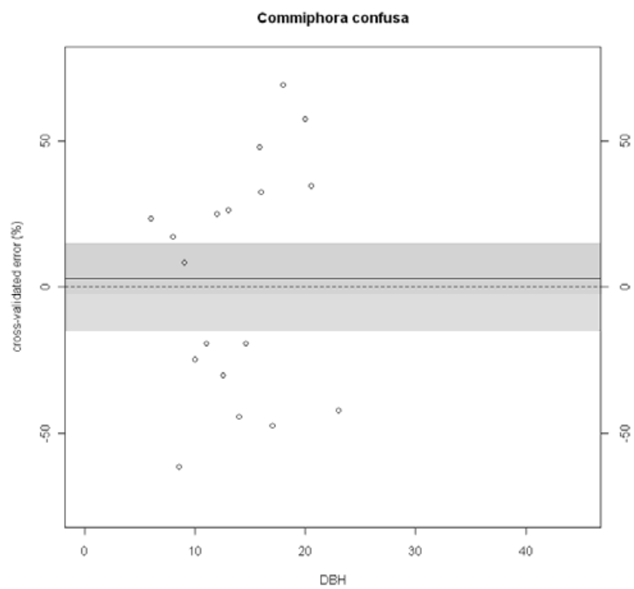
The figures below show the fitted model plotted for each species and the cross validated residuals plotted as a function of DBH. In the plot of fitted models, light grey curves show the f(-i) models fit during cross validation.

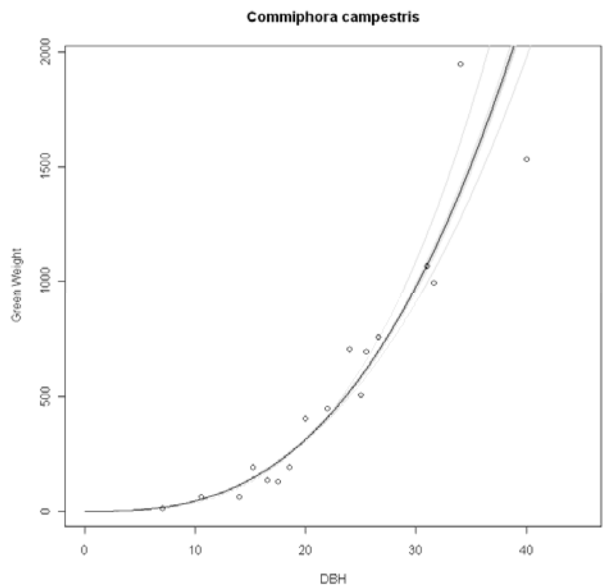


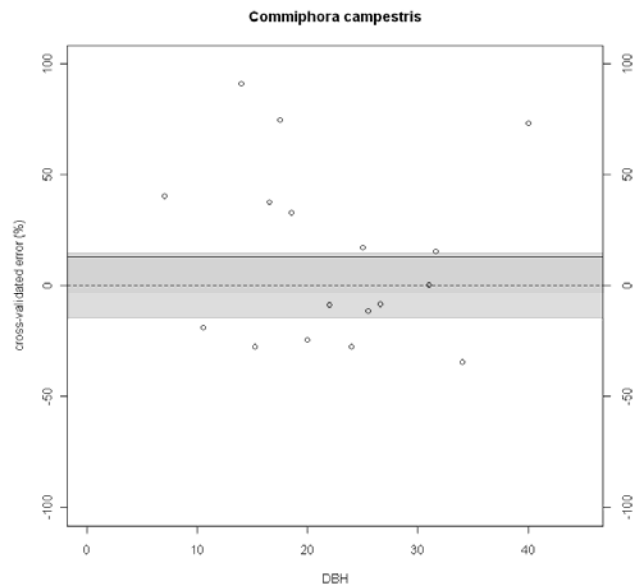

Lannea alata
Green Weight
0
50
100
150
200
0
10
20
30
40
DBH

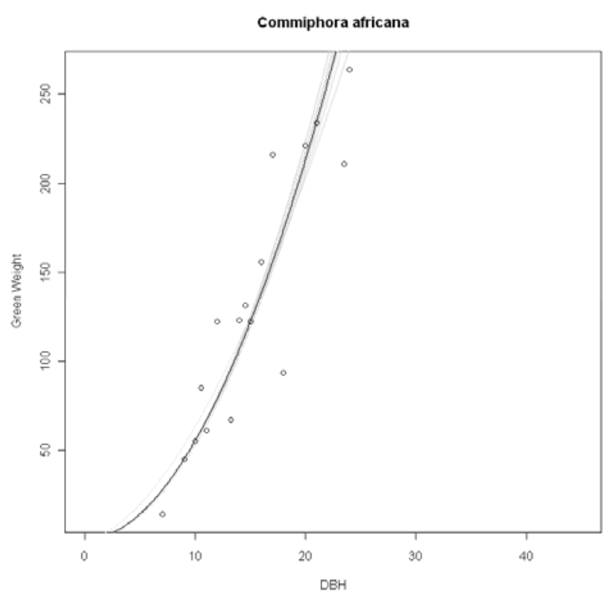

Lannea alata
cross-validated error (%)
-200
-100
0
100
200
0
10
20
30
40
DBH

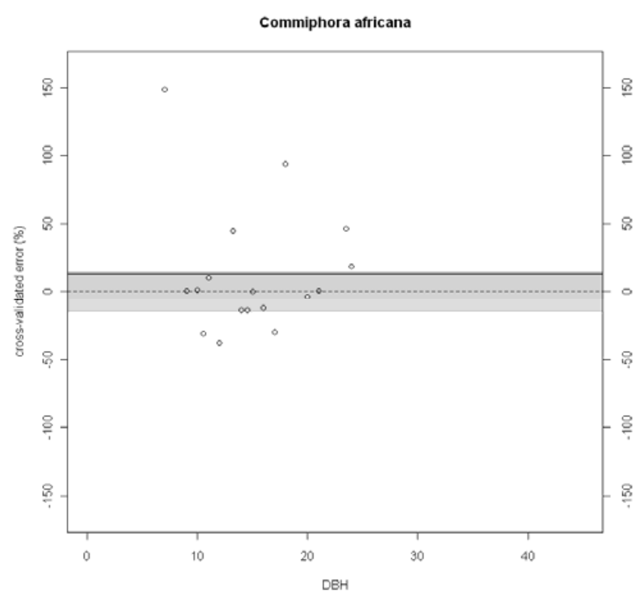

Commiphora confusa
Green Weight
0
100
200
300
400
500
600
0
10
20
30
40
DBH

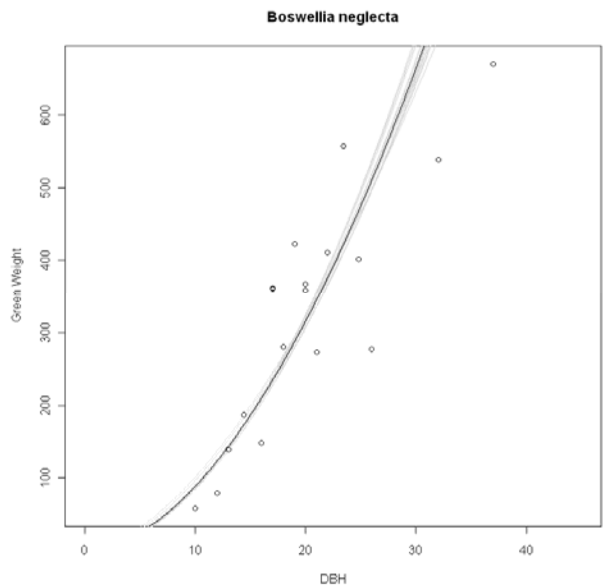

Commiphora confusa
cross-validated error (%)
-50
0
50
0
10
20
30
40
DBH

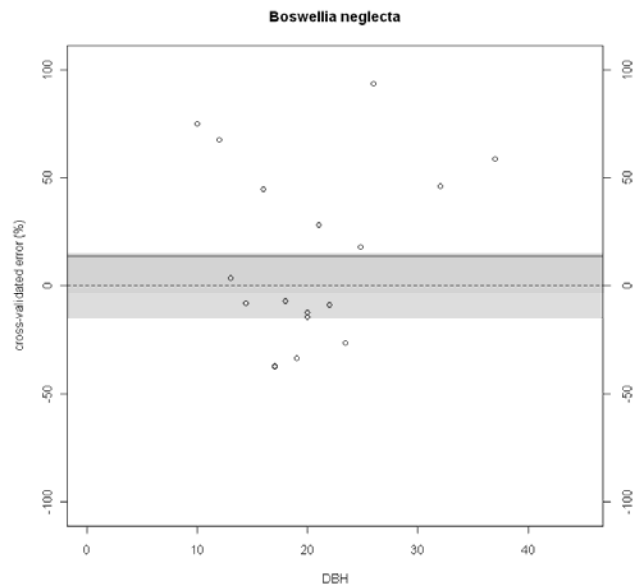

Commiphora campestris
Green Weight
DBH

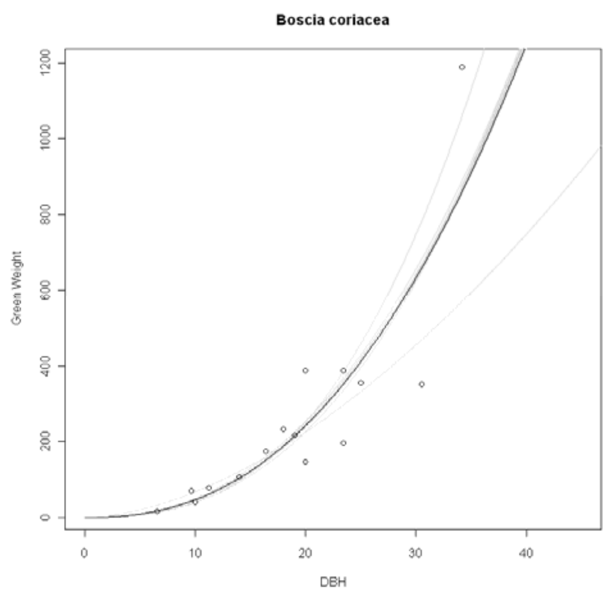

Commiphora campestris
cross-validated error (%)
DBH

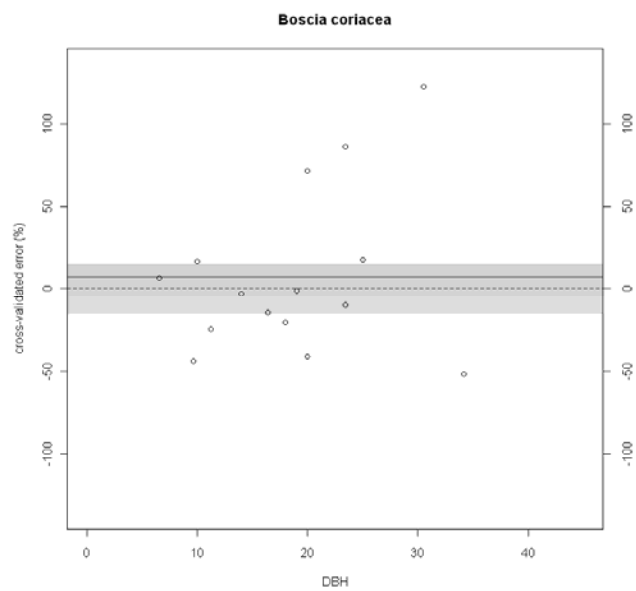

Commiphora africana
Green Weight
DBH

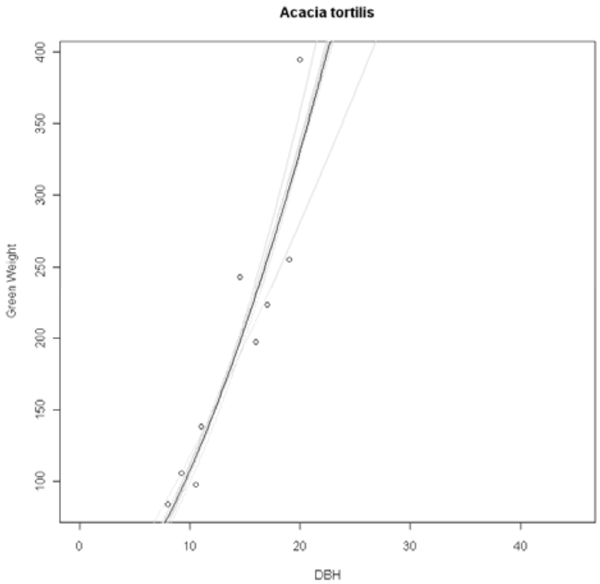

Commiphora africana
cross-validated error (%)
DBH

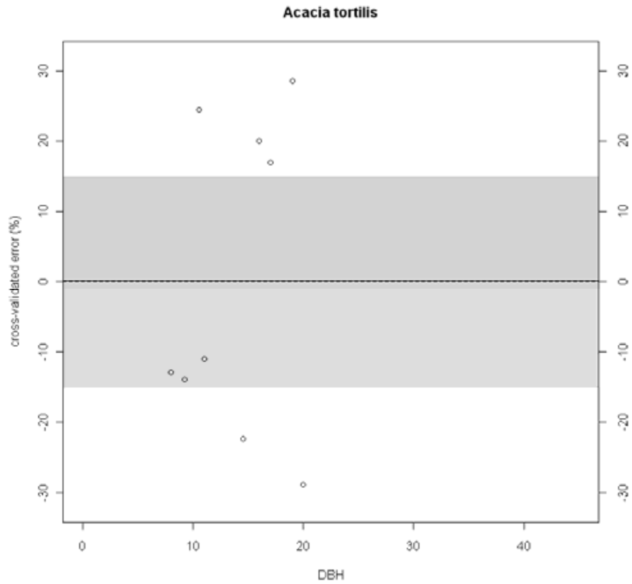

Boswellia neglecta
Green Weight
DBH

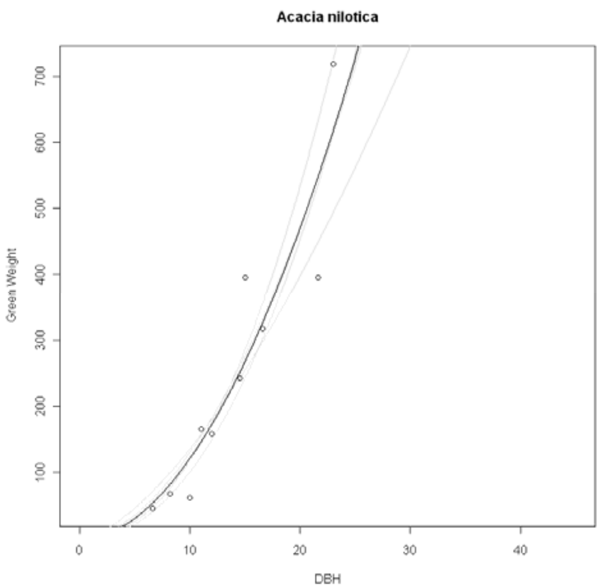

Boswellia neglecta
cross-validated error (%)
DBH

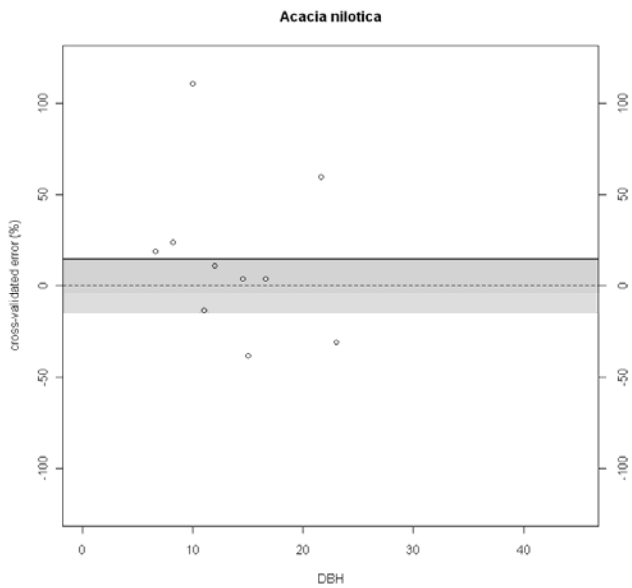

Boscia coriacea
Green Weight
DBH

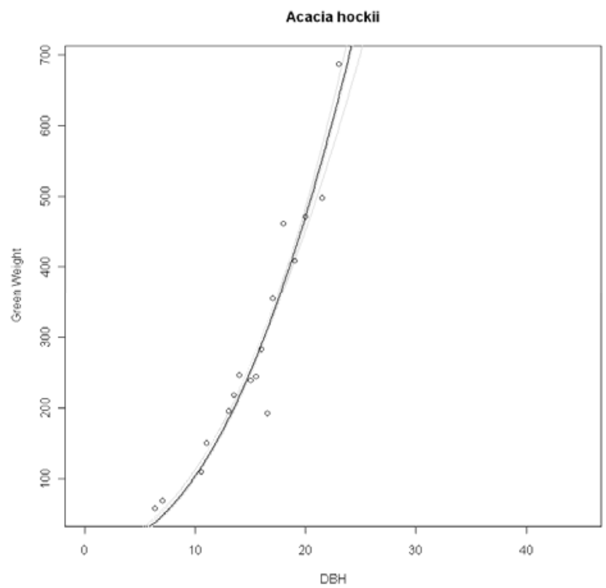

Boscia coriacea
cross-validated error (%)
DBH

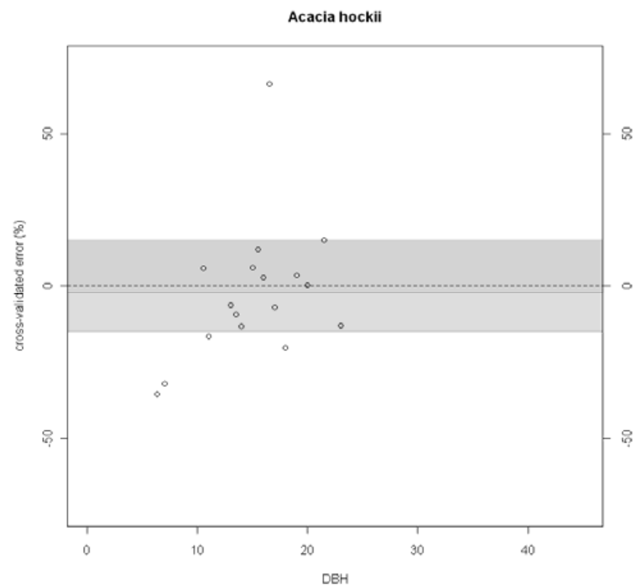

Acacia tortilis
Green Weight
400
350
300
250
200
150
100
0
10
20
30
40
DBH

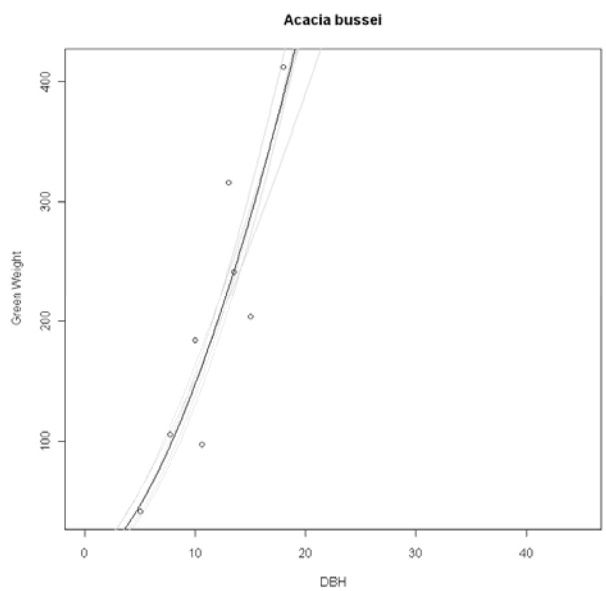

Acacia tortilis
cross-validated error (%)
30
20
10
0
-10
-20
-30
0
10
20
30
40
DBH

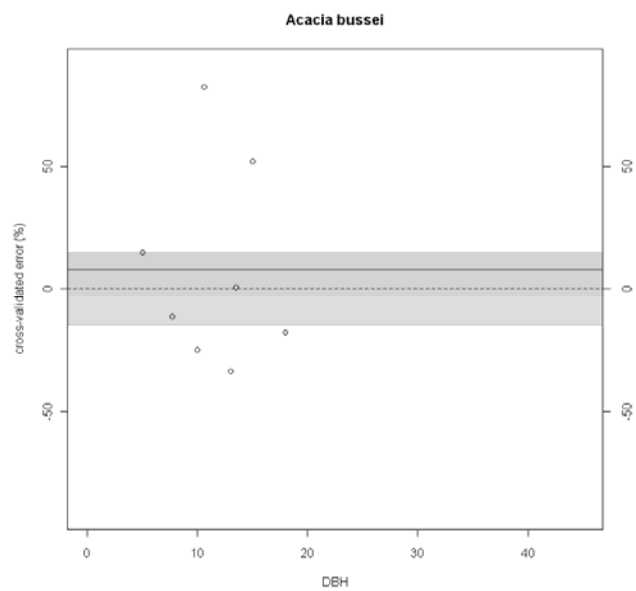

Acacia nilotica
Green Weight
700
600
500
400
300
200
100
0
10
20
30
40
DBH


Acacia nilotica
cross-validated error (%)
100
50
0
-50
-100
0
10
20
30
40
DBH

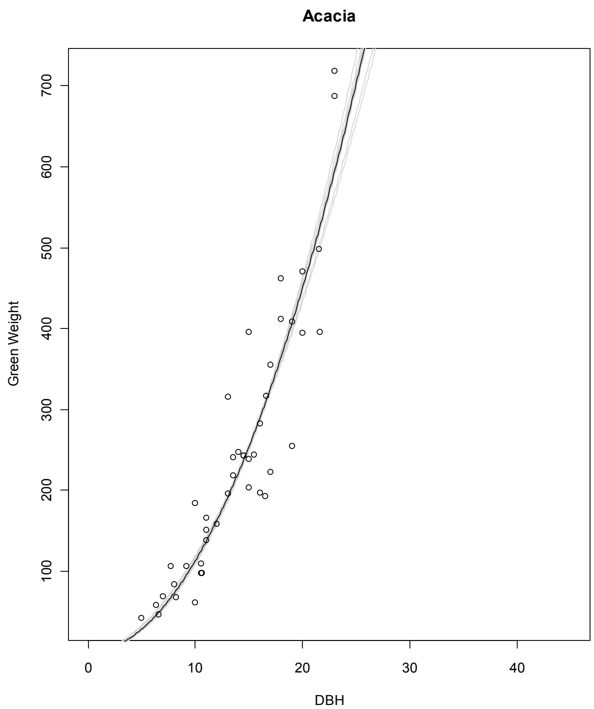

Acacia hockii
Green Weight
DBH

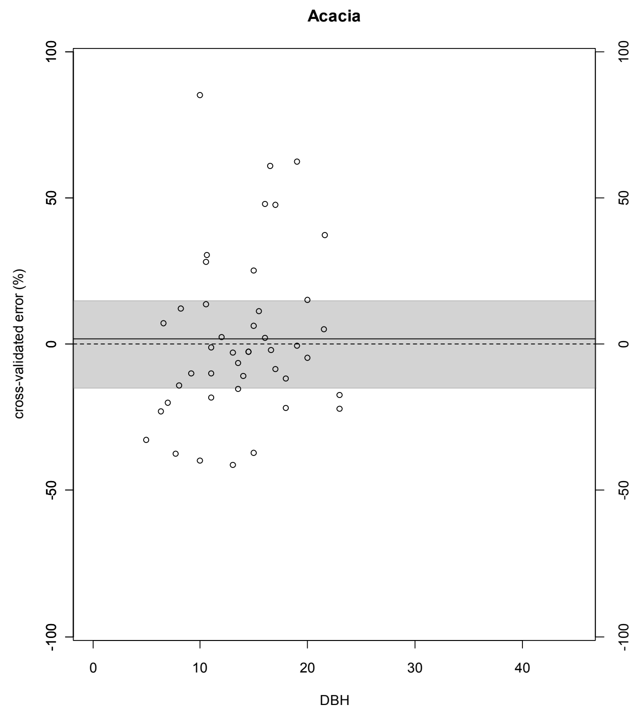

Acacia hockii
cross-validated error (%)
DBH


Acacia bussei
Green Weight
DBH


Acacia bussei
cross-validated error (%)
DBH

Genus Level:


Acacia
Green Weight
DBH
0 10 20 30 40
100 200 300 400 500 600 700


Acacia
cross-validated error (%)
DBH
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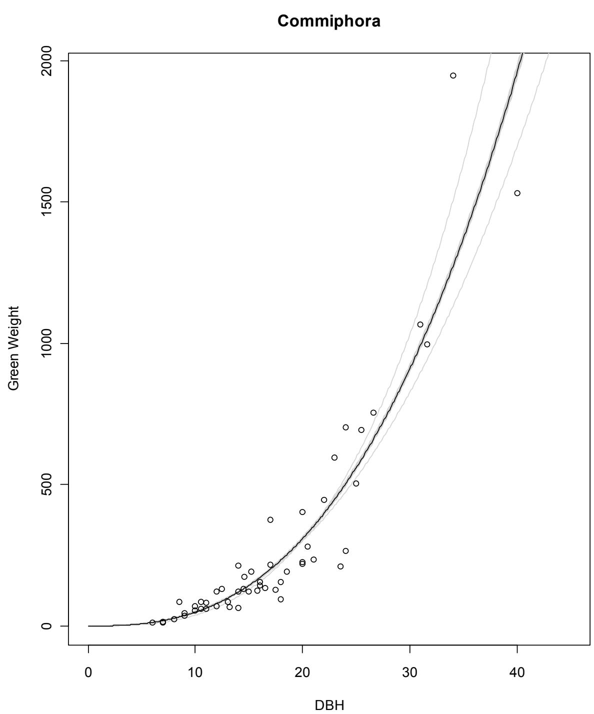
-100 -50 0 50 100


Commiphora
Green Weight
DBH
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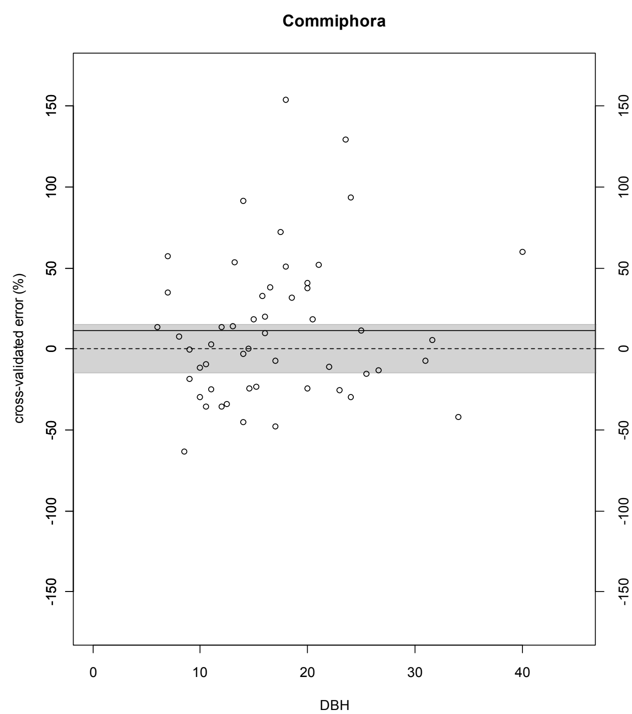
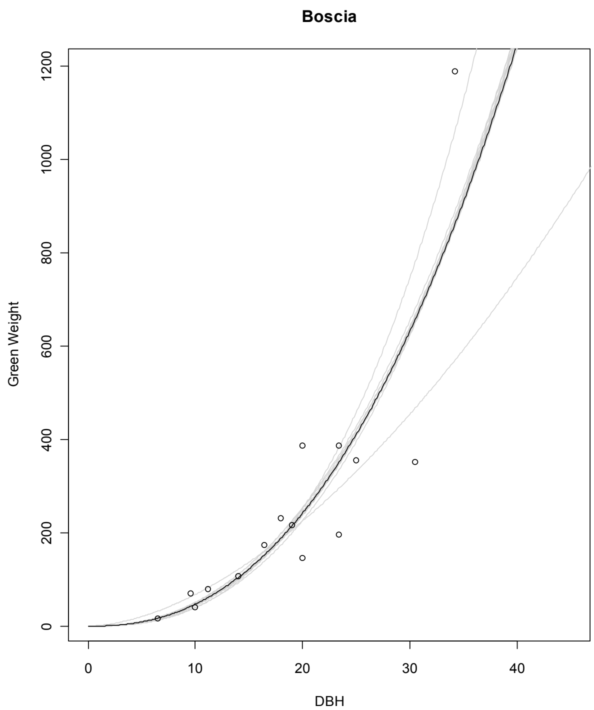
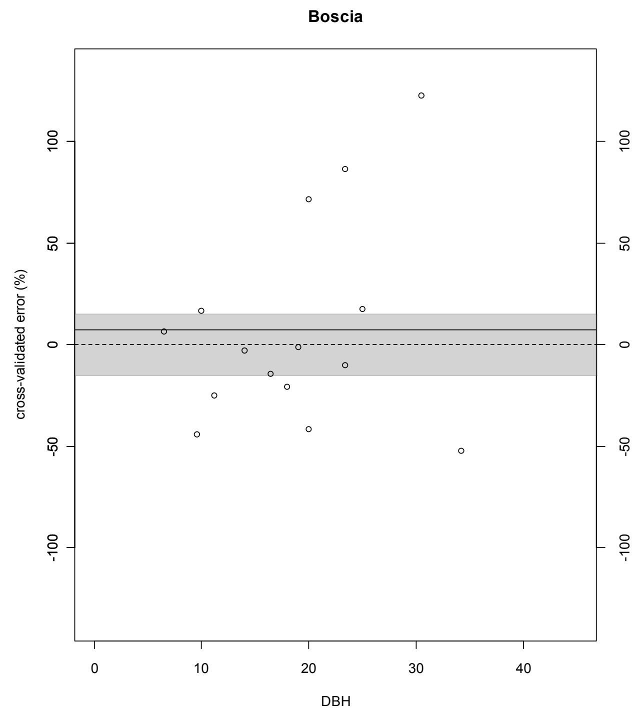
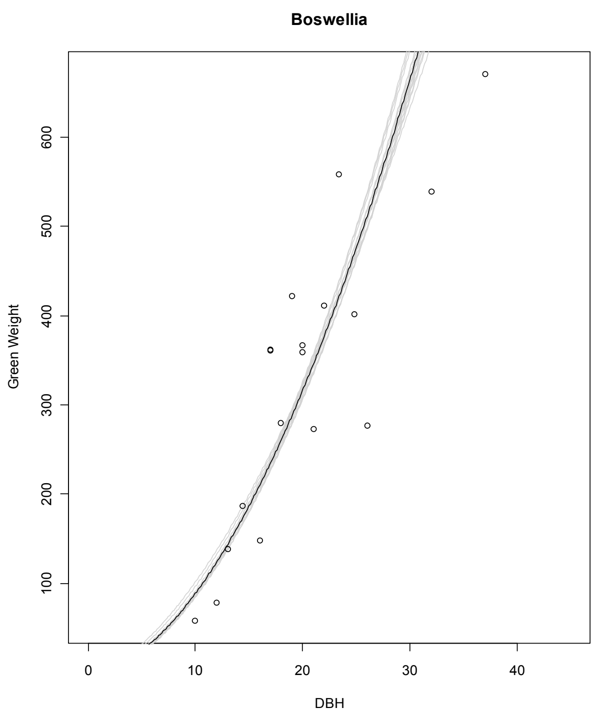
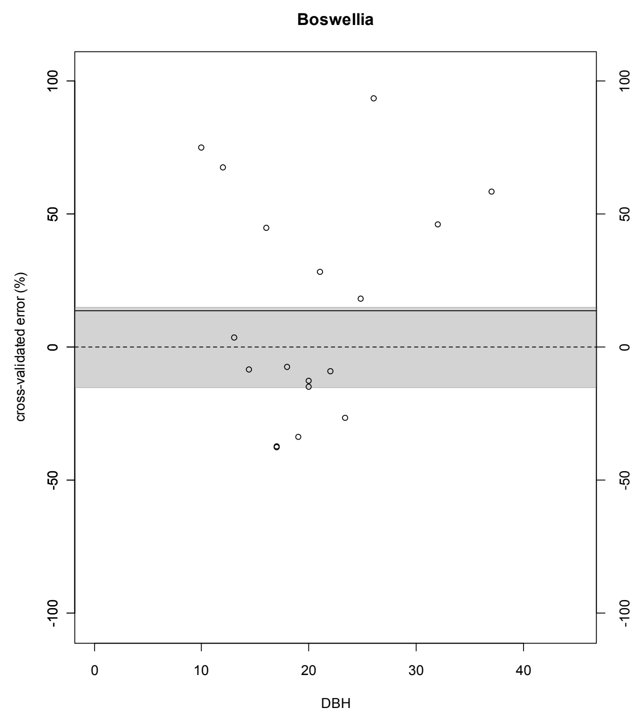
0 500 1000 1500 2000

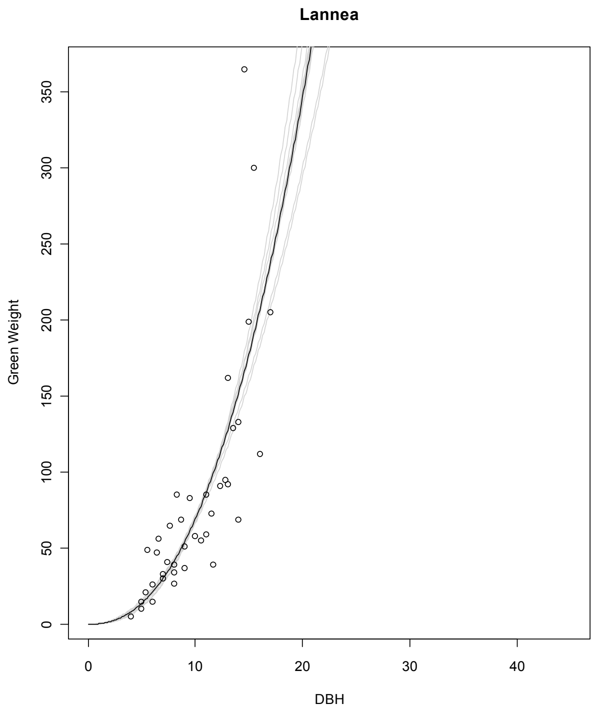

Commiphora
cross-validated error (%)
DBH
0 10 20 30 40
-150 -100 -50 0 50 100 150

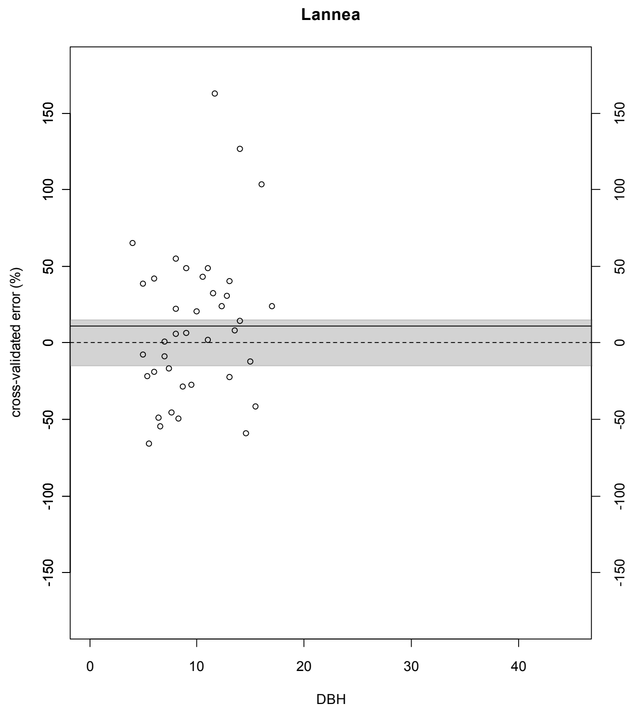

Boscia
Green Weight
0
200
400
600
800
1000
1200
0
10
20
30
40
DBH

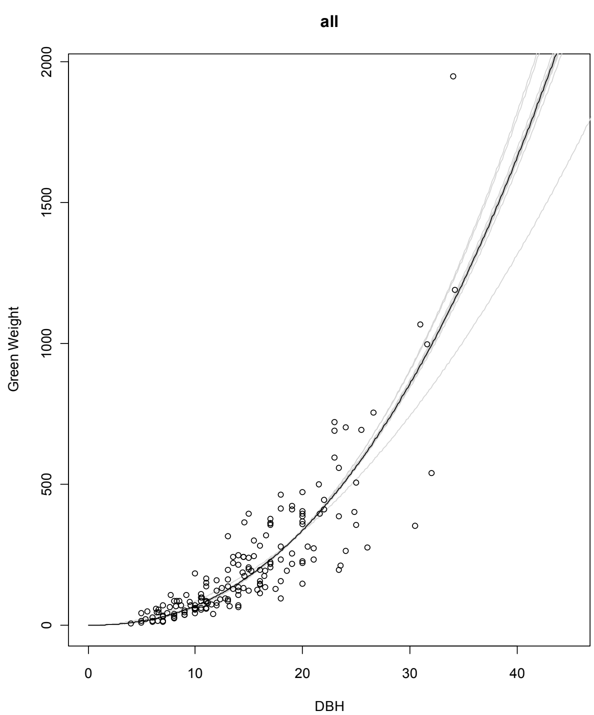

Boscia
cross-validated error (%)
-100
-50
0
50
100
0
10
20
30
40
DBH

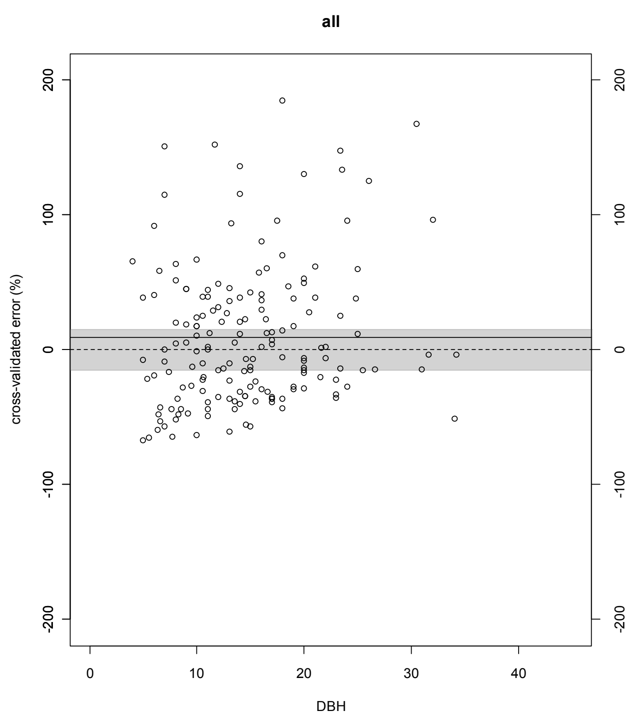

Boswellia
Green Weight
100
200
300
400
500
600
0
10
20
30
40
DBH


Boswellia
cross-validated error (%)
-100
-50
0
50
100
0
10
20
30
40
DBH


Lannea
Green Weight
DBH
0
50
100
150
200
250
300
350
0
10
20
30
40


Lannea
cross-validated error (%)
DBH
-150
-100
-50
0
50
100
150
0
10
20
30
40


all
Green Weight
DBH
0
500
1000
1500
2000
0
10
20
30
40


all
cross-validated error (%)
DBH
-200
-100
0
100
200
0
10
20
30
40

Estimated Total Carbon Stock, Standard Error and Sample Size for each Stratum and Pool

The estimated total carbon stock, standard error and sample size for each stratum and each carbon pool is shown in the table below. This summary is based on the exhaustive field sampling procedures explained in '*Standard Operating Procedure Biomass, 01/11/2011*' and '*Standard Operating Procedure Soils, 01/02/2011*'.

Stratum	n	Area (ha)	Trees Carbon Mean (tCO^2e / ha)	Shrubs Carbon Mean (tCO^2e / ha)	Herbaceous Carbon Mean (tCO^2e / ha)	Total Strata Mean (tCO^2e / ha)	Total Strata Carbon Stock (t C02-e)
ag active	12	713.7	67.98	23.08	2.88	172.24	122,925.5
dryland forest strata 1+2	26	6883.6	39.98	8.48	1.41	91.42	629,289.1
dryland forest strata 3	16	5651.1	40.75	2.45	0.99	81.01	457,776.5
dryland forest strata 4	11	2773.4	47.51	3.04	0.77	94.09	260,949.1
dryland forest strata 5	18	8133.4	46.23	2.30	2.14	92.89	755,520.4
dryland forest strata 6	23	4345.5	35.87	7.26	2.36	83.39	362,368.4
grassland	4	1610.9	3.05	1.40	4.85	17.06	27,474.3
montane forest	3	57.1	45.56	33.45	0.00	144.86	8,265.6
Total:		**30,168.66**					**2,624,568.9**

Table 11. Total carbon stocks for trees, shrubs and herbaceous material for Rukinga Ranch

A detailed biometric database containing all carbon pool measurements for all plots for the project are available to the validators for perusal upon request in the '*Rukinga Carbon Trees Shrubs Grass v7, 01/14/2011*' carbon pool database.

Standard errors of the total for each stratum is listed in the table below:

Strata	Sample Size	Mean Stock	Variance	FPC	FPC * a^2 * var / n	Standard Error
ag active	12	172.24	106559.66	0.997	4508238095.9	67143.41
dryland forest strata 1+2	26	91.42	4726.31	0.999	8607012582.3	92773.99
dryland forest strata 3	16	81.01	1348.43	0.999	2689881737.7	51864.07
dryland forest strata 4	11	94.09	1132.37	0.999	791212498.2	28128.5
dryland forest strata 5	18	92.89	752.86	1.000	2765646392.8	52589.41
dryland forest strata 6	23	83.39	3772.49	0.999	3094010378.6	55623.83
grassland	4	17.06	18.72	1.000	12139791.7	3484.22
montane forest	3	144.86	13667.31	0.990	14679751.0	3831.416

Table 12. Standard Errors for each stratum for all carbon pools for Rukinga Ranch

Trees, shrubs, grass (forest)	
Standard Error	149942.73
95% interval	293887.74
Error percentage	**11.20%**

Table 13. Combined standard error percentage for trees, shrubs and grass

A detailed standard error analysis for each carbon pool by stratum is available in the database '*Rukinga Carbon Trees Shrubs Grass v7, 01/14/2011*'

Soil Carbon measurements were not stratified, as test measurements were made using the strata found in figure 10, and it was concluded that stratification did not improve measurement accuracy. Soil samples were measured both inside Rukinga (the project area) and in the reference region at shambas (farms). The table below shows a summary (means) for the soil organic carbon measured inside Rukinga Ranch and in the shambas in the reference region.

	0-30cm				31-100cm				total (1m)	
	bulk density (g/cm^3)	**Carbon (%)**	**Soil Carbon (t/ha)**	**Soil GHG equiv. (t/ha)**	**bulk density (g/cm^3)**	**Carbon (%)**	**Soil Carbon (t/ha)**	**Soil GHG equiv. (t/ha)**	**Soil Carbon (t/ha)**	**Soil GHG equiv. (t/ha)**
Reference	1.50	0.55	24.44	89.63	1.41	0.38	36.65	134.38	61.09	224.01
Rukinga	1.32	0.70	27.38	100.40	1.34	0.92	84.85	311.13	112.24	411.53

Table 14. Mean Soil Carbon Stocks measured inside Rukinga and in the Reference Region

The % soil loss was determined as **0.456** (see section 6.5.5 - *fitting the soil carbon loss model*), and the corresponding total carbon loss is determined by multiplying this percentage loss by the total carbon stock measured inside Rukinga Ranch:

Rukinga Ranch	
Mean Carbon Stock measured in Rukinga	411.53 t CO2e
Standard Error of mean carbon stock	21.21 t CO2e
Percent Error at 95% confidence	0.10
Soil Crediting Area (conservatively reduced)	28,776.39 ha
Total soil carbon stock measured in Rukinga	11,842,347.78 t CO2e
Total Soil "loss"	**5,396,221.82 tonnes**

Table 15. Summary for soil carbon stocks in Rukinga Ranch

Standard error for soil stocks measured inside Rukinga Ranch are as follows:

Soil - Rukinga	
total stocks	11,842,347.78
Se total	610,218.21
95% interval	1,196,027.68
Error percentage	**10.10%**

Table 16. Standard error percentage for soil

Details for the soil carbon loss model, including standard error analysis are available in the 'Rukinga 1m Soil Analysis, 01/14/2011' spreadsheet.

Estimated Total Carbon Stock and Standard Error for Entire Project Area

The total carbon stocks for trees, shrubs and grass for Rukinga Ranch, above and below ground, is **2,624,569 tonnes CO2e**.

As it is assumed that soil carbon is not 100% depleted during the deforestation process, soil carbon values are measured inside Rukinga Ranch as well as outside the ranch in the reference region at deforested locations. The percentage soil carbon loss is multiplied by the total carbon stock inside Rukinga to yield the carbon "loss" value, and is **5,396,222 tonnes CO2e**.

The total monitored carbon stock for the Kasigau Corridor Phase I Project is:

8,020,791 tonnes CO2e

The total carbon inventory standard error across all pools is the quadratic sum of errors for all pools for all strata:

Total inventory error	
total stocks	14,466,916.7
Se total	628,370.1775
95% interval	1,231,605.548
Error percent	**8.51%**

Table 17. Total Carbon inventory error

Monitoring of Deforestation in the Project Area

For future monitoring periods, Wildlife Works will measure any deforestation within the project area either through intensification of biomass plots, or assessment of remotely sensed imagery. Any measured deforestation will be directly applied to the project's net emissions totals (i.e. subtracted from emissions reductions) for the with-project scenario. If the level of deforestation within the project area falls below the *de minimus* level as stated in IPCC 2006, it shall be excluded.