



The Kasigau Corridor REDD Project Phase II - The Community Ranches



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

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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 forest¹ for at least 20 years and has been a primary forest in its current state since recorded times². The Project Area forest has an average canopy cover of 34.6% 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 arid and semi-arid (ASAL) 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).

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.

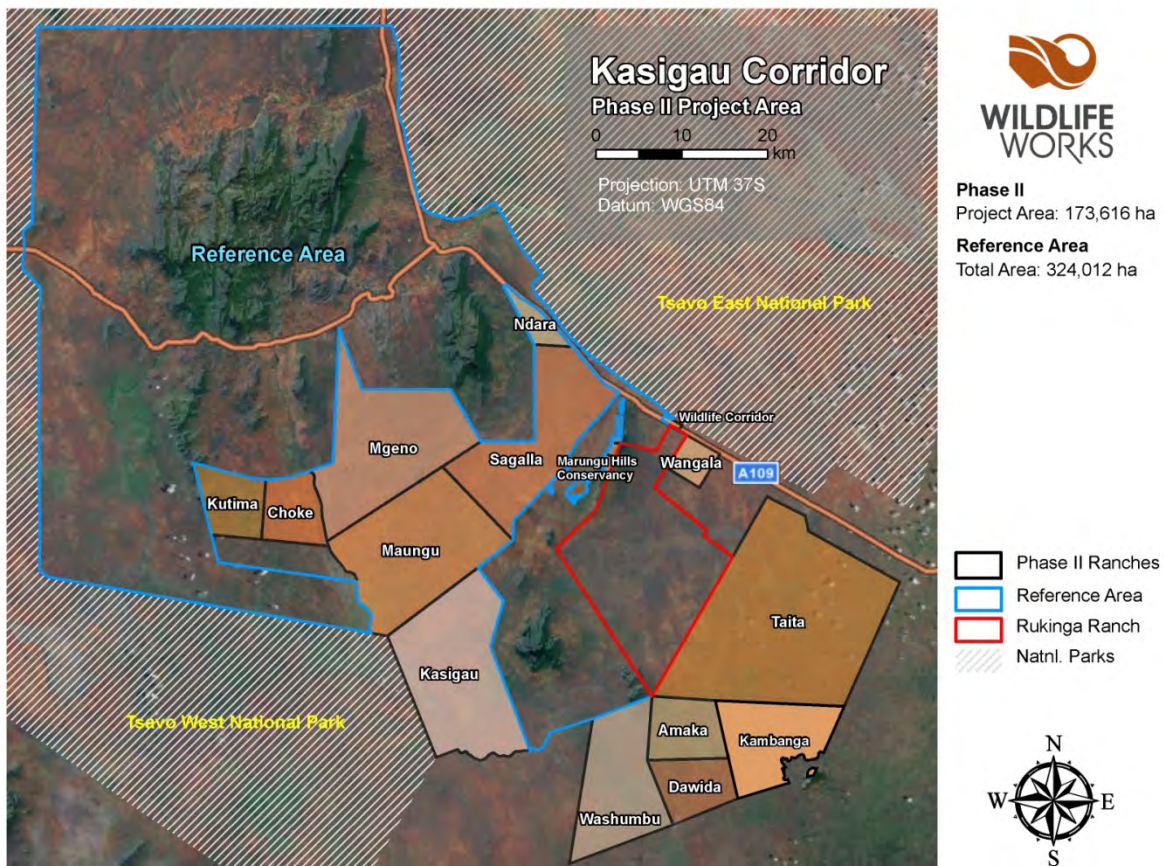
Section 5 Project Boundaries

Section 5.1 Spatial Boundaries

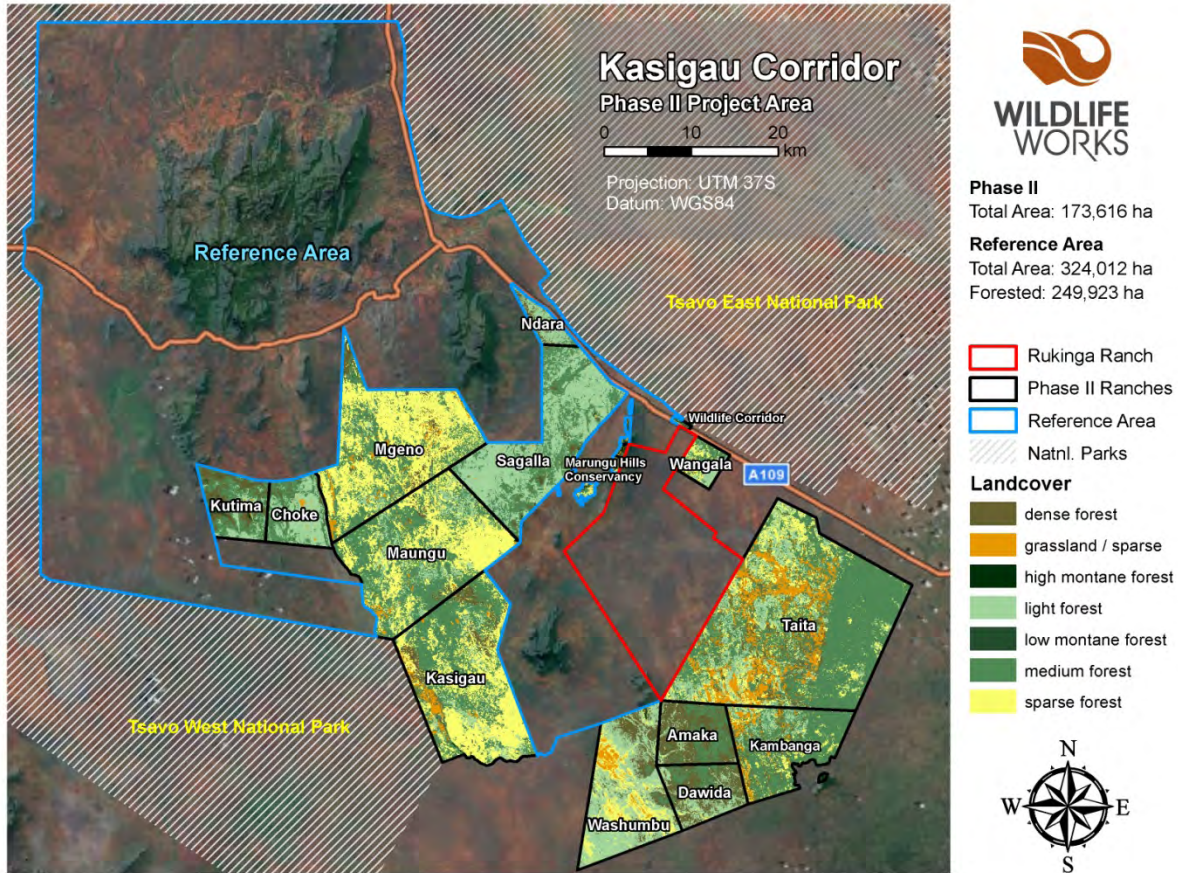
Kasigau Corridor Phase II - The Community Lands

This Project Design Document (PDD) covers Phase II of the Kasigau Corridor Project, involving the forest conservation of 13 blocks of land owned by Indigenous Community Ownership Groups, each one of the thirteen blocks being owned by different legal entities formed years ago by the Communities and the Government of Kenya to hold legal title to the land. Additionally, the project area includes A Community Conservation Area (described below) and a Wildlife Corridor, both in the vein of the new culture of forest and wildlife conservation in the Tsavo area instituted by Wildlife Works.

The Phase II project area covers 169,741 hectares of dryland forest land. It conforms to the latest VCS definition of forest, with an average canopy cover of 34.6%, and mature tree height at 5-10m, and has been primary forest since historic times. A GIS database with canopy measurements for 5 Phase II ranches is available to the validators upon request.



The Kasigau Corridor REDD Project - Phase II Project Area and Reference Region Boundaries



Phase II Landcover Map, Classified from several Landsat 7 scenes, 2003-2005

The following table shows the landcover strata for Phase II and their respective areas. Strata sum to the total area for the project, 169,741.4 hectares.

Stratum	Area (ha)
dense Acacia / Commiphora forest	15,337.00
medium Acacia / Commiphora forest	52,273.92
light Acacia / Commiphora forest	47,346.60
sparse Acacia / Commiphora forest	44,211.34
high montane forest	298.44
low montane forest	581.15
grassland / sparse shrubs	9,692.96
Total area:	169,741.4

Landcover Strata area for the Phase II Project Area

Using these values, forested area (160,048 ha) for the Sanctuary at project start date is calculated as:

$$160,048.40 / 169,741.4 = 94.3\% \text{ forested 10 years prior to project start date}$$

Land Ownership

Phase II of the Kasigau Corridor REDD project includes the forest conservation of 13 blocks of land owned by Indigenous Community Ownership Groups, each one of the thirteen blocks being owned by different legal entities formed some years ago by the Communities and the Government of Kenya to hold legal title to the land. The project also includes Marungu Hill Bio-diversity Conservation and Eco-tourism Project and a Wildlife Corridor adjacent to the Nairobi - Mombasa Highway designed to allow large fauna a safe crossing area.

The 13 group-owned ranches and conservancy land covered under this Phase II of the Kasigau Corridor REDD Project total 169,741.4 hectares (as shown in the table below) and are;

- **Taita Ranch**, which is 35,612 ha known as LR 12264 owned by Taita Ranching Company Ltd a collection of indigenous local shareholders
- **Mgeno Ranch**, which is 21,232 ha known as LR 12178 and owned by Mgeno Ranching (DA) Company Ltd., a collection of indigenous local shareholders
- **Maungu Ranch**, which is 21,619 ha known as LR 12179, and owned by Maungu Ranching (DA) Company Ltd. a collection of indigenous local shareholders
- **Kasigau Ranch**, which is 21,186 ha known as LR 12180, and owned by Kasigau Ranching (DA) Company Ltd., a collection of indigenous local shareholders
- **Wangala Ranch**, which is 2,023.5 ha known as LR 12262 and owned by Livingstone and Alphonse Ikonge, local indigenous shareholders
- **Kambanga Ranch**, which is 12,948 ha known as FR 195/6 and owned by Kasigau Ranching (DA) Company Ltd., a collection of indigenous local shareholders
- **Dawida Ranch**, which is 4,046.86 ha known as LR 14208 and owned by Dawida Ranching Group Company Ltd., a collection of indigenous local shareholders
- **Washumbu Ranch**, which is 14,501 ha known as LR 14206 and owned by Washumbu (DA) Ranching Company Ltd., a collection of indigenous local shareholders
- **Amaka Ranch**, which is 5,998 ha known as LR 14207 and owned by Amaka Development Limited., a collection of indigenous local shareholders
- **Sagalla Ranch**, which is 17,402 ha known as LR and owned by Sagalla Ranching (DA) Company Ltd., a collection of indigenous local shareholders
- **Ndara Ranch**, which is 1834.77 ha known as LR 12176 and owned by Eliud Timothy Mwamunga, a local indigenous stakeholder
- **Choke Ranch**, which is 5076 ha known as LR 12199/3 and owned by Raymond Joel Mwangola a local shareholder
- **Kutima Ranch**, which is 5076 ha known as LR 12199/4 and owned by Kutima Investments Limited, a collection of indigenous local shareholders
- **Marungu Hills Conservancy Area**, a small 1000ha, but important community owned strip of land at the ridge of the Marungu Hills that the Community has requested be placed in the REDD project.
- **Wildlife Corridor Link**, 156.3ha secured by Wildlife Works as a safe crossing point for local fauna.

As of the writing of this PD, 10 of the Phase II ranches possess title deeds indicating their status as legal owners of the land (all group ranch land in Kenya is owned under the British system of leasehold from the government), whereas the remaining three ranches possess letters of allotment from the government indicating that the land belongs to them, and that title deeds are in the process of being issued.

Phase II - Kasigau Corridor Areas	Area (ha)
Amaka Ranch	5,998.00
Choke Ranch	5,076.00
Dawida Ranch	4,046.86
Kambanga Ranch	12,948.00
Kasigau Ranch	21,186.00
Kutima Ranch	5,076.00
Maungu Ranch	21,619.00
Mgeno Ranch	21,232.00
Ndara Ranch	1,834.77
Sagalla Ranch	17,402.00
Taita Ranch	35,612.00
Wangala Ranch	2,023.50
Washumbu Ranch	14,501.00
Marungu Hills Community Area	1,018.61
Wildlife Corridor	156.35
	169,741.471

Section 5.2 Temporal Boundaries

The project was commenced on January 1, 2010. Since this time, Wildlife Works has been successfully protecting the Phase II Project Area from agricultural encroachment (deforestation), wildlife poaching and forest degradation. The Phase II Project is 30 years in length. The project will therefore end on December 31, 2039. Wildlife Works took financial responsibility for all conservation activities within the Phase II Project Area as of January 1st 2010, as is evidenced by the presence of Wildlife Works rangers and their active protection of the land. Conservation Easements have been signed with all Phase II entities, copies of which have been provided to the validators.

Wildlife Works will monitor the project every year, producing accurate and credible documentation for all VCS required project accounting. Wildlife Works will finance the verification of 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, 2020 and January 1, 2030. If the VCS standard regarding baseline revision periodicity changes in the future, Wildlife Works will commit to performing baseline revisions whenever specified by the VCSEA.

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

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 II 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 possess 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, we considered it unnecessary to conduct a participatory rural appraisal (PRA) to demonstrate a clear understanding of the principle driver of deforestation in the reference region: 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.

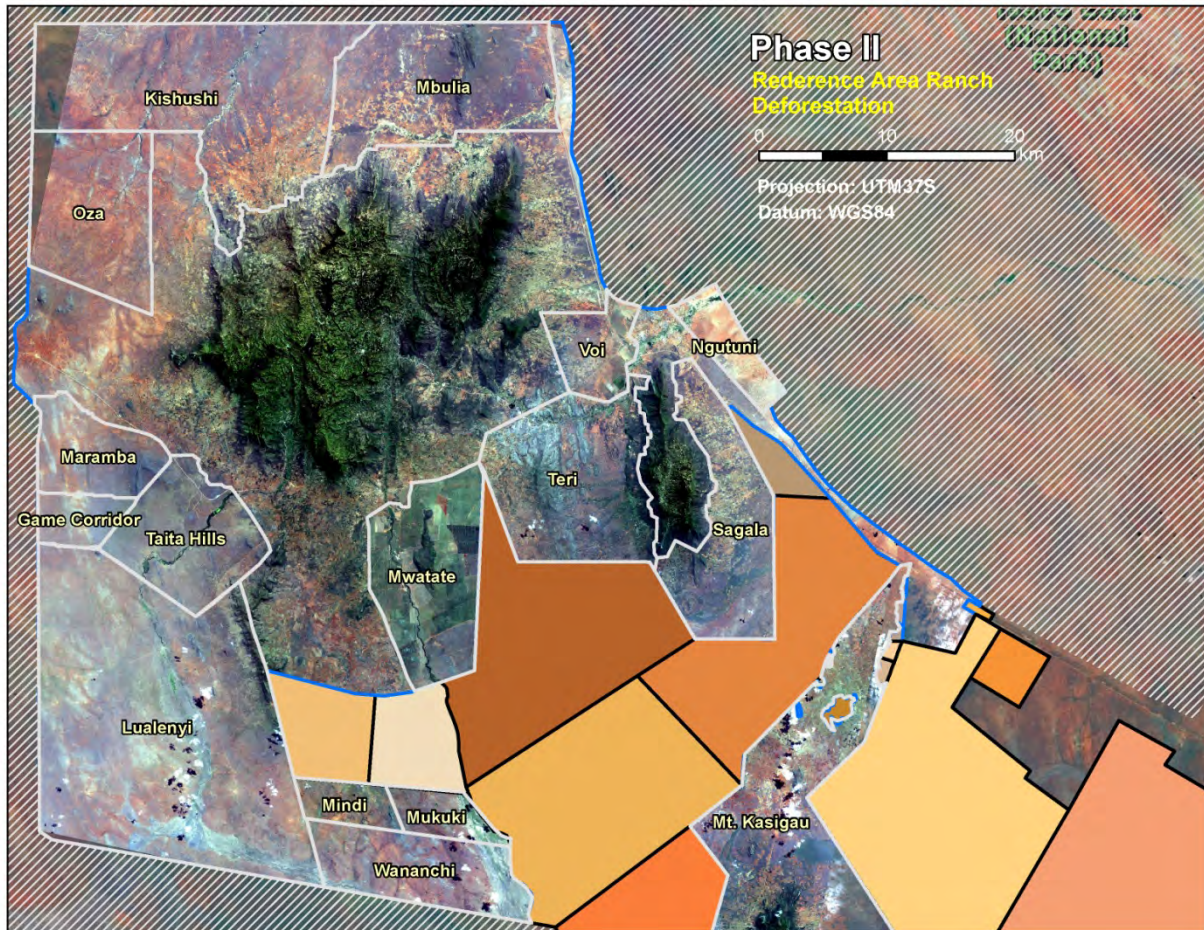
Both of the aforementioned populations began aggressively converting land in the 1990s prior to Wildlife Works' arrival in the area in 1997. After rendering it impossible to illegally farm private group ranch land, immigration to the area virtually ceased, and in fact many Duruma families returned to 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.

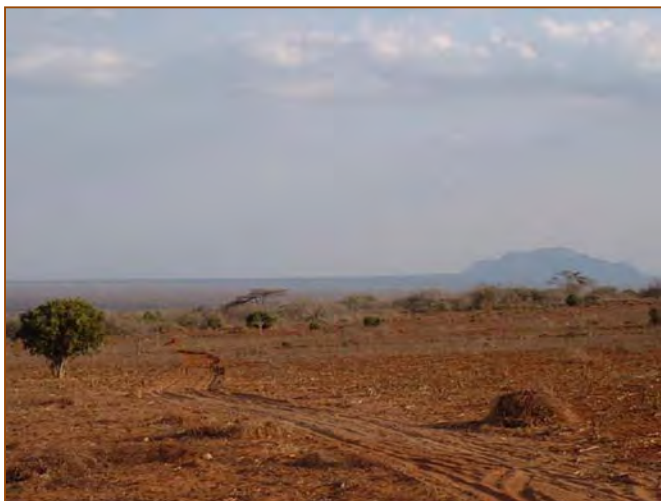
Narrative describing why the agents of deforestation are evident

Wildlife Works contends that the reasons for the presence of the agents of deforestation are evident. 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 (see map below). To demonstrate similarity between the reference area and carbon project area, it is important to observe similarity in deforestation agent behavior in the historical reference area. The reference area therefore contains many group ranches with identical land tenure to those in the project area. Observing illegal deforestation within these reference area ranches indicates that legal ranch boundaries have not served as a deterrents to illegal slash and burn subsistence agricultural in the past in the reference area, and are therefore highly unlikely to do so in the future in the project area. Wildlife Works contends that this presents a compelling case for the chosen location of the reference area for this project, as well as its appropriateness in depicting deforestation agent activity that would take place under the with-project scenario. The map below is a "truecolor" (human visible) satellite snapshot of the reference area with legal group ranch boundaries overlaid. Clear deforestation can be observed in most of the ranches:



Group ranches in the reference area. Satellite imagery: 10m ALOS, 2008.

From the ground, 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.



Deforestation 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 project area to Mt. Kasigau.

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 led 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 area³.

List of Project Activities designed to mitigate deforestation

The Project Activities designed to mitigate deforestation include (grouped by category);

Wildlife Works Sustainable Development Initiatives

Wildlife Works has implemented a wide range of sustainable development initiatives in the project area 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 area once the funding for Phase II of the Carbon project begins. These initiatives collectively form the basis of our carbon offset leakage avoidance strategy, and an Implementation schedule for these Project Activities, with timelines and budgets was shared with the project validator.

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

Organic clothing factory

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, moving 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 been unable to produce a new fashion collection for the past two years, due to general lack of funding. Upon receipt of carbon funds in 2010, we immediately initiated a new collection, requiring a near doubling in organic factory staff . This new collection will be sold online and will re-launch our brand into the international marketplace, now with 100% of production being done at 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. Currently, we are in mid-design for our 2010 collection, and have just completed a pilot production run for this latest batch.

Organic Greenhouse

Wildlife Works established an organic greenhouse to grow citrus trees which we sell at a discount to local farmers so that they can plant a tree for shade that will also earn 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 oleifera to local farmers, to meet their medicinal, nutrition and fuelwood needs. With the financing from

the Carbon project we will initiate a number of new Project Activities in this area. In Phase I of the Kasigau Corridor REDD project we expanded our core greenhouse at Rukinga to add a second shade house and to double our capacity adding two additional greenhouse workers from the local community. A full budget for this activity was provided to the validator.



Wildlife Works Organic Greenhouse

We will establish (as part of our Phase II project objectives) at least 10 new nurseries each with a capacity of 40,000 seedlings per year in the villages surrounding Kasigau Wildlife Corridor. Each nursery will use the same template and budget as for our own Shade house (see above), and each nursery will employ an additional 5 members of the local community, 50 new employees in all. Each nursery will be responsible for working with their immediate community to plan and implement a cash crop of jojoba seedlings, fuelwood and construction pole strategy for that community, using 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 selling cash crop trees and jojoba to contribute to the budget. We will provide training in organic agroforestry and our Organic Project Team Leader Joseph Mwanganda will manage these new nurseries.

Phase II Nurseries are being sited and discussed now and will be in Maungu, Marungu, Sasenyi, Mukameni and Kisameni. It is hoped that as Carbon funds are released all 5 nurseries will be completed by the end of 2011. Their positions must be carefully planned as all land in these communities have already been subdivided into legally held (deeded) family plots. Long term tenure must be sought through the Land Office and Community officers so that the construction and investment of these nurseries are free from any potential land ownership conflict. The nurseries also need relatively easy access to water to ensure that the seedlings can be managed until they are strong enough to be planted out into the family owned agricultural plots.

The Marungu Hill Conservancy Association, a local CBO, approached Wildlife Works and asked that their Community Group be a part of the REDD Project. The Communities they represent immediately neighbor Rukinga and Sagalla ranches, and are an essential part of the success and sustainability of the project, so we agreed to explore a closer working relationship.

Planning for Phase II nurseries will begin immediately on successful Validation of this Phase of the project, and will extend our influence in job creation, and resource delivery much farther afield than Phase I, reaching literally tens of thousands more local people.

Dryland Farming - Jojoba propagation & extension into Community

In partnership with Kenya Agricultural Productivity Project (KAPP), Natural Aromatics Ltd, Rukinga Wildlife Sanctuary, Kenya Forestry Research Institute (KEFRI), and the Ministry of Agriculture a 2 year trial period exploring the use of Jojoba as an ideal cash crop in arid and semi-arid lands (ASAL) was completed in 2010. Wilson M Thangana, the project leader, had begun the project to research Jojoba from best propagation, to finished value added essential oil.

Jojoba (*Simmondsia chinensis*) is a highly valued shrub that grows in the arid and semi-arid areas. About 80% of Kenya is ASAL and experiences frequent crop failures when annual crops are grown. The research team - Joseph, Lenjo and Cosmos here at Rukinga- has for the last two years been experimenting with getting the best most superior propagules for enhancing productivity and reducing generation time to less than 3 years. Ideal conditions have been recorded and proven and now the most superior Jojoba plant is ready for propagation.

The Jojoba plant is a non-conflict plant, that thrives in dry conditions and will survive drought once established, and the plan is to develop an outgrower model where jojoba will be planted together with companion crops of herbs such as *Cymbopogon* species (Citronella and Lemon Grass) and Chamomile (also drought resistant) which produce valuable essential oils that can provide a livelihood for the Farmers until the Jojoba crop reaches maturity. Citronella oil has the added value that it is known to repel blood sucking insects such as mosquitoes, ticks and fleas which are vectors of diseases such as Rift Valley Fever.

Superior rooted cuttings (rather than seed that produces up to 60% male to female ratio) from the Jojoba here at Rukinga are now superior to the original germplasm (Thagana et al 2004). These plants can now be propagated through rooted cuttings and within 8 weeks only be sold to the farming communities. The communities will benefit hugely as it provides them with a high end cash crop, that wildlife and insects do not destroy, that is drought resistant, and can assist in the reduction of soil erosion.

Through research trials carried out historically, the ideal ratio for Jojoba plantations is one male plant to between 6 to 10 female plants. On an acre of very poor land a farmer can plant (as instructed) 260 female plants with between 26 to 30 males – the bull count. Each female plant produces 5 kgs of seed twice a year. So one acre will provide the local farmer with 2,600 kgs of sellable seed. The price for this is 100 KSh- a kg . This represents an income potential of 260,000 kshs – ten times the amount of money that the farmers are currently getting (or not if the rains fail) for an acre of maize. Today one acre of land in this area will produce 900 kgs of maize twice a year – market value of 15 KSh- per kg or 27,000 KSh- per year.



Wildlife Works Jojoba Project

The plan would be to use the nurseries that are already in the project to assist in providing advice and helping to be points of plant distribution and seed collection as the crops are harvested. At all times the project manager Joseph will be traveling around to the individual farms and communities to provide assistance, advice and help at all times. In time the nursery employees can learn the management needs of the plants and the needs for advice for the local out growers.

During Phase II, we will develop a full business plan for how to create a self-sustaining venture and increase value to the community. The lifespan of a Jojoba bush is 50 years and the harvest from the plants increases in quantity and improves in quality over time. From research with the best plants it is observed that they will produce seeds in the first year but because of the immaturity of the bush and the weight of the harvest it is better to abort. Year 2 to 5 will produce 1 kg biannually, Year 5 to 10 will produce 3 kgs, Year 10 to 50 a steady harvest of 5kgs twice a year. So it is a long term investment and more importantly to the local producers an economically improving harvest.

This project is ideal for this ecosystem, and the next phase of the Jojoba project would be to expand the ideas into Kenya as a whole. The research, and knowledge gained could easily be released to other communities in ASAL areas. There are extremely successful Jojoba industries in India, Israel and Brazil and under the marketing umbrella of Wildlife Works the products could reach international consumers.

Mushroom Farms from Elephant Dung

We will continue a project activity through which we provide relatively small amounts of elephant dung from Rukinga Sanctuary to a local women's group called the Imani Women's Group periodically at their request so that 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 no negative impact on biodiversity or land use.

Wildlife Works Eco-Charcoal Production Facility for the Kasigau Corridor REDD Project

The Kasigau Corridor REDD Phase II project has created a new economic incentive for the landowners and communities within the corridor to protect their forest. Wildlife Works Carbon LLC is now working with the landowners and local communities to implement forest management plans that exclude the destructive use of forest resources for fuel wood or charcoal, and as a result, the supply of "free" wood for local charcoal use will be greatly reduced.

Wildlife Works Carbon, LLC had an obligation to investigate providing a substitute to firewood and lump wood based "bush" charcoal to meet the fuel consumption needs of the local communities surrounding the Kasigau Corridor REDD project. Given this obligation we set out to explore the rural "bush" charcoal issue in the entirety of its value chain to determine the most economically viable alternative "eco" or low carbon impact solution to this enormous problem that plagues much of rural Africa.



EcoCharcoal

After surveying hundreds of people at all elements of the Value Chain, we determined that low impact community based charcoal production can offer a sound alternative to ecologically damaging practices, such as hardwood extraction for “lumpwood” charcoal from primary forest destruction which is often accompanied by “bushmeat” hunting of wildlife species.

Wildlife Works advanced funding for this critically important project activity, so that the work could begin prior to validation and verification and receipt of carbon funds from Phase II. The results of the three phases of work were analyzed and conclusions developed about the best way forward for the production of “eco” charcoal in the Kasigau corridor.

Financial Aid to Marungu Hill Conservancy Association

In Phase II we have decided to provide limited direct financial support for the Marungu Hill Conservancy Association, so that they can provide support and advice to the community on environmental issues.

Reforestation of Mt Kasigau

We will restart a 3 year reforestation project on the slopes of Mt. Kasigau, working closely with the Kasigau Development Trust (KDT) to plant 20,000 indigenous hardwood trees over the next three years in one of the project area’s HCV areas, to replace trees taken out for charcoal or construction over the past years. We will be using the nursery built at Makwasinyi and Sasenyi as the base for propagating the seedlings of the indigenous trees in the first year, until Phase II of this project when 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.

Wildlife Works REDD Forest and Biodiversity monitoring

There are a number of specific project activities in this area that we will be completing according to the project implementation schedule provided to the validator;

Wildlife Works Rangers



First recruit of female Rangers



With the Phase II carbon finance we plan to add several new permanent ranger Stations around the project area, to give us a presence at all the points furthest from Rukinga Headquarters, and in each new ranger Station we will add a full new section of 8-12 Wildlife Works rangers, recruited and trained from the local community with a new Team Leader promoted from within our existing ranger force. This is primarily to prevent incursions of illegal cattle, and to make patrolling the far boundaries easier, in addition to developing closer working relationships with the communities furthest from Rukinga HQ.

In anticipation of Phase II financing we made a significant investment in modernizing our patrol fleet to reduce the carbon emissions from our patrol vehicles, and to reduce the cost of operating and maintaining them, and perhaps most importantly to ensure we have a reliable fleet to ensure constant ranger patrol support. We purchased 2 new landcruiser pickups for patrol work. We will retire the oldest patrol vehicle which is a 1980 Toyota Land Cruiser – HJ45 Diesel.

We also plan to improve our ability to monitor the HCV species in the Project Area 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.

HCV species spotted in the project area by one Wildlife Works' rangers (actual photos)



Additionally to improve our monitoring of HCV species, we plan to establish a GIS center of excellence in Rukinga using Camp Kenya facilities at Camp Tsavo, for which we have hired one full time Kenyan GIS/Wildlife expert, Patrick Kabatha, who we will provide with an assistant from the local community and a small four wheel drive car, and set up a state-of-the-art GIS computer station. Patrick and his assistant will be responsible for liaising closely with the HCV ranger Team, with the Ecotourism partner in the project area, and with all WW ranger patrols to maintain daily sighting logs of the HCV species in addition to those other species of ecotourism value, such as Elephant, Buffalo, Giraffe, Common Zebra that are being recorded on the WW Standard Daily ranger patrol sheets. All data will be input into a spatial database. They will also be responsible for maintaining a local copy of the Kasigau Corridor REDD project GIS database.

Community Wildlife Scouts

We have also implemented a program of Community Wildlife Scouts whereby we provide funding, training and logistics support to organized groups of Community Wildlife Scouts operating outside the Project Area but within the reference area to monitor and deter illegal activity such as charcoal burning and bushmeat poaching, working closely under the supervision of our WW ranger force. This extends our monitoring capability beyond the boundaries of the Project Area. One example of such a Community ranger Group is the Kasigau Conservation Trust.

Kasigau Conservation Trust

In the last 30 years the human settlement and population growth around the Kasigau Hills and the hunting of wild animals in the area have both risen proportionately and dramatically. The area has also recently witnessed the introduction of commercial poaching, where animals are poached on a large scale and their meat sold for profit, as opposed to “for the pot” poaching that might be labeled as ‘traditional’. The emergence of charcoal burning and mining activities in the area has attracted a large itinerant population of casual labor. These people feed themselves and subsidize their income by laying snares and poaching wild animals. The people of Kasigau realized that the threat to the wildlife was increasing and so they formed the Kasigau Conservation Trust (KCT) in 2003. At the beginning of 2004 they received funding to build and equip an office; a base from which future conservation projects can be implemented and monitored.

Now using Carbon Funding the Kasigau Conservation Trust can expand its activities in partnership with Wildlife Works, using ideas and methods put forward by the KCT and members of the Kasigau community to create a team of Community Scouts, which will enable the community to protect the wildlife that remains on the Mountain as an asset for future generation. The Wildlife Works rangers will train and work with six community scouts 2 days in a month and the scouts will work another 6 days on their own every month, making a total of 8 days a month. This proposed project will run for three years. The Kasigau community felt that whilst they could patrol on their own, they would be far more effective if they were accompanied by experienced outsiders as well.

Kasigau Conservation Trust (KCT) will co-ordinate the community scouts and the co-ordinator will write reports detailing the daily findings and progress for each month. The primary methods for achieving this will involve patrols on foot removing set snares using pliers and bolt cutters. The team leader will report to the authorities and/or KWS, any cases of habitat destruction and any injured animals and also co-ordinate the rescue of trapped animals and document human activities that could be detrimental to the environment.

The team will set out in the early morning by vehicle and alight at hotspot areas and will be expected to contribute 5-8 hours each day to de-snaring for a period of 5 days. Five days of the project time shall be dedicated to sensitizing the community on environmental issues, the need to co-exist in harmony with wildlife and to value them. The team will visit the five villages in the Kasigau area and hold workshops using the established Participatory Rural Appraisal (PRA) approach. Priority will be given to women's groups and the youth.

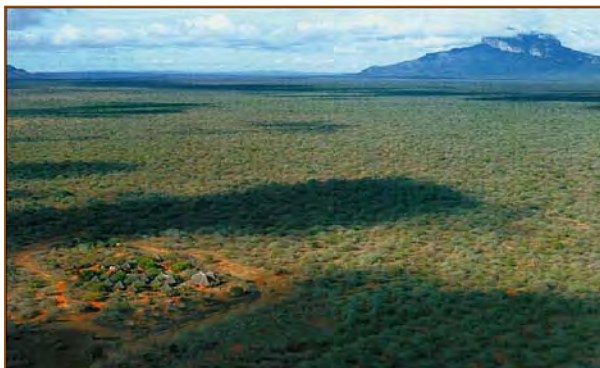
6 Kasigau community scouts will be picked to work with the Wildlife Works rangers. There will most likely be one scout selected from every village. The Kasigau Conservation Trust (KCT) office will help in the selection and co-ordination of the scouts. The Community Scouts will work a total of 8 days in a month. Two days will be with the Wildlife Works rangers and 6 days on their own. The use of bicycles will enable the rangers to move from their homes to their base. The coordinator will work on the project for 10 days each month. On 8 days he will work with the scouts in the field and for 2 days he will compile the monthly report. He will be based at the Kasigau Conservation Trust (KCT) office. This will be to enable the Kasigau Conservation Trust (KCT) office to coordinate the rangers and compile reports to Wildlife Works and the Biodiversity Monitoring Centre.

REDD Carbon Inventory Monitoring

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, to look for degradation or improvement in existing stocks. In addition we plan to acquire remote sensed imagery to support the absence of large scale deforestation or boundary changes. Also in this category in 2011 was an investment in a gyrocopter flown by Rob Dodson to perform aerial monitoring of the Project Area and project area. We will be investing in outside auditors coming to verify the project carbon inventory every five years.

Ecotourism

Wildlife Works located an ecotourism provider who operates a safari camp in the center of the Rukinga Sanctuary. This provides employment for safari guides and other service jobs, and a market for local produce. Without the REDD Project providing funding for our continued protection of the biodiversity in the Project Area this business would collapse.



Ecotourism Center at Rukinga - "Camp Tsavo"

The primary ecotourism tenant is called Camp Kenya and they bring groups of young people to the camp mostly from the UK, and these young people stay at the camp, but spend their days in the communities of the project area implementing community projects, a significant benefit to the communities.

We then negotiated for a second player called EcoTraining to come to Rukinga and they are a South African Safari Guide Training company, and they have agreed to allow us to put 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.

We also intend to explore a second high end ecotourism retreat on Rukinga, to bring yet more jobs and income to the Project. This will have to be self-funded by outside investment partners as it represents a significant capital expenditure.

Taita Ranch Ecotourism

On February 4th 2010, Wildlife Works agreed to enter into an agreement, with the Directors of Taita Ranch, to explore the ecotourism possibilities within their ranch, commencing April 1st 2010. This agreement is an exclusive option, to investigate and engage in ecotourism practices within the 88,000 acres of Taita Ranch. In order for any ecotourism option to be successful on Taita, the huge number of Somali owned cattle on the ranch that have been competing with the wildlife for grazing, and negatively impacting the biodiversity of the ranch, have to be addressed.

In order to solve this issue of external grazing contracts, Wildlife works agreed as part of the agreement to pay a monthly fee, adequate to allow Taita Ranch to not have to renew any cattle leases on the land during the time-span of the agreement. This would leave the approximately 500 head of cattle belonging to Taita ranch shareholders intact and free to graze, but would reduce the number significantly from the excess of 3,000 head of cattle (and the large amount of people tending them), that have been currently grazing on the ranch. By doing this we expect much of the wildlife that was present on the ranch in previous times to be given a chance to return and flourish, in a more stable environment. Negative effects of overgrazing to the ranches fauna, are also expected to be relieved by this agreement, and through careful monitoring and protection of the biodiversity we are expecting significant improvements.

With such an agreement now in place, along with increased revenue opportunities for the ranch, should any eco-tourism practices commence, we feel this is a very valuable example of what is possible in other areas within the Kasigau Corridor. By protecting such areas and therefore allowing the stakeholders the opportunity to explore future business ventures in a more eco sensitive fashion.

Taita Ranch will serve as an experiment, and hopefully a future example of what is possible. It borders Tsavo East National Park and Rukinga Ranch and so is a natural environment for wildlife to re-habituate or migrate through, given favorable conditions to do so.

Many other naturally beautiful or elevated areas exist within the Project Area, that would lend themselves to small, exclusive, low impact, eco-lodges. With such an extensive area, careful and sensitive planning, and environmental impact studies, would ensure no "overcrowding" as sadly experienced in some of the country's more popular national parks and reserves.

Kasigau Rangelands Trust and Eco lodge

One investor has already secured a 15,000 acre wildlife conservancy, The Kasigau Rangelands Trust, in the Kasigau Corridor area, on Kasigau Ranch, within the REDD Project Area. An ecotourism lodge is in the final stages of construction, a clear indicator of some of the future prospects of the area. James Omondi and David Ogiga (Finch Travel) are in partnership with the shareholders of Kasigau Ranch in the Trust. The shareholders of Kasigau are from the immediate communities around Mt Kasigau so they

have a vested interest in its success. The shareholders come from the villages of Rukanga, Jora, Bungule, Kiteghe and Makwasinyi. The idea of the trust is that it will exist as a legal and long term entity way beyond the life of the project. James has secured a lease with KRT to put aside 15,000 acres (with expansion to 22,000 acres) of the Ranch as a wildlife conservancy. It is a no go zone for any cattle or livestock and this has been enforced now for over 6 months. The funding for the project was initially sought in 2003 from the EU and TTF and funding was actually approved, but the 2007 election troubles stopped that completely. James and David had to go to Slovakia for the project funding to finally be released. Their plan is to open a small and simple eco lodge with a maximum of 12 guest rooms. Their market through Finch Travel has been successful privately guided clients who are conservationists who wish to learn more than the big five. Cultural community education visits, emphasis on conservation and sustainability within the wildlife areas are a good ethos for this area. James and David are extremely happy at the knowledge that the Carbon funding will go a long way to helping to preserve the Kasigau Corridor and hope to become strong partners in the project. They employ 3 community scouts in the conservancy who are recording a “tenfold increase in wildlife after only six months and a definite improvement in the flora and fauna.”

Saghasika Wildlife Conservancy Trust and Eco lodge on Zagitisa Hill

In 2005 Sagala Ranch, Mgeno Ranch and Maungu Ranch came together in partnership to form of a memorandum of understanding on the collaborative development and management of their ranches and natural resources. The idea was that the ranches that are party to the MoU to pursue joint conservancy related activities for their sustainability and socioeconomic development. From this MoU the Saghasika Wildlife Conservancy Trust was formed and signed on 22 September 2006. The plan was that each ranch would donate 5,000 acres to the trust and assign these 15,000 acres of land as a Wildlife Conservancy Area. Having created the trust an area on Zagitisa hill was identified as a potentially beautiful sight for some sort of wildlife Tourism project and investors where to be sought. Since then nothing has happened and project is on a back burner. It would be great to use the Carbon Funding to get this project of the ground and invest time in investigating, designing and building a wildlife eco-lodge on this sight. It is one of the few situations where the shareholders themselves have invested their time and energy into a project and one worth supporting fully.

Kasigau Corridor and Kasigau Wildlife Forum Tourism development

Eco-tourism should however, not be narrowed down to lodges alone. Other possibilities within that idea can be fully explored too, within all areas currently under the REDD project. Walking Safari's, horseback safaris, camel safaris, fly-camping to name a few, would all have a valid potential in the Project Area. Specific areas of certain resources remain essentially untapped, such as the historical and cultural aspects of ecotourism. There are several significant historical sites dating back to World War I, with areas of fortification, old breastwork and battle sites that are still clearly visible in the Mount Kasigau area.

70% of all Kenya's tourists visit the coast. 35% of all Kenya's tourist visit Diani on the South coast. The option to explore linking the Kasigau Corridor, to both the Shimba Hills National Reserve, and the South Coast becomes obvious and very attractive, given the proximity of these areas, and the draw of tourists to them.

Furthermore, possibilities of forming a Kasigau Wildlife Forum are also to be explored. Such important issues, for example, as combined marketing and marketing strategy, feasibility studies for new projects, improved game driving and tourism structure could all be addressed through such a forum.

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 existed. 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 area. 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.

Group Ranch Office Renovations

For each of the ranches engaged in Phase II, we committed to providing them help in renovating their Ranch Headquarters buildings. We have already completed the renovations of the Ranch headquarters for Kasigau, Maungu and Taita. The rehabilitation included investing in solar energy and lights, renovating completely the structure to ensure that it is safe and livable again, providing radio communications and base stations, rangers posts for the accommodation of 20 WWC rangers, rain catchment and water tank repairs. Roof leaks repaired etc.. Also in these projects was the renovation and decoration of a Carbon

office. These Carbon offices will be open to the public and shareholders and be important points of communication between the WWC and the community. They will be information centers with maps and copies of the Carbon easement agreements so that anybody who has any questions has an easy and accessible point of contact. When more funds are released Maungu and Kambanga headquarters will be done as well.

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 REDD Project Phase II was chosen to specifically address the behavior of the local agents of deforestation as well as the drivers of deforestation for the ecosystem. The area is composed almost entirely of local inhabitants engaging in subsistence farming practices. In the area that is 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 decidedly 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.

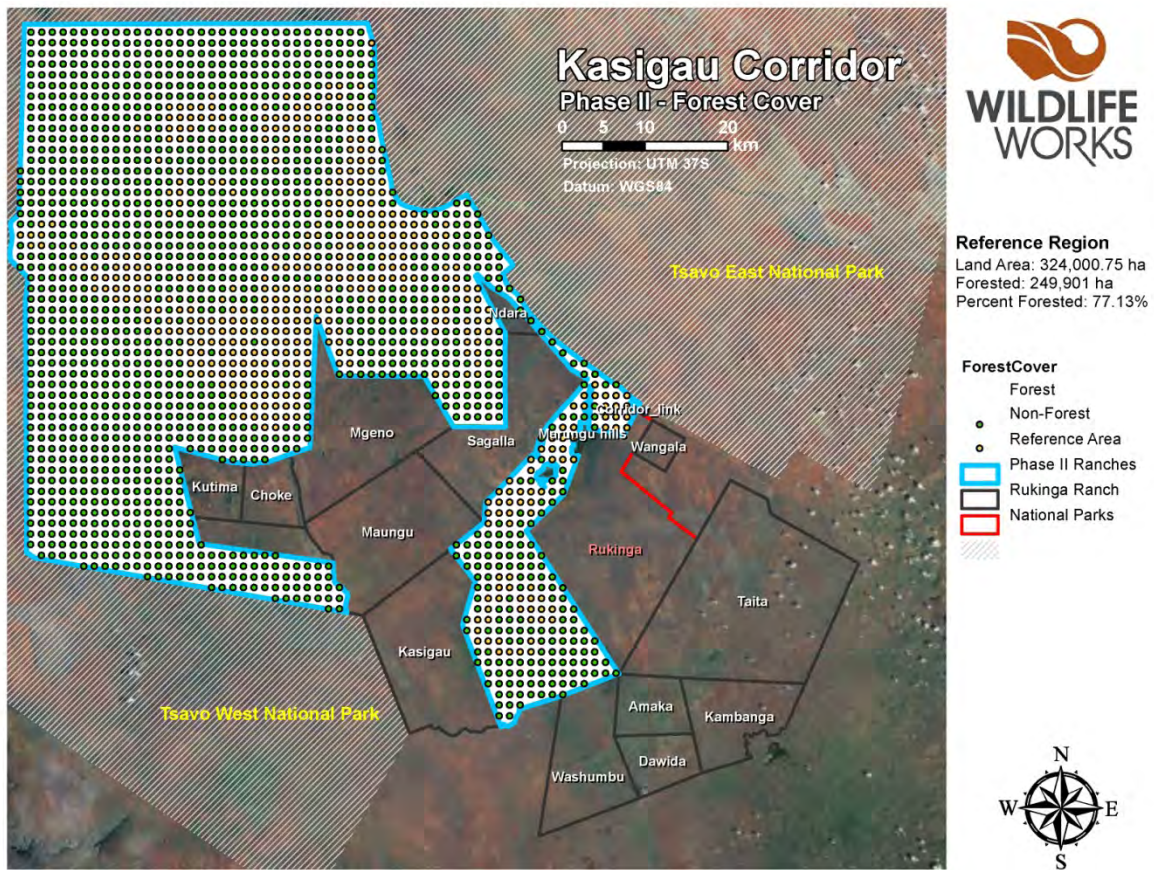
Narrative describing the rationale for selection of the reference region boundaries

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 quite similar to those of the Phase II project area. Forest type, soils, river density, and infrastructure are virtually identical. 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 (see history of the area description in section below). It would be inappropriate to omit the hills simply due to their elevation, as is mandated in other methodologies. 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 the project area.

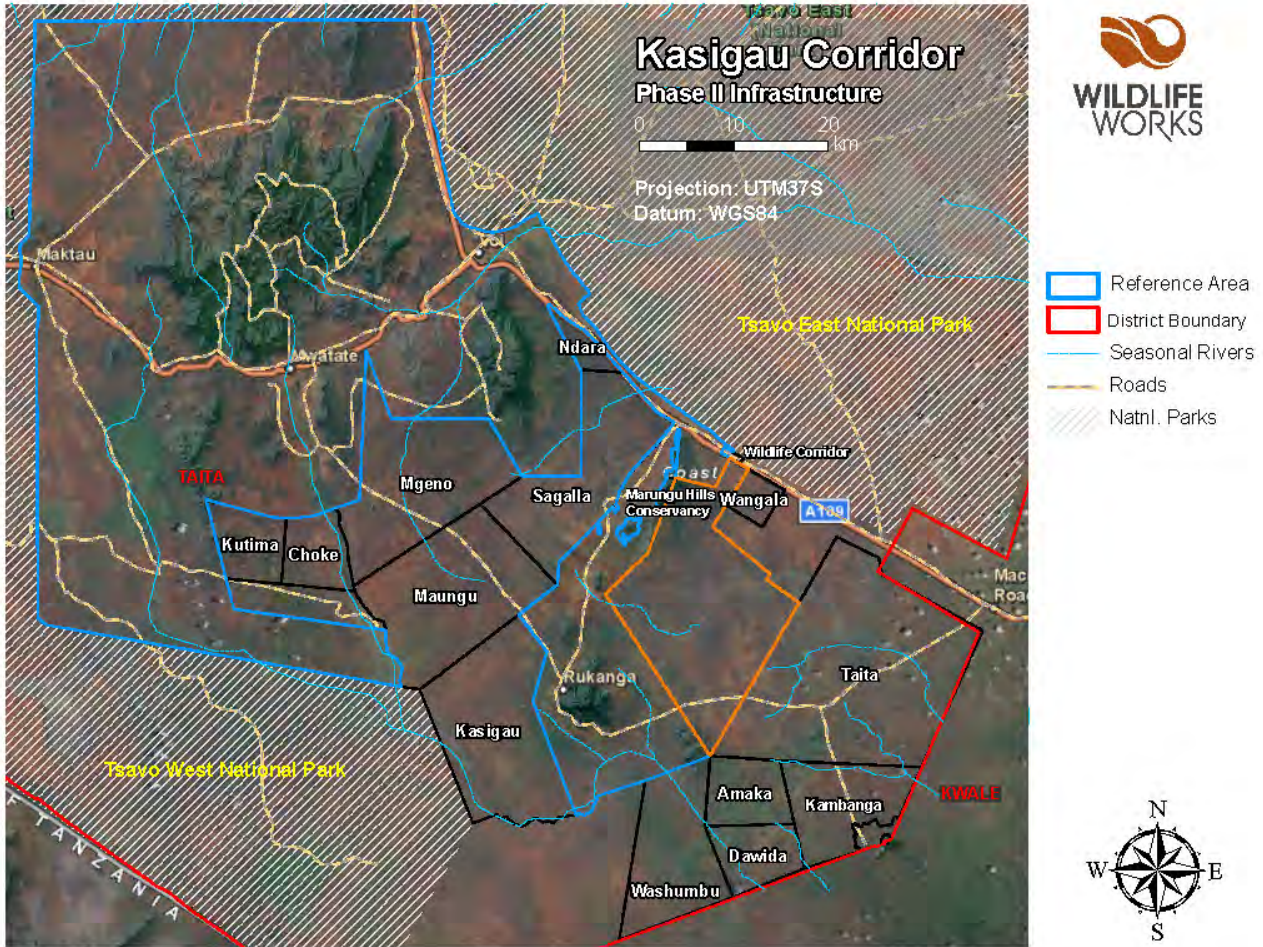
The MED requires that the reference region contain at least as much forested area as does the project. The map below, generated using Wildlife Works' GIS Forest Cover Analysis tool, demonstrates that the Phase II reference region meets this requirement. The reference region contains 249,901 ha forested, whereas the project area (as shown in Section 5. Project Boundaries) contains 160,048 ha:



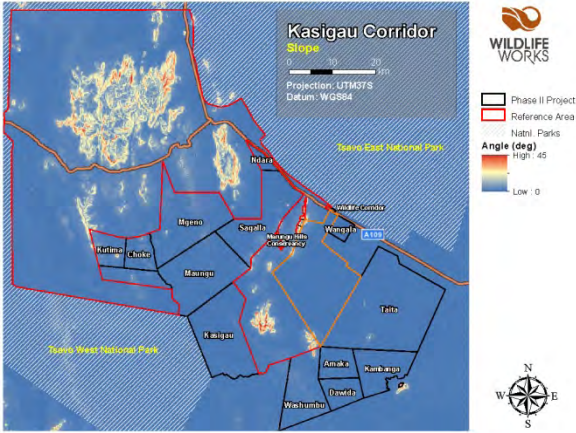
Phase II reference region forest cover analysis

The following maps demonstrate the geographic features of the reference area that render it appropriate for evaluating the baseline scenario for this project. Larger versions of these maps are presented at the end of this document in appendix A.

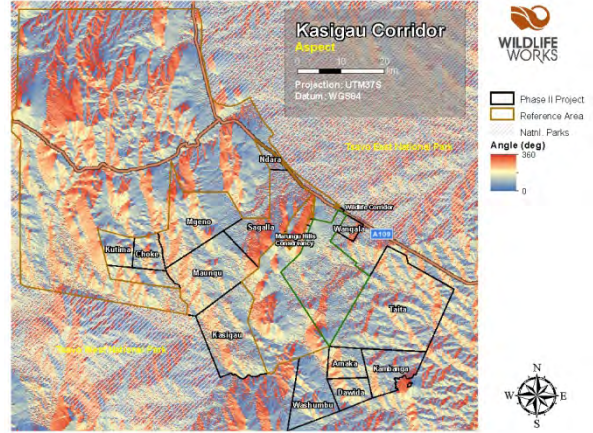
Phase II reference area maps



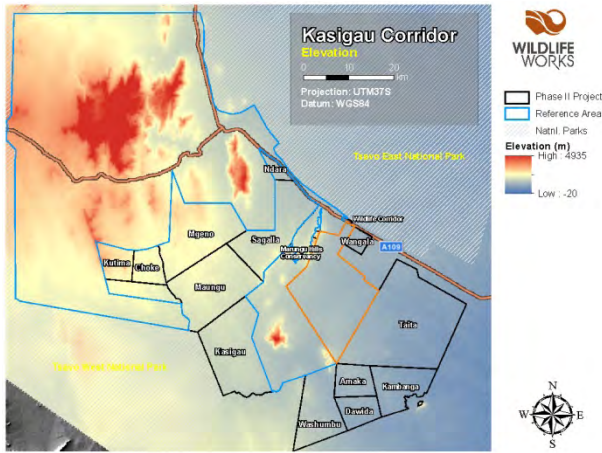
Kasigau Corridor Land Tenure Boundaries, Roads, major Markets and Seasonal Rivers



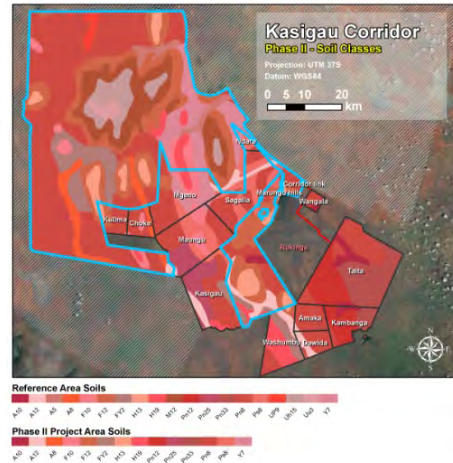
Kasigau Corridor Slope



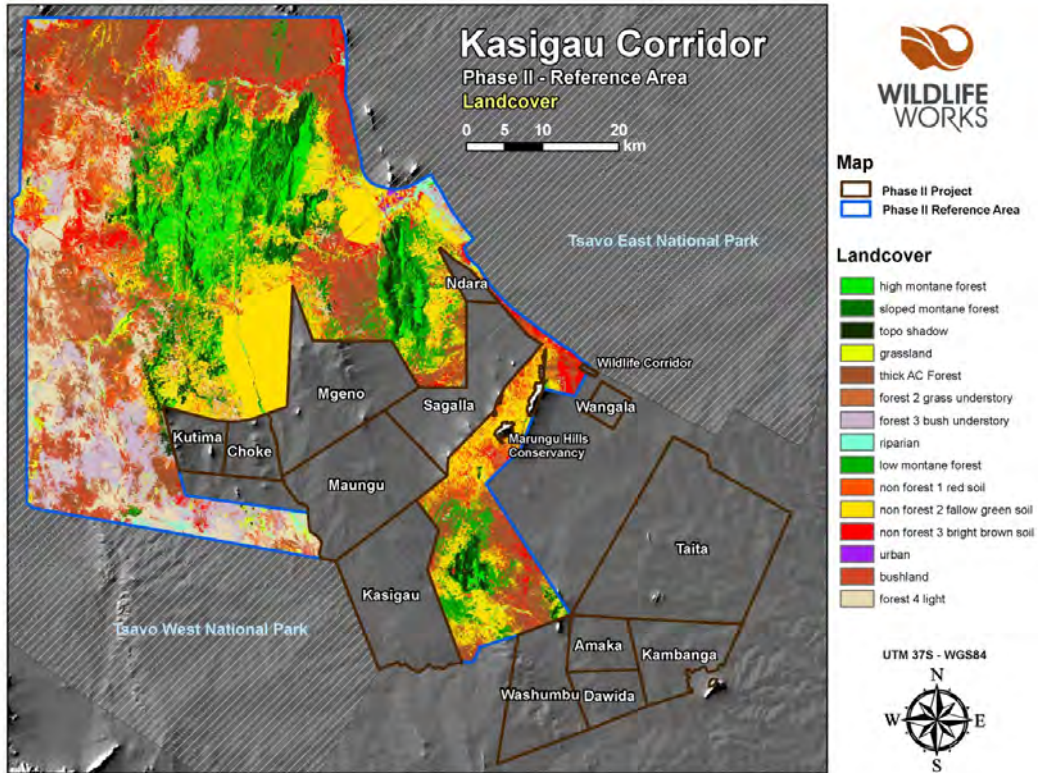
Kasigau Corridor Aspect



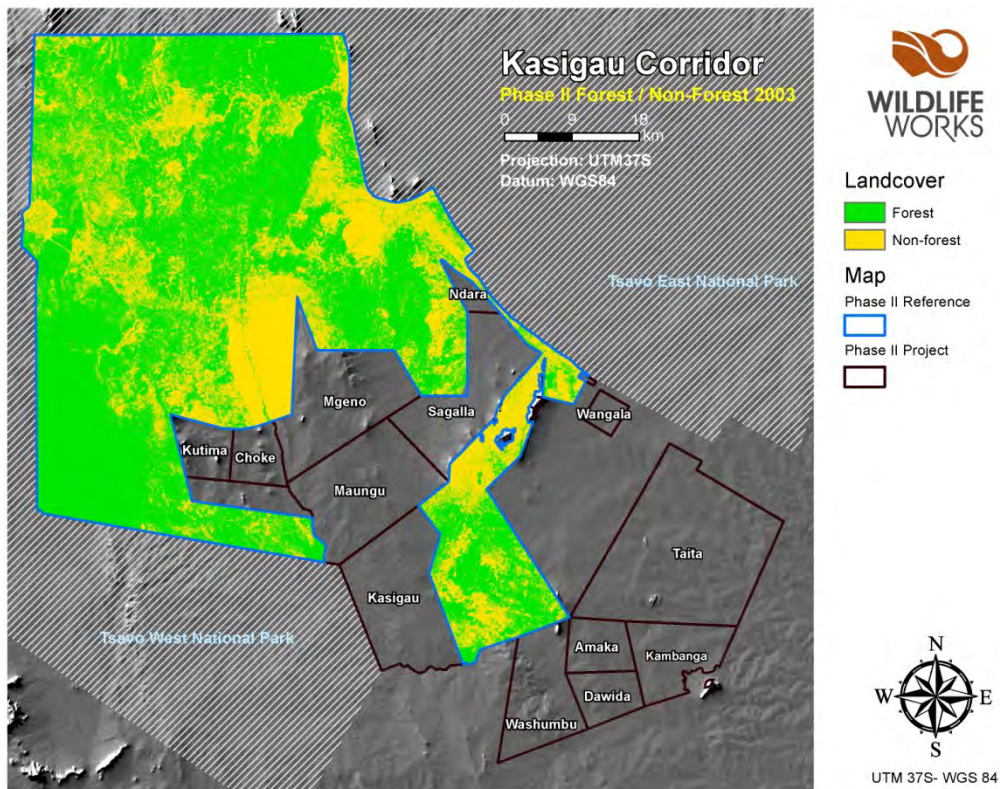
Kasigau Corridor Elevation



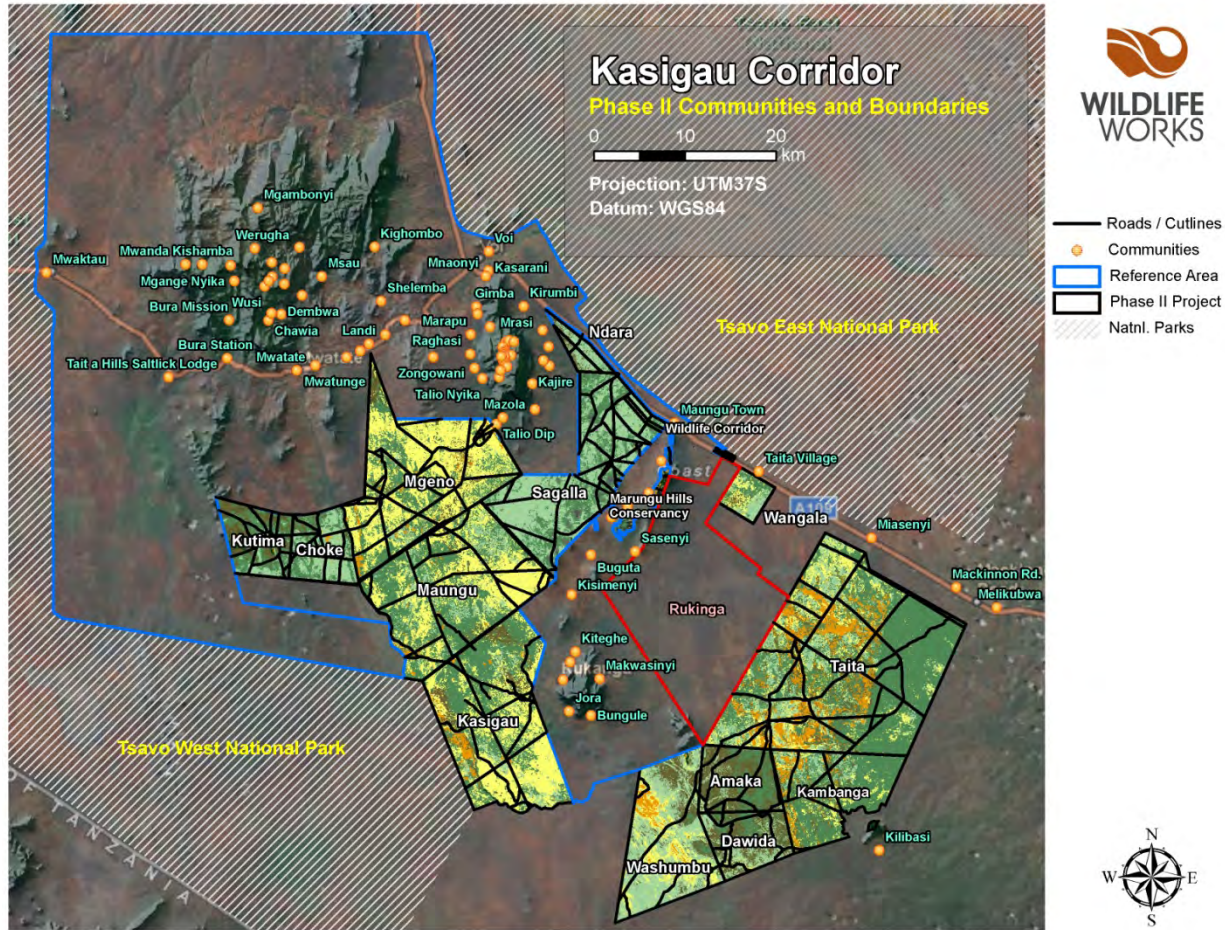
Kasigau Corridor Soil Classes



Kasigau Corridor Phase II reference area thematic landcover



Kasigau Corridor Phase II forest / non-forest, 2003



Kasigau Corridor Phase II communities and roads

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 start date, January 1st, 2010. Wildlife Works then located historical imagery covering as much of the reference area as possible, both on a spatial and temporal basis. The table below indicates imagery used in building the cumulative deforestation model (CDM).

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 validator 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.

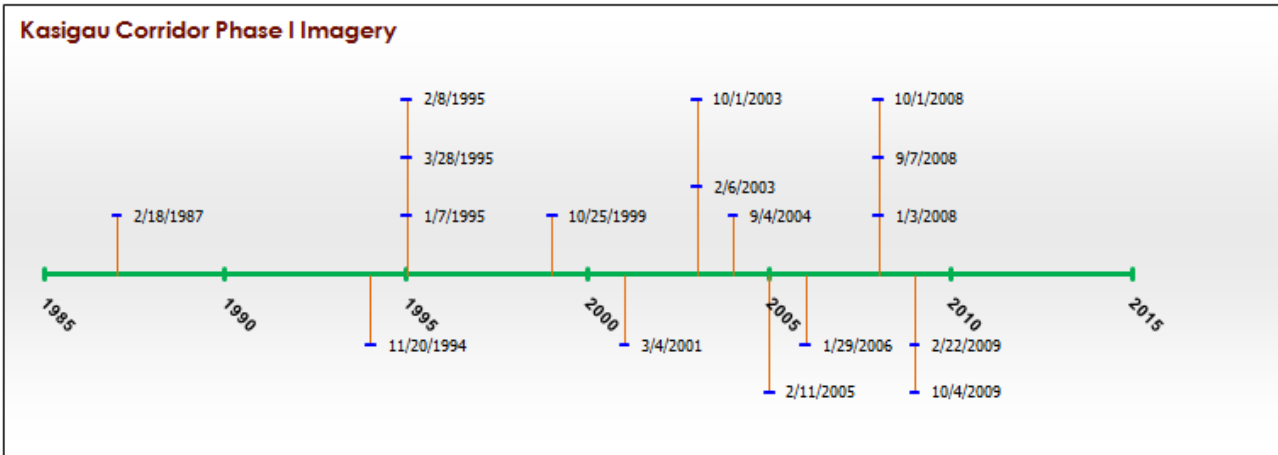
Kasigau Corridor Phase II Available Imagery

	Image Number	Image Year	plot line height	Imagery date	Satellite/sensor	Tile / record	Used in CDM?	Notes
Historical Reference Period	1	1987	10	2/18/1987	Landsat 5 - TM	167/62 167/63	YES	
	2	1994	-12	11/20/1994	Landsat 5 - TM	167/62 167/63	YES	
	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	YES	
	7	2001	-12	3/4/2001	Landsat 7 - ETM+	167/62 167/63	YES	
	8	2003	15	2/6/2003	Landsat 7 - ETM+	167/62 167/63	YES	
	9	2003	30	10/1/2003	Quickbird-2 (Multi-spectral)			
	10	2004	10	9/4/2004	Landsat 7 - ETM+	167/62 167/63	YES	SLC-OFF
	11	2005	-20	2/11/2005	Landsat 7 - ETM+	167/62 167/63	YES	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	YES	
	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	YES	SLC-OFF

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.

Historical Reference Period Image Line Plot



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, and then settled on a value of 1968 points after clipping the reference area to all project polygons. To support the collection of data for the CDM, Wildlife Works developed an image classification protocol, and a toolbar, which includes a tool that generates the dot grid overlaid on the historic imagery, and a tool that supports the analyst in performing the deforestation analysis of each of the grid values over time. Additional tools were developed to support other requirements of the MED, including a "double coverage analyzer" and a forest cover calculation tool. An excerpt of the image classification protocol and toolbar user manual is provided below, and the full document was provided to the validator. A toolbar demonstration was also performed.

Excerpt from "Image Classification Protocol"

Evaluating points

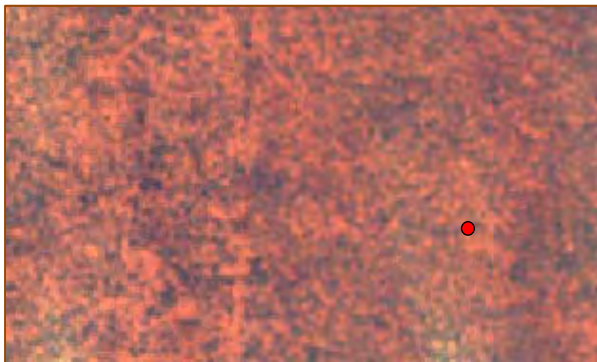
When classifying the points in the grids it is very important to evaluate the area around each point to get a clear understanding of the land cover features and classification type, not just the area directly under the point. Points will often land in transition areas so a thorough review must be done 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.

Example 1: Forests

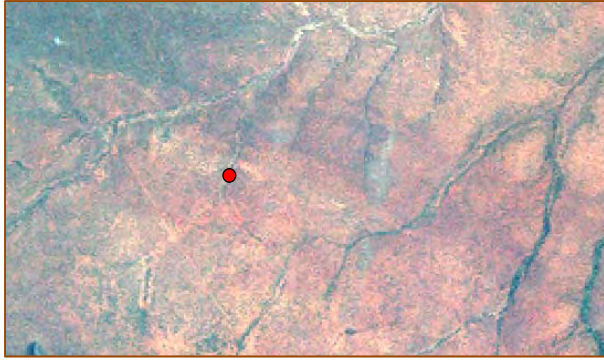
- A. **High density** – This point is in the center of a forest. This forest is consistently deep green and very little to no soil is visible.



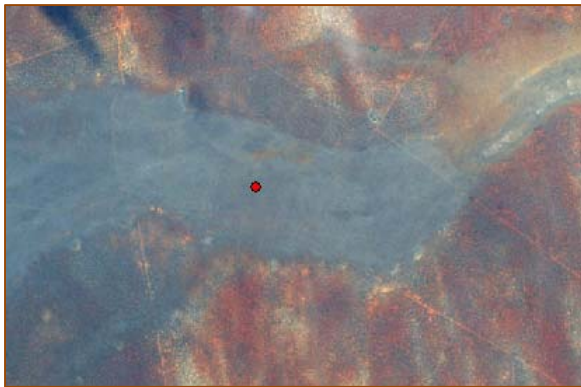
- B. **Low density** – This point is on a low density forest where a lot of soil can be seen. The dark spots in the image are trees and the red area is soil visible between the trees.



- 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.



Example 2: Anthropogenic deforestation

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.



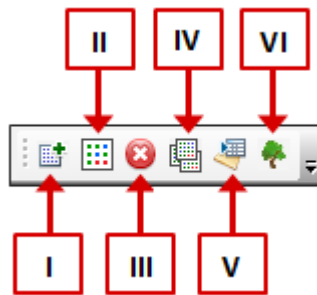
Excerpt from image classification protocol

Excerpt from "How to Use the Wildlife Works Toolbar"

Wildlife Works Toolbar: Grid Creation, Classification and Analysis Tools

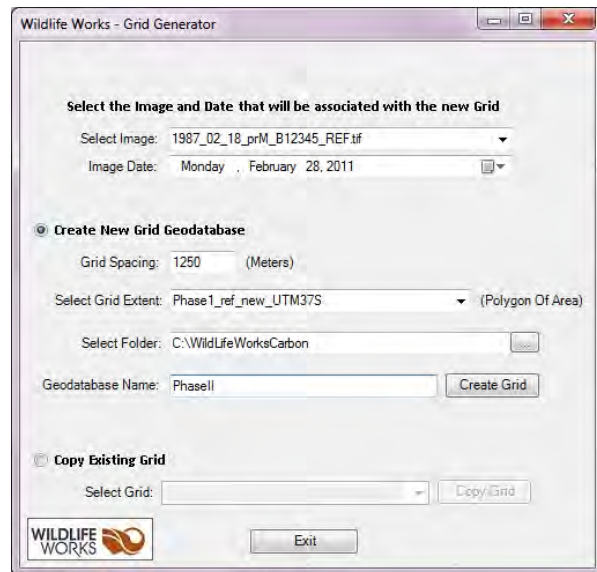
The purpose of the Wildlife Works Toolbar is to standardize and simplify the way the data is collected so that the data is in the correct format to develop a cumulative deforestation model. The toolbar consists of six tools that are designed to generate the grids, classify the points in the grids and perform the spatial analysis required to develop the cumulative deforestation model based on the Methodology for Avoided Mosaic Deforestation of Tropical Forests. The toolbar is an add-in tool for ESRI's ArcGIS Desktop 10, specifically ArcMap. For more information about the Wildlife Works Toolbar see: **Wildlife Works Toolbar User Manual**.

The toolbar consists of six different tools:



I. Grid Generator

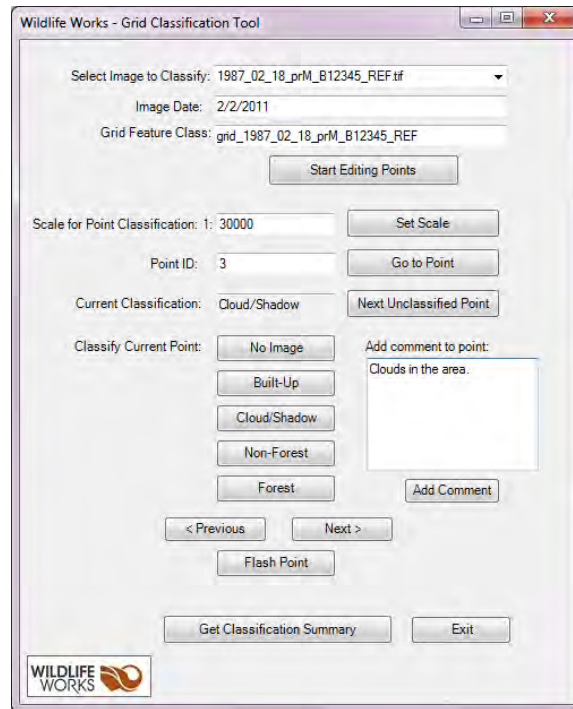
The Grid Generator tool generates a point grid within the extent of the reference area. Once an initial grid has been created for a project, the grid can be duplicated for each of the remaining images in the reference period by using the tool. One grid feature class should be created for each image in the reference period.



II. Grid Classification

The Grid Classification tool is used to classify the point grid based on the land cover identified below and surrounding the point. The point can be classified into the following categories:

- **Forest:** Forest cover consists of any area that is covered with trees and shrubs that has not had any anthropogenic activity.
- **Non-forest:** Non-forest consists of any areas where anthropogenic activity is present and has resulted in the removal of the natural vegetation.
- **Cloud/Shadow:** The cloud and shadow classification type should be used to represent points that fall over clouds or shadows resulting from the clouds that prevent you from clearly seeing the land cover.
- **Built-up:** Built-up should be used to classify points that land on buildings or other structures.
- **No Image:** if an image does not cover the entire reference area, the points that do not cover the image should be classified as No Image.



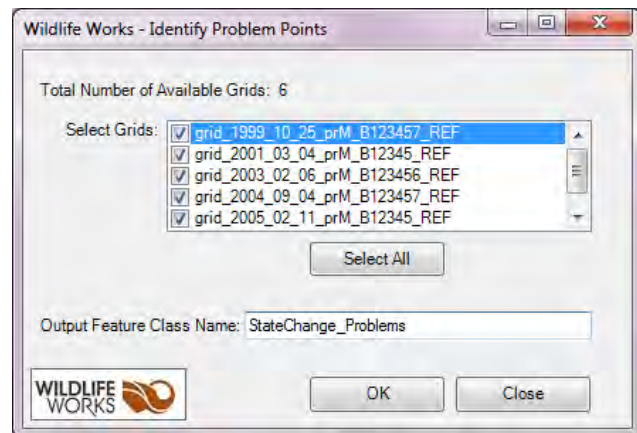
III. Identify Problem Points

The Identify Problem Points tool is used to identify points that have unlikely forest state change during the reference period. For example, it is unlikely that the classification of any given point in the grid would transition from forest to non-forest and then back to forest during the reference period. This tool identifies any points with the following questionable forest state transition over the reference period:

- **Non-Forest** (value = 2) to **Forest** (value = 1)
- **Built-up** (value = 4) to **Forest** (value = 1)

The output from this tool consists of a feature class that contains all of the points that have unlikely forest state transitions during the reference period.

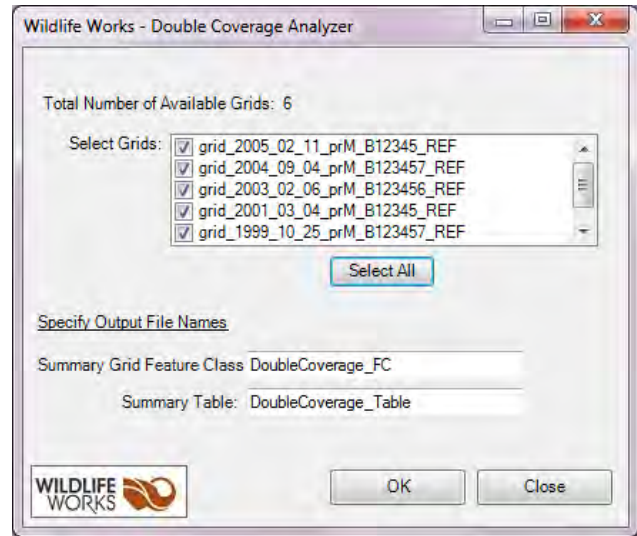
IV.



V. Double-Coverage Analyzer

The Double-Coverage Analyzer tool is used to determine the percentage of the reference area that has at least “double-coverage”. A point is considered to have double-coverage within the reference period if it falls over a cloud-free portion of at least two images. This tool produces two outputs:

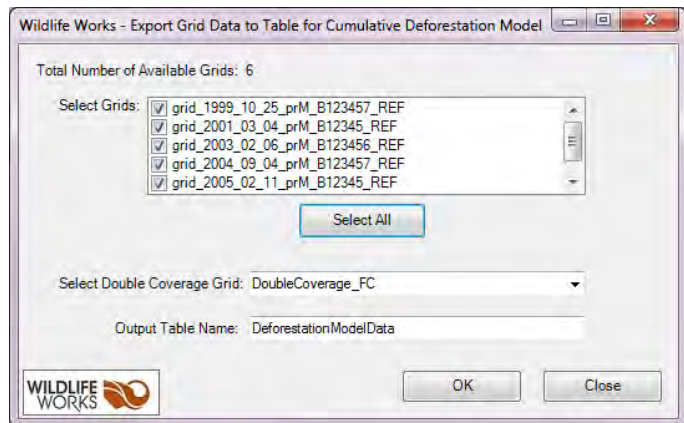
1. **Double-Coverage Feature Class:** Symbolizes the points based on whether the point has double-coverage or not over the reference period.
2. **Double-Coverage Summary table:** Summary of the double-coverage, including point count and percentage of points with double-coverage.



VI. Export Data for Cumulative Deforestation Model

This tool summarizes the results from all of the grids and calculates the observation weight for each point, the number of times each point is observed over time and the number of points in each grid. It also removes all points for which the first point classification is non-forest, and it removes points that do not have “double-coverage” within the reference period. This tool produces the following output:

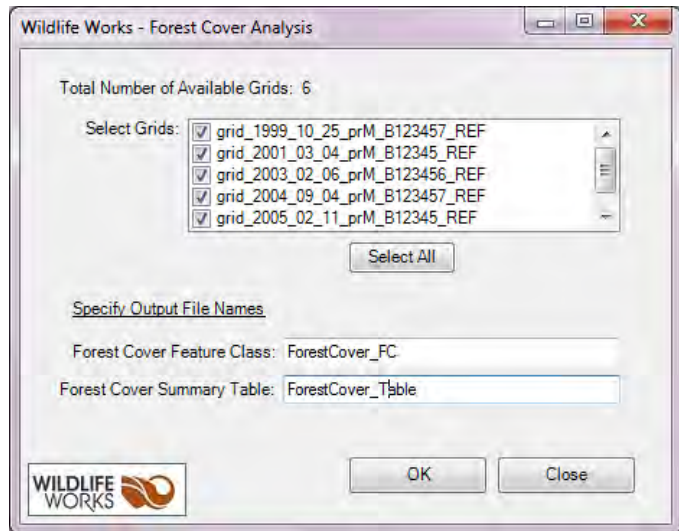
1. **Cumulative Deforestation Model table:** A summary of point data from all of the grids and the observation weight of each point, so that the data is ready to develop the cumulative deforestation model.



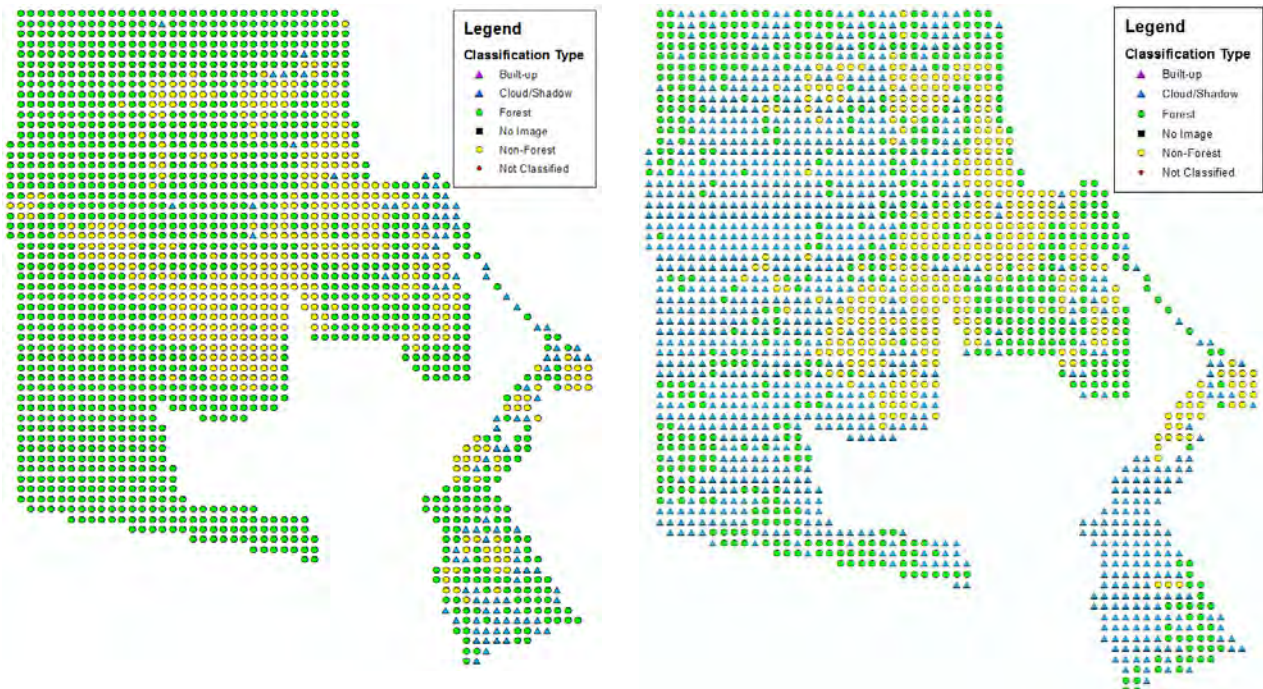
VII. Forest Cover

The Forest cover tool evaluates all of the points in the grids and determines the number of points that have a first classification state of forest. This tool produces the following output:

1. **Forest Cover Feature Class:** Symbolizes the points based on whether the point had an initial classification type of forest or not.
2. **Forest Cover Summary table:** Summary of the initial forest cover in the reference area.

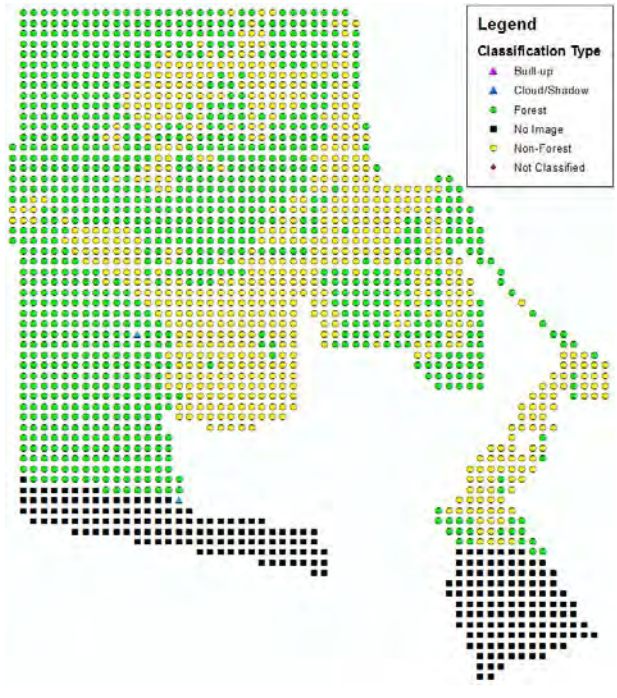


The grid data was collected according to the procedure described in the MED and using the Grid Classification Tool (shown above). The result of this data collection analysis for the Reference Area for all time periods follows:



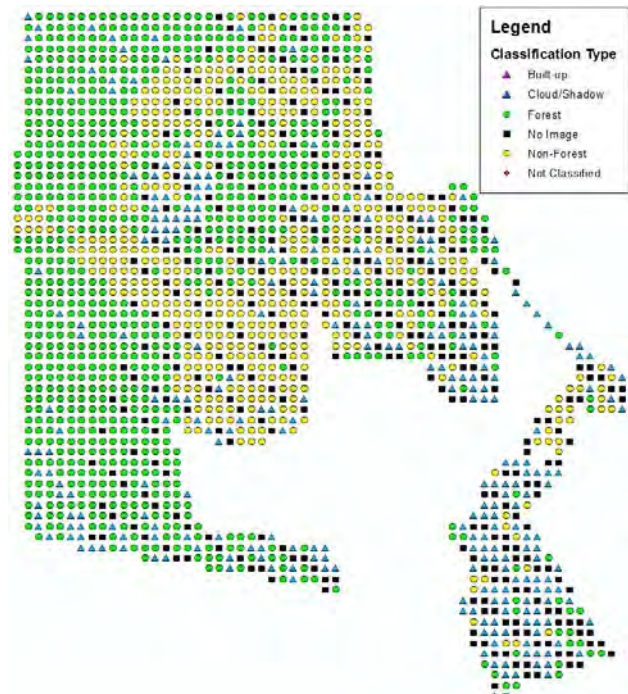
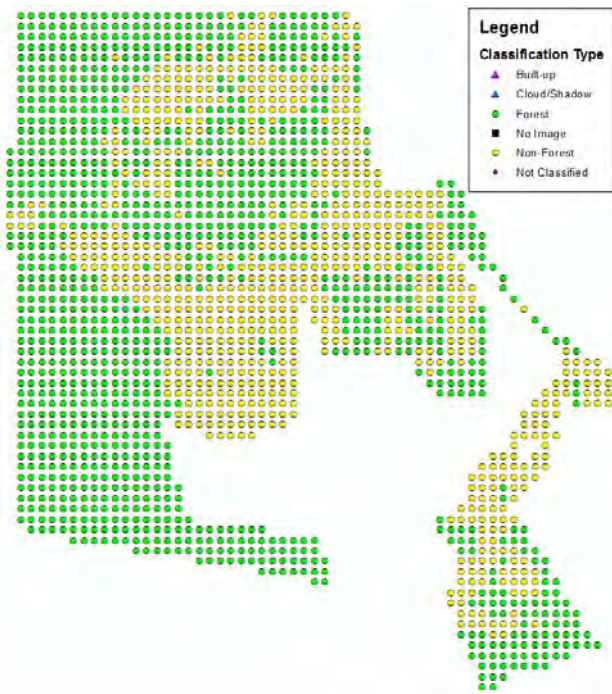
1987

1994



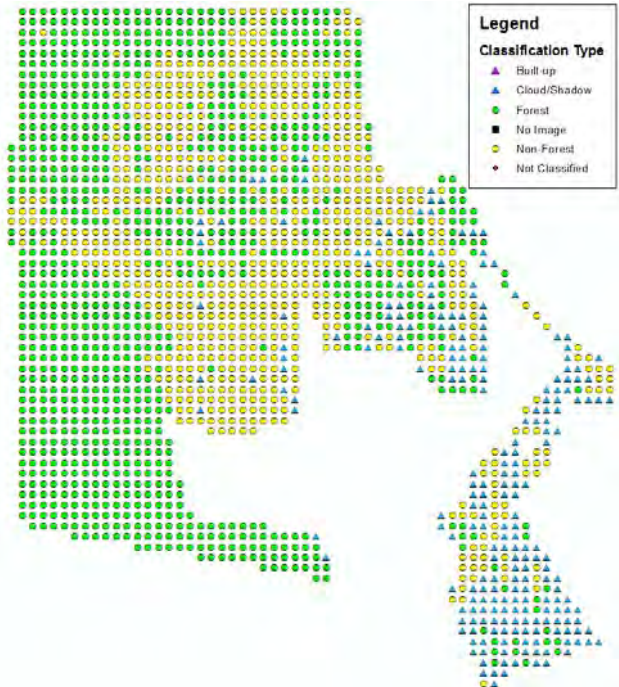
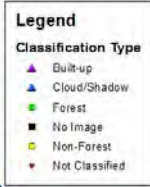
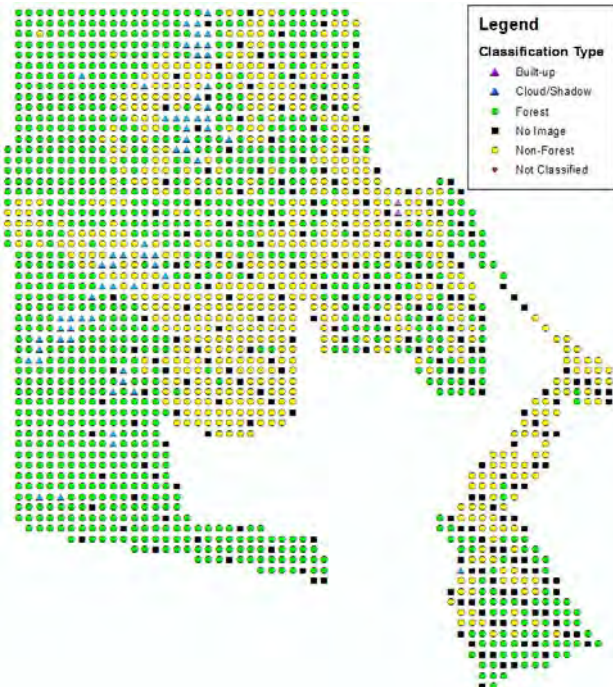
1999

2001



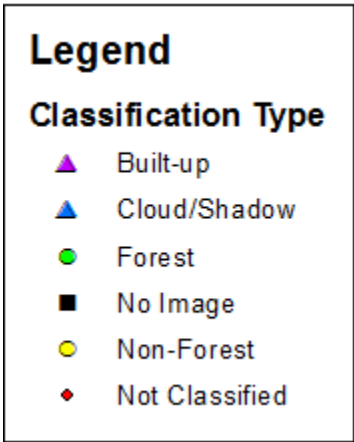
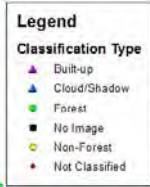
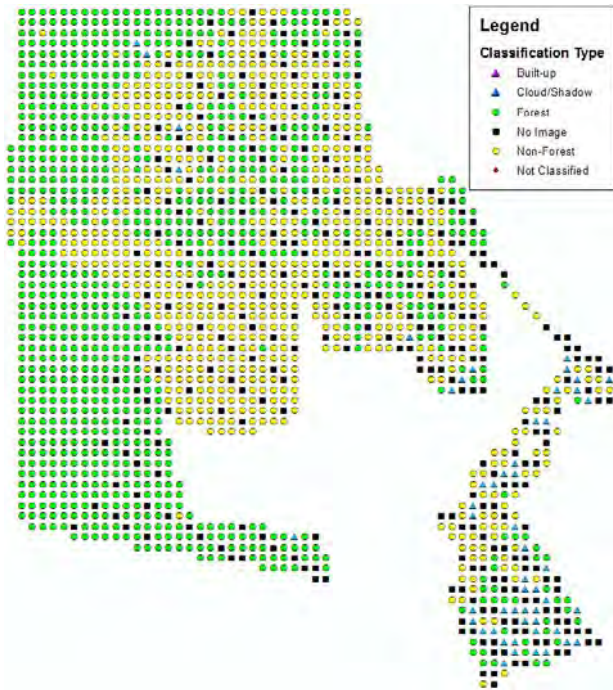
2003

2004



2005

2008



2009

Classification Legend

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 (see excerpt above) 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.

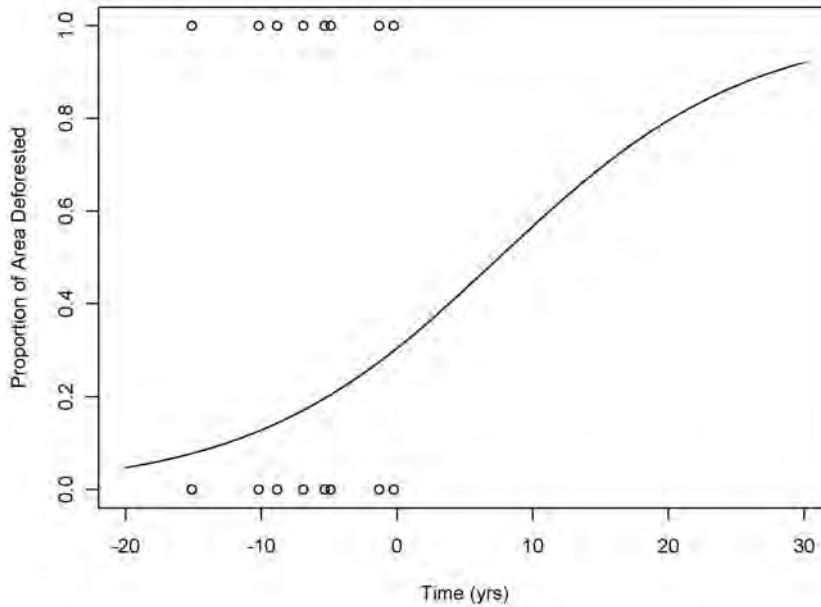
Model	AIC
Forest State = Alpha + Time	4
Forest State = Alpha + Time + Sagalla	6
Forest State = Alpha + Time + Kasigau	6
Forest State = Alpha + Time + (Sagalla + Kasigau)	12

Linear predictors considered and corresponding AICs.

The selected linear predictor, per equation 7 is

$$\hat{\eta} = -0.8230546 + 0.0002991x$$

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.



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

$$y = 0.03069x$$

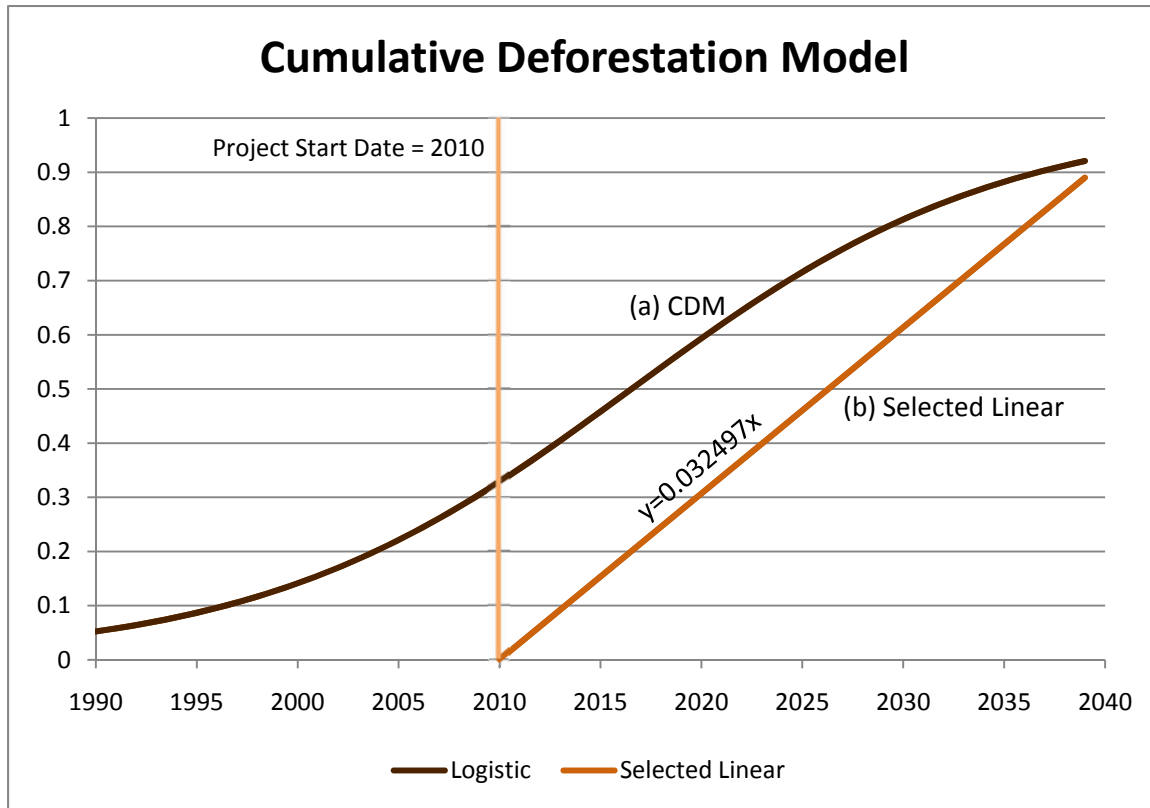
where x is the number of days since the project start date, and y is proportion of area deforested. This linear rate is conservative because it predicts less baseline deforestation than the cumulative deforestation model, does not cross the CDM, and is at least 20 years in length. For the end date of this monitoring period, the projected proportion of cumulative deforestation by the cumulative deforestation model is 0.329, while the linear model is 0.0307, 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	0.03069047

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 the conservative nature of the linear rate.



A plot of the logistic CDM (a) and the selected linear rate (b).

Estimating Uncertainty in the Cumulative Deforestation Model

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

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

$$0.33579384 = \sqrt{0.12954(1 - 0.12954)}$$

where 0.12954 is equal to $\sum_{i \in J} w_i o_i$.

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

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

$$U_{DF} = \frac{1.96 \times 0.375707}{\sqrt{11231} \times 0.12954}$$

where 8650 is the number of state observations made to fit the cumulative deforestation model. The uncertainty in the deforestation model is

$$U_{DF} = 0.053641$$

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 in the Phase II project area. 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.

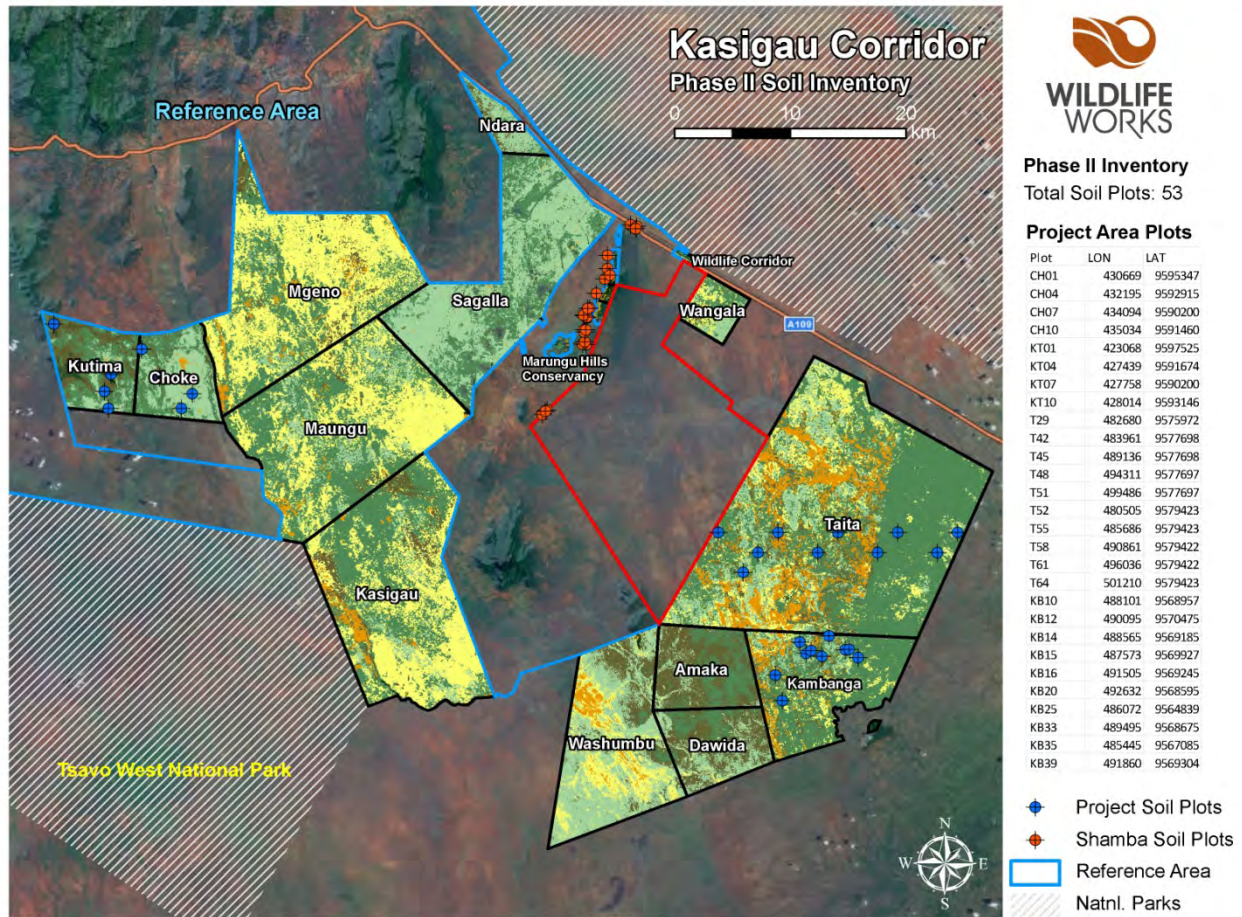
We selected 25 soil sample locations outside of the project boundary in farms (shambas), all at least 10 years since conversion to farm land with conversion as recently as 10 years and as distant as 40 years ago. We also randomly selected 28 locations inside the project on Taita, Kambanga, Choke and Kutima ranches in intact dryland forest, ensuring even spatial coverage of the project area.

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

Name	Location	Primary Subsistence Crop	Age (yrs)	Sample Depth (cm)
Mzungu	Sasenyi	maize and green peas	28	100
Nemu	Marungu	maize & green peas	10	100
Nzangi	Kulikila	maize & green peas	17	100
Ndaro	Sasenyi	maize & green peas	35	100
Ngome	Sasenyi	maize & green peas	37	100
Maziko	Sasenyi	maize & green peas	26	100
Jira M	Sasenyi	maize & green peas	40	100
Kzungu	Sasenyi	maize & green peas	30	100
Kamau	Itinyi	maize & green peas	12	100
Walter	Marungu	maize & green peas	10	100
Kivuva	Itinyi	maize & green peas	20	100
Mwanjila	Itinyi	maize & green peas	10	100
Marungu primary	Marungu	maize & green peas	40	100
J. Mkala	Sasenyi	maize & green peas	40	100
Alima	Marungu	maize & green peas	10	100
Mwikali	Lokichigio	maize & green peas	20	100
Nicholus	Lokichigio	maize & green peas	10	100
M. Ngele	Itinyi	maize & green peas	13	100
Kibarangoma	Marungu	maize & green peas	13	100
F. Kamau	Itinyi	maize & green peas	16	100
Mwanyuma	Marungu	maize & green peas	14	100
Chimanga	Mwagwede	maize & green peas	17	100
Mwadule	Mwagwede	maize & green peas	17	100
Lomitir	Lokichogio	maize & green peas	18	100
M. Mtima	Marungu	maize & green peas	17	100

List of soil samples in the reference region.

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



Soil samples within the Phase II Project Area and Shambas in the Reference Area

For each plot location, soil was sampled to a consistent depth of 1m. We chose this depth due to the results of a pilot study using a few test pits. Analysis showed that soil carbon loss was 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 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. Additionally, soil was sampled to 1m for Phase I of the Kasigau Corridor REDD project. We chose to continue on with this protocol for Phase II.

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 an independent soil laboratory in Nairobi, Crop Nutritional Services, Inc. Wildlife Works has been using this soil sampling laboratory - in fact using the same analyst - for many years. The laboratory analyst / manager, Jeremy Cordingley, 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 "shamba" samples

Farm	Location	Top Soil Bulk Density (g/cm ³)	Top Soil Carbon (%)	Sub Soil Bulk Density (g/cm ³)	Sub Soil Carbon (%)	Total Soil Carbon (t/ha)	Soil GHG Equivalent (t/ha)
Mzungu	Sasenyi	1.57	0.6395	1.42	0.5233	82.13	301.16
Nemu	Marungu	1.43	0.7965	1.36	0.5523	86.75	318.09
Nzangi	Kulikila	1.31	1.34	1.29	0.6395	110.30	404.44
Ndaro	Sasenyi	1.53	0.5058	1.38	0.1744	40.07	146.91
Ngome	Sasenyi	1.57	0.3198	1.36	0.2733	41.08	150.61
Maziko	Sasenyi	1.45	0.3605	1.41	0.2151	36.91	135.34
Jira M	Sasenyi	1.43	0.6221	1.38	0.1919	45.22	165.81
Kzungu	Sasenyi	1.43	0.8140	1.31	0.6221	91.96	337.20
Kamau	Itinyi	1.69	0.1977	1.52	0.343	46.52	170.57
Walter	Marungu	1.5	0.4128	1.47	0.3721	56.86	208.50
Kivuva	Itinyi	1.51	0.4012	1.37	0.2500	42.15	154.54
Mwanjila	Itinyi	1.5	0.7791	1.43	0.2965	64.74	237.38
Marungu Primary	Marungu	1.52	0.2558	1.42	0.1860	30.16	110.58
J Mkala	Sasenyi	1.58	0.2442	1.46	0.3488	47.23	173.16
Alima	Marungu	1.48	0.6395	1.42	0.5058	78.67	288.47
Mwikali	Lokichigio	1.53	0.6860	1.39	0.3372	64.30	235.77
Nicholus	Lokichigio	1.56	0.5000	1.41	0.3779	60.70	222.56
M Ngele	Itinyi	1.33	0.4651	1.57	0.1512	35.17	128.96
Kibarangoma	Marungu	1.57	0.5640	1.5	0.2791	55.86	204.84
F Kamau	Itinyi	1.59	0.5116	1.5	0.2558	51.27	187.97
Mwanyuma	Marungu	1.54	0.4244	1.29	0.5058	65.28	239.37
Chimanga	Mwaqwede	1.56	0.5233	1.38	0.5465	77.28	283.37
Mwadule	Mwaqwede	1.34	0.9128	1.28	0.7616	104.94	384.77
Lomitir	Lokichogio	1.51	0.4419	1.45	0.3547	56.01	205.38
M Mtima	Marungu	1.55	0.4302	1.44	0.3547	55.75	204.43

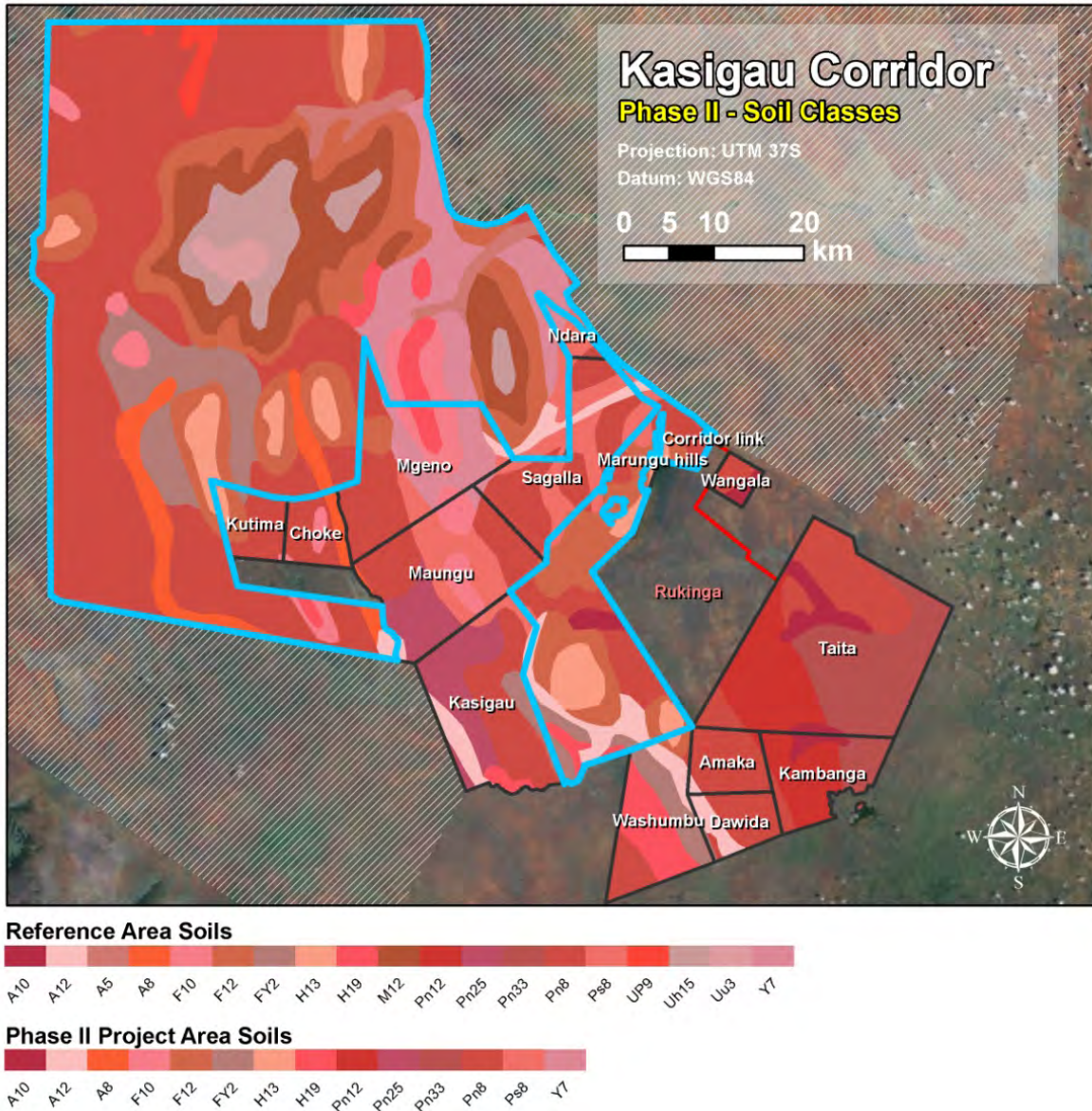
Phase II Project Area Samples

Ranch	Plot	Top Soil Bulk Density (g/cm ³)	Top Soil Carbon (%)	Sub Soil Bulk Density (g/cm ³)	Sub Soil Carbon (%)	Total Soil Carbon (t/ha)	Soil GHG Equivalent (t/ha)
Choke	CH01	1.290	1.470	1.300	0.790	128.779	472.190
Choke	CH04	1.290	1.210	1.310	0.750	115.602	423.874
Choke	CH07	1.420	0.920	1.320	0.480	83.544	306.328

Choke	CH10	1.350	1.090	1.300	0.690	106.935	392.095
Kutima	KT01	1.330	1.070	1.320	0.250	65.793	241.241
Kutima	KT04	1.210	0.800	1.380	0.420	69.612	255.244
Kutima	KT07	1.160	0.510	1.220	0.430	54.470	199.723
Kutima	KT10	1.200	0.960	1.440	0.370	71.856	263.472
Taita	T64	1.348	1.732	1.304	1.099	170.389	624.760
Taita	T52	1.304	1.341	1.324	0.648	112.574	412.773
Taita	T58	1.434	1.436	1.399	1.216	180.784	662.874
Taita	T42	1.377	1.341	1.341	0.880	137.983	505.938
Taita	T29	1.369	1.543	1.332	0.900	147.340	540.248
Taita	T61	1.328	1.484	1.257	0.687	119.512	438.209
Taita	T45	1.446	1.218	1.364	0.674	117.204	429.747
Taita	T48	1.354	1.166	1.302	1.019	140.292	514.404
Taita	T55	1.524	0.915	1.397	0.715	111.797	409.923
Taita	T51	1.247	1.578	1.281	0.868	136.897	501.956
Kambanga	KB10	1.376	1.417	1.467	0.804	141.101	517.372
Kambanga	KB12	1.320	1.186	1.345	0.854	127.347	466.938
Kambanga	KB14	1.382	0.867	1.343	0.781	109.337	400.904
Kambanga	KB15	1.261	1.428	1.279	0.781	123.904	454.316
Kambanga	KB16	1.399	0.731	1.399	0.819	110.916	406.692
Kambanga	KB20	1.179	1.673	1.350	0.884	142.743	523.391
Kambanga	KB25	1.363	1.599	1.357	0.636	125.821	461.342
Kambanga	KB33	1.520	1.001	1.396	0.897	133.236	488.531
Kambanga	KB35	1.416	1.215	1.399	0.883	138.034	506.124
Kambanga	KB39	1.327	1.540	1.299	1.294	178.951	656.155

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 Kenya⁴ from which the soil classification map for the Reference Area, and the supporting data below (please see Appendix B for full sized version), was produced:



Soil classes in the reference and project areas.

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.

2 Soil Classes:

Reference	Area (ha)	Contib area (ha)	Soil Unit(s)	Soil Sub Type(s)	Soil Type	contrib (%)	Lithology	Area (ha)	Contib area (ha)	Phase II
A10	1173.921642	1,174	BK	Calcic Cambisols	Cambisols	100	I	5197.145989	5,197	A10
A12	5620.683267	5,621	VC	Chromic Vertisols	Vertisols	100	UE	6627.308038	6,627	A12
A5	5933.516119	5,934	JE	Eutric Fluvisols	Fluvisols	100	UF			
A8	10101.17409	10,101	JC	Calcic Fluvisols	Fluvisols	100	SC2	1271.911055	1,272	A8
F10	6847.822023	6,848	LC	Chromic Luvisols	Luvisols	100	SO1	6946.436722	6,946	F10
F12	60554.92875	30,277	FR	Rodic Ferralsols	Ferralsols	50	MA2	4553.682411	2,277	F12
		18,166	QF	Ferralic Arenosols	Arenosols	30			1,366	
		12,111	LIC	Ferralo-chromic Luvisols	Luvisols	20			911	
FY2	18239.36256	10,944	LC	Chromic Luvisols	Luvisols	60	MA2	5528.70361	3,317	FY2
		7,296	KH	Haplic Kastanozems	Kastanozem	40			2,211	
H13	13832.11353	8,299	RE	Eutric Regosols	Regosols	60	IA1	922.70311	554	H13
		1,383	DK	Calcic Chernozems	Chernozems	10			92	
		1,383	OK	District Histosols	Histosols	10			92	
		2,766	ROCK	Eutric Regosols	Regosols	20			185	
H19	6271.765671	6,272	EC	Cambic Rendzinas	Rendzinas	100	SC3	7594.235273	7,594	H19
M12	30348.07007	21,244	BH	Humic Cambisols	Cambisols	70	MA			
		6,070	RD	Dystric Regosols	Regosols	20				
		3,035	ROCK	Eutric Regosols	Regosols	10				
Pn25	37.165606	37	DC	Calcic Chernozems	Chernozems	100	SO1	12291.55189	12,292	Pn25
Pn8	121166.9486	121,167	FR	Rodic Ferralsols	Ferralsols	100	MA2	64848.9541	64,849	Pn8
Ps8	4069.689618	4,070	LF	Ferric Luvisols	Luvisols	100	MB3	15138.58191	15,139	Ps8
UP9	2913.744959	2,914			Other	100				
Uh15	14188.00868	8,513	AC	Chromic Acrisols	Acrisols	60	MA2			
		2,838	B	Cambisols	Cambisols	20				
		2,838	F	Ferralsols	Ferralsols	20				
Uu3	2893.226313	1,447	U	Rankers	Rankers	50	MA			
		1,447	DH	Calcic Chernozems	Chernozems	50				
Y7	19606.01947	19,606	LIC	Ferralo-chromic Luvisols	Luvisols	100		6986.123216	6,986	Y7
			FR	Rodic Ferralsols	Ferralsols	50	MA2	16776.1431	8,388	Pn12
			FO	Orthic Ferralsols	Ferralsols	50			8,388	
			LO	Orthic Luvisols	Luvisols	70	SC3	18982.40824	13,288	Pn33
			AO	Orthic Acrisols	Acrisols	30			5,695	
total:		323,798							173,666	

Soil Comparison		
Type	Reference	Phase II
Cambisols	7.80%	2.99%
Vertisols	1.74%	3.82%
Fluvisols	4.95%	0.73%
Regosols	6.23%	0.43%
Ferralsols	47.65%	48.31%
Chernozems	0.89%	7.13%
Histosols	0.43%	0.05%
Luvisols	16.55%	26.83%
Kastanozems	2.25%	1.27%
Acrisols	2.63%	3.28%
Rankers	0.45%	0.00%
Rendzinas	1.94%	4.37%
Arenosols	5.61%	0.79%
Other	0.90%	0.00%
total:	100.00%	100.00%

Soil type comparison between the Phase II Project Area 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 soil sampling team has been collecting soil samples for over two years in the project area and has collected well over 150 soil samples during that time. Our VP African Field Operations, Rob Dodson, personally trained the teams as to the proper procedures and he and the VP Carbon Development

conduct periodic field 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

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

$$\hat{\ell}_{max} = 1 - \frac{224.01}{445.60}$$

$$\hat{\ell}_{max} = \mathbf{0.4973}$$

where 224.01 is the estimated mean carbon stock (tonnes CO₂e/ha) of shambas in the reference area and 445.60 is the same for the project area. The default of 20% was selected for the 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

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

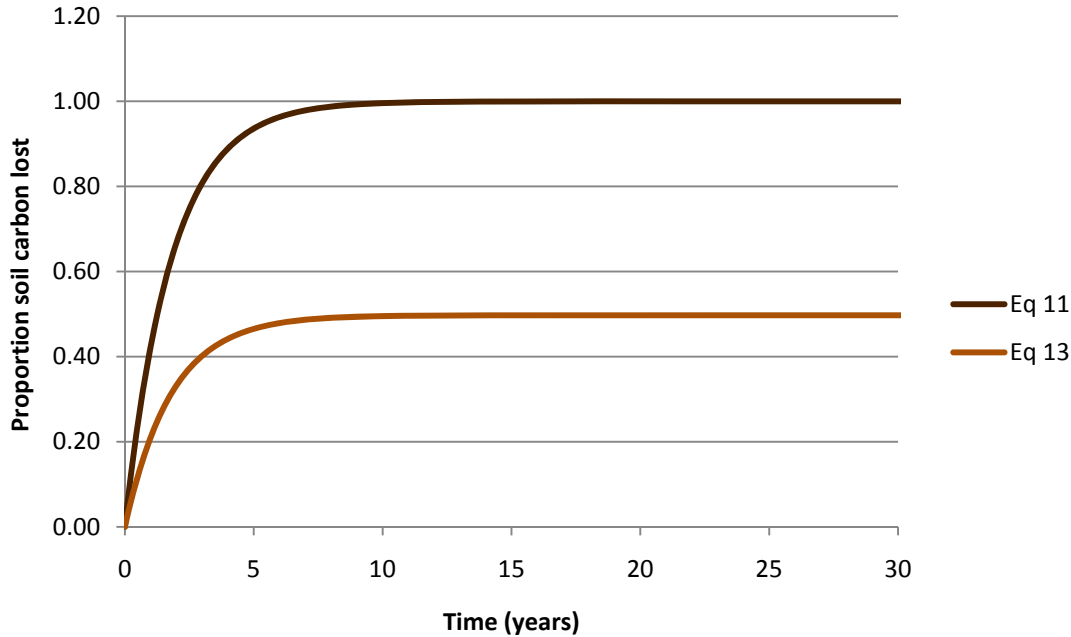
$$= \ell_{max}[1 - \exp(-\lambda t_2) - 1 + \exp(-\lambda t_1)]$$

$$S(t_1, t_2, \lambda, \ell_{max}) = \mathbf{0.497}\{[1 - \exp(-\mathbf{0.55}t_2)] - [1 - \exp(-\mathbf{0.55}t_1)]\}$$

Predicting Soil Carbon Loss

The final soil model is displayed by equations 11 and 13 in the plot 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 0.497.

G(t, lambda)



Equation 11 (general soil loss form) and Equation 13 (general carbon loss form applied for Phase II)

Estimating Uncertainty in the Soil Carbon Loss Model

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

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

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

$$U_{SCL} = 0.1391$$

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 the Phase II project area 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 de minimus 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.



Local farmer's house in the Phase II reference area

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 community group cattle ranch:

Since the implementation of the REDD project in the Phase II project zone, the Project Proponent has spent a significant and unsustainable amount of money financing activities to attempt to protect the Phase II forests from destruction, including additional ranger patrols, patrol vehicle purchase, expanded community investments etc.. Those activities provide no significant sources of income from the land to offset the land protection costs. The ranch lands were being degraded prior to the project start date when the Project Owners could not afford significant protection, and the inability of the Project Proponent to continue to protect the forest in the absence of carbon funding is clear.

b. Land use in the ten years prior to Project start date:

Cattle Ranching - The current majority landowners of each of the ranches all acquired their respective interests in the 13 Community Ranches more than 10 years prior to the proposed Project Start Date. For most of the prior ten years, the owners of most of the ranches were leasing their land on a financially unsustainable basis to commercial Somali cattle ranchers, who frequently overloaded the land in violation of their lease and overgrazed the lands to the point of damage to the Dryland Forest. The area is too dry with no permanent water for sustainable cattle ranching, and there was predation by lions on the cattle which lead to poisoning of lions by the herders and other significant human wildlife conflicts.

Illegal Charcoal – in several of the ranches there were small scale illegal charcoal operations that provided a small income to the ranches but was significantly degrading the forest by taking out the best hardwoods.

Ecotourism - The owners of one of the community ranches had a failed ecotourism facility on their land, which failed because of pressure from poaching and overgrazing by large illegal Somali cattle herds, which made it difficult for the local tourism operator to provide a wildlife product to his safari guests.

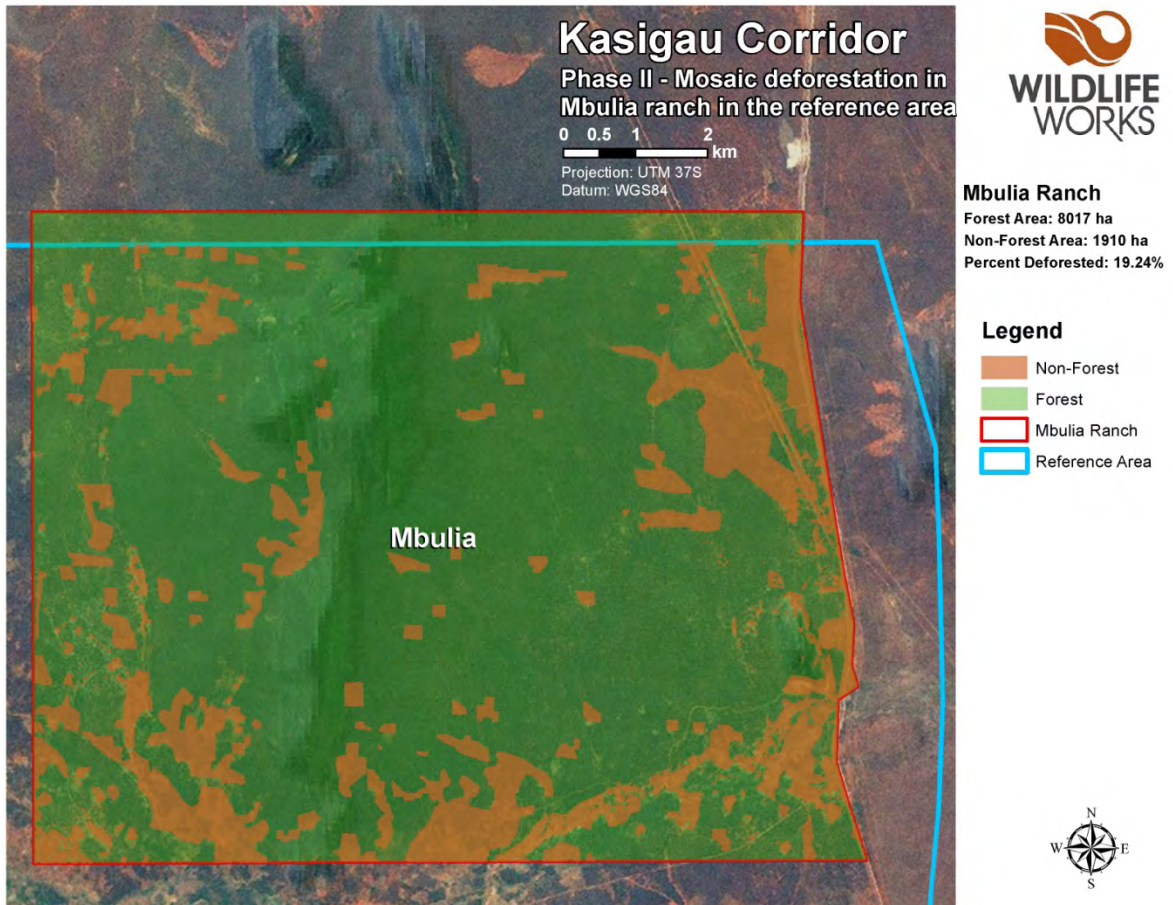
c. Slash and Burn Agriculture by subsistence farmers:

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. To demonstrate this case in point, an evaluation of the reference area was performed. The reference area contains group ranches under identical land tenure (group-owned ranches) as those within the project area. The map below depicts Mbulia ranch landcover analysis using Landsat 7 ETM+ data from 2009. The classification confirms that the land tenure status, identical to that within the project area, offers little to no protection against incursion, and it can be easily observed below following a classic mosaic configuration. The analysis shows that nearly 20% of the ranch has been deforested illegally through 2009. Please refer to the map in section 6., which shows all group ranches in the reference area overlaid on 10m high-resolution visible imagery for further evidence of illegal incursion, despite legal ranch boundaries.



Mbulia Ranch in the Kasigau Corridor reference region

Thus, all the land uses above are considered 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 are projected to cost the Project Proponent approximately \$1,000,000 per year. 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 in areas 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 carbon pools measured in the project area, which are then applied to the Cumulative Deforestation Model (determined by sampling historical imagery with the Wildlife Works classification tools). 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 *gross* estimated baseline emissions for the first monitoring period are **1,253,588 tonnes CO₂e**. These emissions are based on the selected linear predictor of cumulative deforestation. It should be noted that it is not required 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 'Phase II NERs v6, 04/19/2011' provides complete Net Emissions Reduction (NER) analysis for the 30 year project crediting period, and has been provided to the validator.

	2010	2011	2012	2013	2014	2015
Linear Model (%)	3.07%	6.14%	9.21%	12.28%	15.35%	18.41%
AGLT	323,011	323,011	323,011	323,011	323,011	323,011
BGLT	129,204	129,204	129,204	129,204	129,204	129,204
AGST	0	0	0	0	0	0
BGST	0	0	0	0	0	0
AGNT	26,523	26,523	26,523	26,523	26,523	26,523
BGNT	10,609	10,609	10,609	10,609	10,609	10,609
SDW	0	0	0	0	0	0
LDW	0	0	0	0	0	0
WP	0	0	0	0	0	0
SOIL	769,090	1,023,567	1,107,768	1,135,629	1,144,848	1,147,898
Total Emissions	1,253,588	1,508,066	1,592,267	1,620,128	1,629,346	1,632,397

Gross baseline emissions by carbon pool and year for the first 6 years of the Phase II project.

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

For a comprehensive list of project activities / leakage mitigation activities, please refer to section 6 Baseline Scenario, subsection " List of Project Activities designed to mitigate deforestation" of this document. An overview of leakage mitigation categories carried out by Wildlife Works is presented below:

- 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 have 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.
- 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.

- Fuelwood and sustainable charcoal (see *EcoCharcoal Project Design Document.docx*, 2/28/2011):
 - a) We are establishing 5 organic greenhouse extensions within the Project area to produce fuelwood and other agroforestry 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 region for this project is identical to the reference area, which consists of 249,901 ha of forest. The MED stipulates that this leakage area must contain at least as much forested area as does the project area, which in turn contains 160,048 ha (see Section 6.3 for this analysis). Several polygons were extracted from this leakage area. The leakage polygons shown in the map in section 10.3.2 below, were selected from forested areas within the leakage area 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 (leakage area) is very remote and unlikely to suffer leakage. Soil fertility and 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.

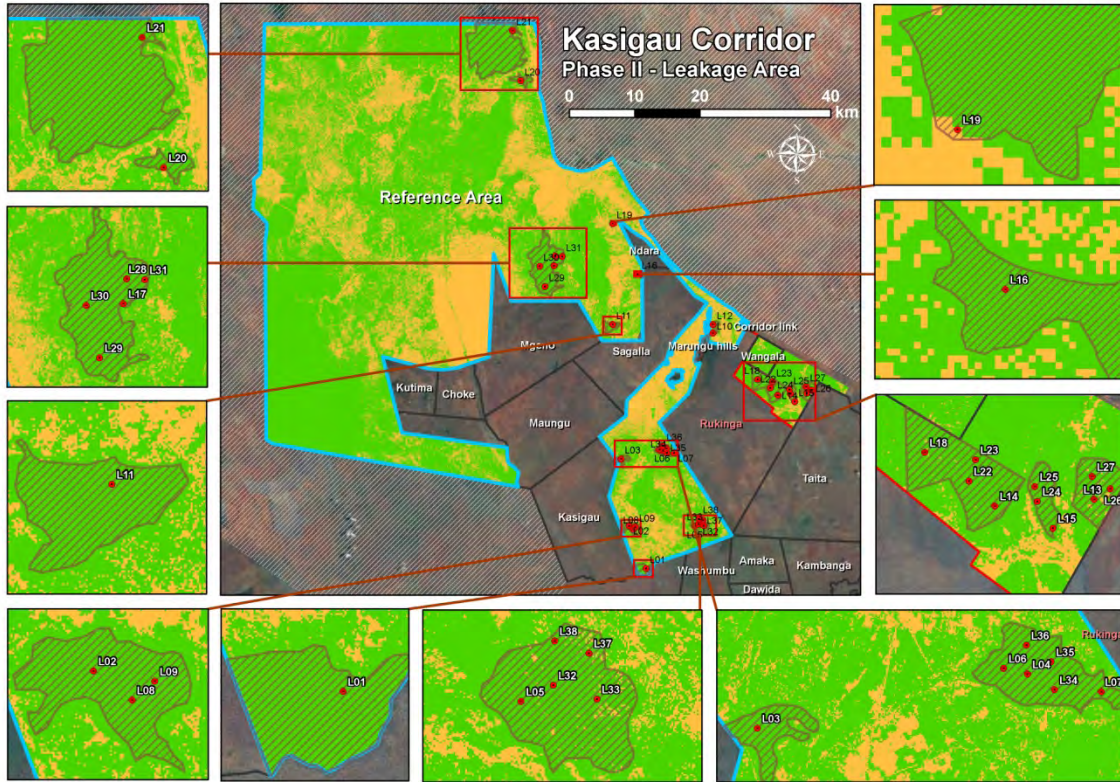
Equation [10], dependent on the standard deviation of the forested state observations, was used to calculate the number of sample point locations required, and yielded a result of 38 locations within the leakage area

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

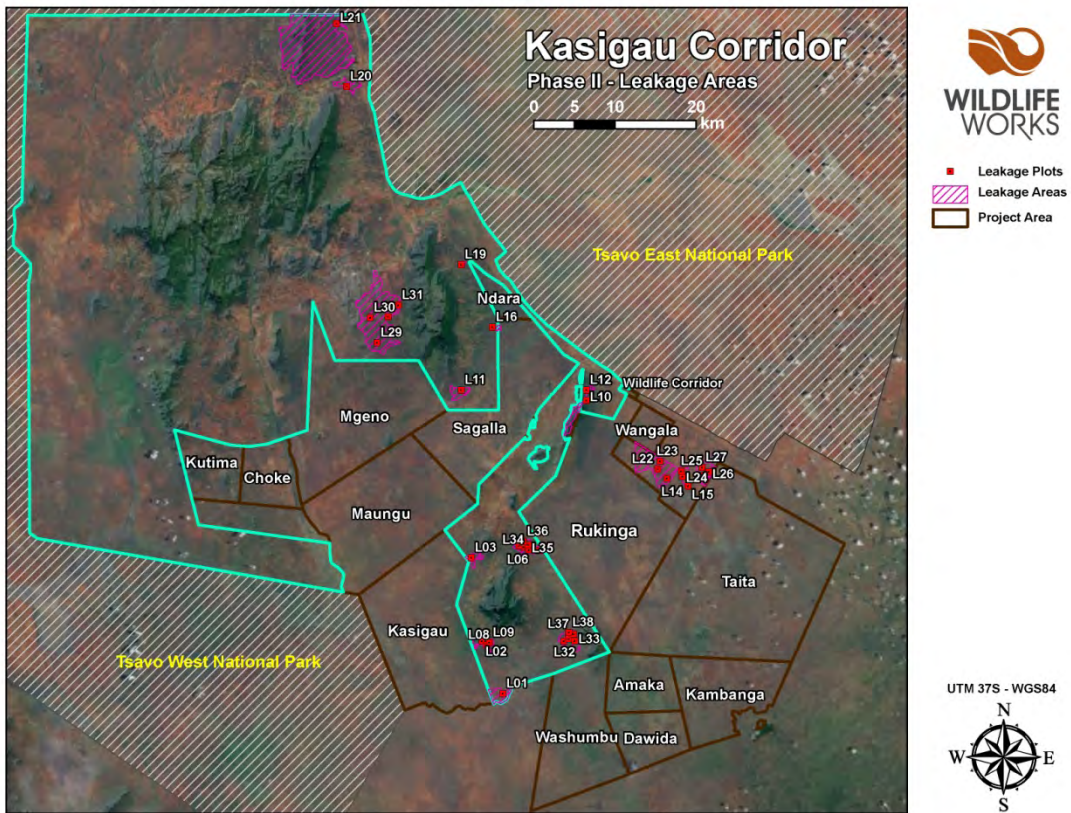
$$\hat{m}_{LE} \geq \left(\frac{(.3126)(1.96)}{0.1} \right)^2$$

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

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.



Leakage plots overview (below) and exploded view overlaid on a forest/non-forest map (above)



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			Degradation % Dec, 2010	value
Plots	Point X	Point Y		
L01	462290.6	9566407.4	0-20	0.2
L02	459730.6	9572807.4	41-60	0.6
L03	458450.6	9583047.4	21-40	0.4
L04	464850.6	9584327.4	0	0
L05	469786.6	9572839.4	21-40	0.4
L06	464287.6	9584462.4	61-80	0.8
L07	466596.6	9583913.4	21-40	0.4
L08	460305.6	9572376.4	61-80	0.8
L09	460640.6	9572657.4	61-80	0.8
L10	472530.6	9602247.4	0-20	0.2
L11	457170.6	9603527.4	61-80	0.8
L12	472530.6	9603527.4	0-20	0.2
L13	486859.7	9593065.8	0-20	0.2
L14	482453.6	9592769.8	21-40	0.4
L15	485034.1	9591786.5	41-60	0.6
L16	461010.6	9611207.4	41-60	0.6
L17	448210.6	9612487.4	21-40	0.4
L18	479344.8	9595139.2	20-40	0.4
L19	457170.6	9618887.4	0-20	0.2
L20	443090.6	9640647.4	0	0
L21	441810.6	9648327.4	0	0
L22	481307.2	9593867.3	0-20	0.2
L23	481598.5	9594812.8	21-40	0.4
L24	484344.9	9592969.2	0-20	0.2
L25	484231.9	9593633.8	21-40	0.4
L26	487579.8	9593521.9	0-20	0.2
L27	486771.0	9594064.8	0-20	0.2
L28	448401.6	9613947.0	61-80	0.8
L29	446810.4	9609307.4	61-80	0.8
L30	446012.1	9612379.7	41-60	0.6
L31	449457.4	9613888.1	21-40	0.4
L32	470359.3	9573125.2	61-80	0.8
L33	471130.8	9572882.0	41-60	0.6
L34	465491.1	9583961.7	21-40	0.4
L35	465407.2	9584618.5	21-40	0.4
L36	464821.6	9585006.8	0-20	0.2
L37	470989.6	9573694.4	41-60	0.6
L38	470380.8	9573910.4	21-40	0.4

Leakage Area Polygons	
perimeter (m)	area (m ²)
409,233	262.3
83,361	23.6
179,049	52.2
308,573	248.8
695,873	371.4
325,981	162.6
405,826	394.2
382,952	279.5
709,497	1,346.7
309,368	256.7
347,347	493.4
1,282,955	2,992.8
1,507,221	5,617.0
339,346	342.1
361,201	472.1

Leakage polygons (ha) **13,315**
 Forested *project* area (ha) **160,048**
 Forested *Leakage* area **249,901**

deg	value
0	0
0-20	0.2
21-40	0.4
41-60	0.6
61-80	0.8
81-100	1.0

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 **0.421053**, applied to equation 9 to compute the lag period as

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

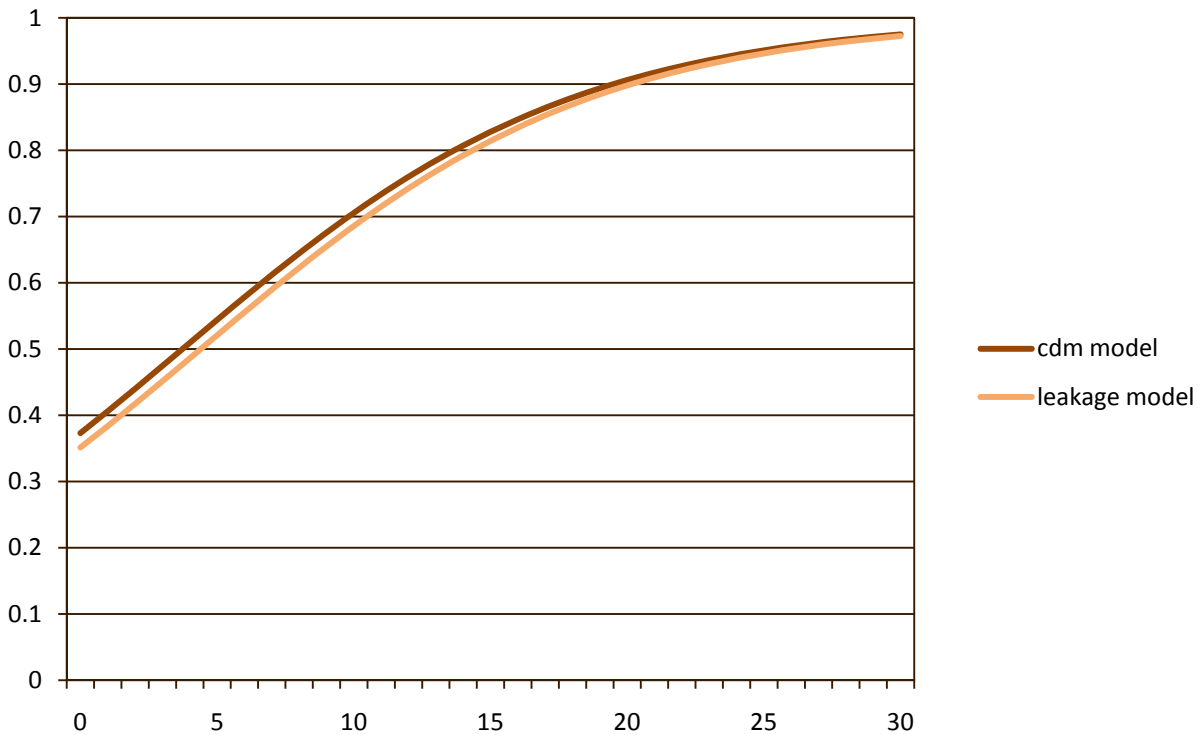
$$\hat{\delta}_{LE} = \log(0.421053) + \log(1 - 0.421053) + 0.5196534$$

$$\hat{\delta}_{LE} = -0.09337$$

And the final leakage model per equation 8 is then

$$F_{LE}(t, \hat{\eta}, \hat{\delta}_{LE}) = \frac{1}{1 + \exp(-(-0.5196534 + 0.0003817x) + 0.09337)}$$

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



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 **0.421053** 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 **250,718** and **1,002,871 tonnes CO₂e** to buffer pool and issuance, respectively.

Component	Value
Estimated Baseline Emissions	1,253,588
Uncertainty Deduction	0
Project Emissions	0
Emissions from Leakage	0
Gross Total NERs	1,253,588
NERs to Buffer Pool (20%)	250,718
Net Total NERs	1,002,871

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

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

$$U^{[m]} = \sqrt{\frac{[15,944,631 \cdot 0.053641^2 + 15,944,631 \cdot 0.0800^2 + 75,311,455.22 \cdot 0.1391^2]}{(2 \cdot 15,944,631) + 75,311,455.22}}$$

$$U^{[m]} = \mathbf{0.1224 (12.2\%)}$$

where the inputs are presented below.

Variable	Description	Value
$C_{TOTAL}^{[1]}$	Total forest carbon stock at monitoring period [1]	15,944,631
$C_{SOIL}^{[1]}$	Soil carbon stock within the project area at monitoring period [1]	75,311,455
U_{DF}	Estimated uncertainty in the CDM	0.053641
$U_{TOTAL}^{[1]}$	Estimated uncertainty of total carbon stocks at monitoring period [1]	0.0800
U_{SCL}	Estimated uncertainty in the soil carbon	0.1391

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 **48,448,769 tonnes CO₂e**.

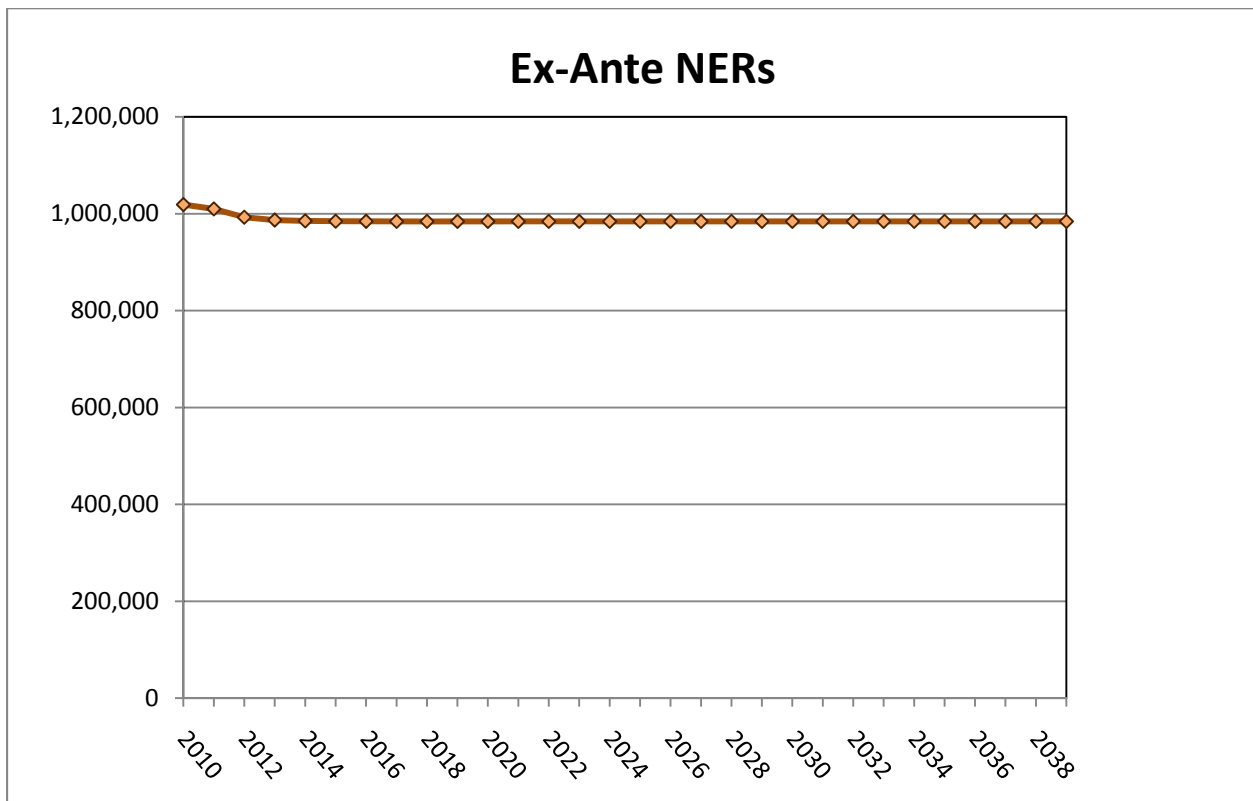
The project activities described in detail in Section 10 Leakage and Section 6.1 Baseline Scenario Overview, were specifically designed to mitigate deforestation and human-wildlife conflict, and therefore

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 uses a conservative value of 20% ex-ante leakage deduction. Applying this factor to gross NERs yields an estimate of total net NERs over the project lifetime of:

$$\text{Net ex - ante NERs} = 48,448,769 - (48,448,769 * 0.20)$$

$$\text{Net ex - ante NERs} = 38,759,015$$

This analysis is available in the spreadsheet *Phase II NERs v6.xlsx, 04/19/2011*, 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 certainly vary from these conservative ex-ante estimates.



Ex-Ante Calculation of NERs for the Phase II project lifetime.

Section 13 Monitoring

Section 13.14 Monitoring of Carbon Stocks in the Project Area

Summary of sampling procedures

(See *Standard Operating Procedure - Biomass* and *Standard Operating Procedure - Soils* provided to the validator for detailed field protocols)

The Project area comprises 169,741 ha of dryland forest located in the southeast of Kenya. Altitudes range from approximately 450m to 1000m (see elevation map in section 6.3 The Reference Region), and the ecosystem encompasses montane forest on the slopes of the higher elevations, transitions through Acacia-Commiphora dryland forest at mid elevations and levels at grassland-dominated savannah at the lowest elevations. In order to most accurately estimate biomass in the Phase II project area, with reasonable time and expense, we divided the area into 7 landcover strata based on ecosystem type, as there is a high perceived variation in average biomass across the 6 forest strata, with larger trees in high density in the dense montane forest stratum, medium to large trees and lots of shrubs in the middle dryland forest strata and scattered trees, very few shrubs and heavy grass cover in the grassland / sparse stratum. Overall, the 7 strata sum to the total project land area, depicting overall landcover in the Phase II project.

Biomass plot sampling was conducted throughout the monitoring period under the supervision of Wildlife Works VP Carbon Development Jeremy Freund and VP African Field Operations Rob Dodson. All plot sampling was conducted using the same successful, exacting protocol that was used for the Kasigau Corridor Phase I, Rukinga Sanctuary VCS project. Proper adherence to the SOP was ensured throughout the sampling process for all 13 group ranches.

To most accurately estimate biomass in the sanctuary, within the monitoring period at reasonable cost, we determined that a stratified random plot sampling technique would be best suited to the project area. A total of 429 Plots were overlaid on each of the 13 group-owned ranches in a stratified random pattern for all strata identified in the landcover map shown below, and the Biomass SOP was used to collect a comprehensive forest inventory, also summarized below.

Soil inventory coordinates were provided to the soil plot sampling teams by our GIS team, at randomly selected forest plot locations, in a subset of ranches, as well as in shambas (farms) adjacent to the project area. They sampled using the following method, illustrated further in the Standard Operating Procedure Soils provided separately to the validator.

Step1 For a plot inside the Project Area, coordinates are provided to the soil plot sampling teams by our GIS team, at randomly selected forest 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 30cm is piled together and the larger lumps are smashed with the back of a hoe.

Step 4. While 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 30cm - 100cm (subsoil) 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, age and other identifying qualities for the farm and any comments are recorded on the bag and in the sampling notes, and Top Soil(0-30cm) and Sub Soil(31-100cm) are recorded for the respective samples. Care is 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 to us in 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.

Additional training and field audits were conducted throughout the Phase II field campaign, which extended from February, 2009 to November, 2010.

The Standard Operating Procedures for Biomass and Soils were produced following refinement of the field techniques by this initial team. Four additional teams have been trained using the procedure and by accompanying our permanent team on their work, to ensure consistency in method. Jeremy Freund, VP Carbon Development is now responsible for plot sample design and ensuring proper adherence to sampling procedures, and he has audited numerous plot measurement exercises in the field.

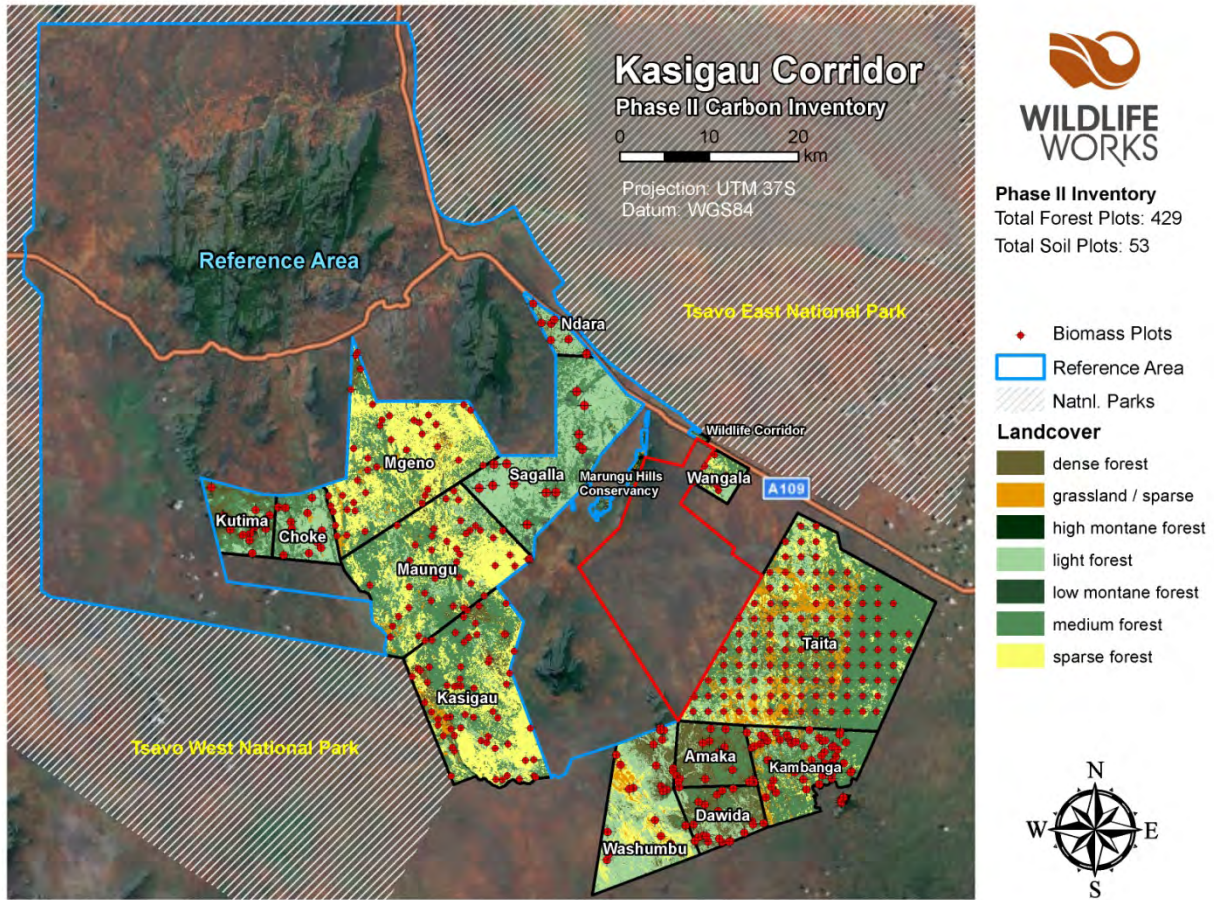
Documentation of data quality assessment such as the results from a check cruise

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 collecting the data for the first time.
2. The QC team returns to headquarters with data sheets, which are given to a third party analyst, who also were not part of the original nor the QC plot team, for comparison against the original plot data sheets.
 3. Any discrepancies are noted, and when all data 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 variance ($\pm 15\%$)
 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 makes a determination, based on the total number of plots found to be inaccurate, as to how this effects the validity of the original monitoring, and whether or not further team training is required before the next monitoring period. They also make a determination as to whether or not plots must be re sampled for the current monitoring period.

Map Depicting Strata Boundaries and Plot Locations for Phase II



Stratification of the project area and forest carbon inventory plots for Phase II

List of Plot Coordinates

A list of plots and corresponding coordinates was provided to validator, as it was determined to be too large for this document. The list of coordinates represents the true plot coordinates as measured in the field campaign, rather than the modeled coordinates, which may differ from each other due to plot location revision, as described in the Standard Operating Procedure - Biomass document.

Description of Plot size

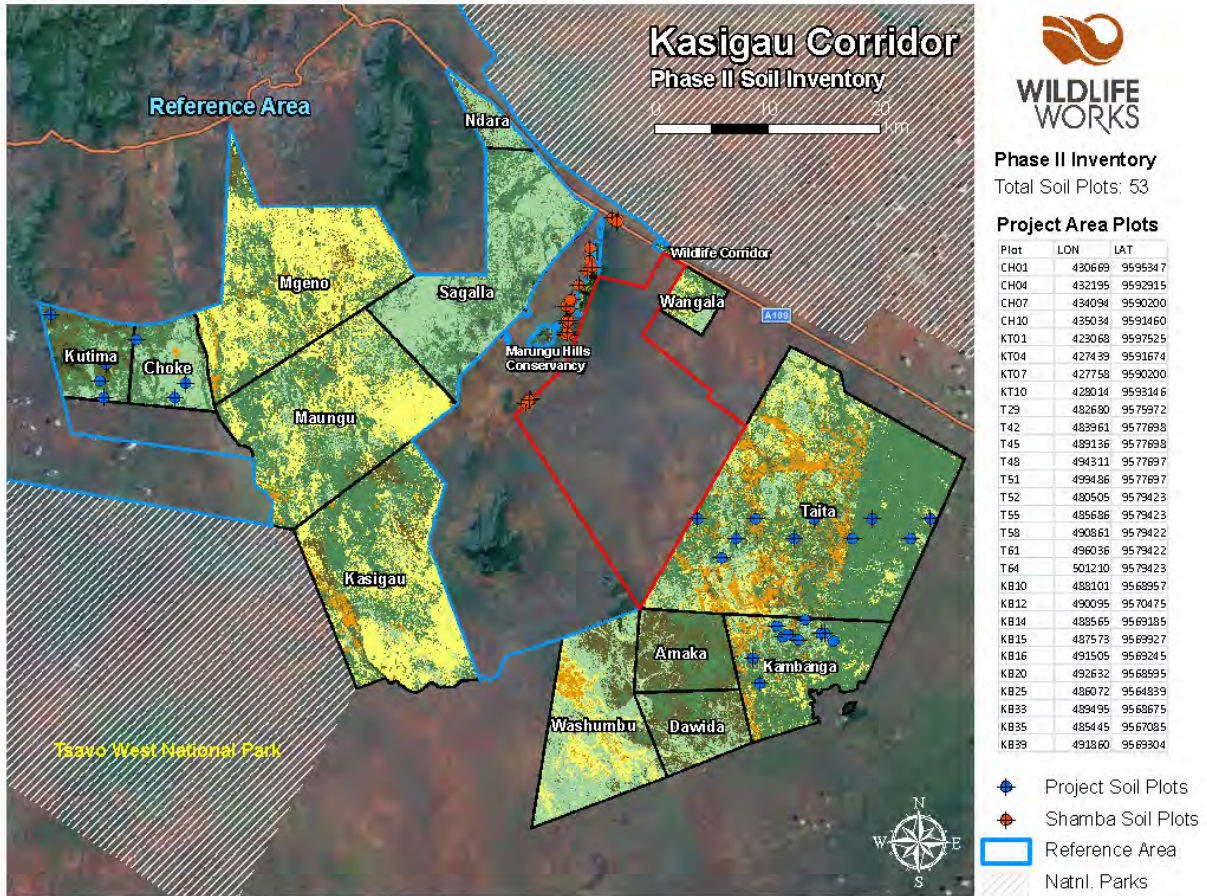
The following describe the forest biomass plots for Phase II;

- 17.84m (1/100 ha) radius circle for large and small trees, shrubs for all plots
- 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 (apart from Phase I) to calculate aboveground biomass for the species of trees found in Acacia-Commiphora woodland, there unfortunately existed no existing published allometry. We therefore resorted to a destructive harvest campaign for Phase I and Phase II in the Kasigau Corridor.



Phase II Soil Carbon Plots - 28 plots in the Project Area, 25 plots in reference area shambas (farms)

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 *Green weight* total aboveground biomass for a range of tree sizes from 10cm to 50cm dbh. The resulting allometric equations predict biomass in green weight in kilograms given diameter at breast height (DBH) in centimeters. A green to dry weight ratio was later used to convert to dry weights.

A graph of dbh vs. wet weight was then plotted, as described in the spreadsheet 'allometry_weighted_PhaseII.xlsx, 03/24/2011 ' 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 typically 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 (S,M,L), 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 species, 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 weight (Biomass).

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

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 d.m.) as a function of DBH(cm), based on the data provided by Wildlife Works in the aforementioned “AllometricFormulasEXP” spreadsheet. All equations are of the form :

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

It should be noted that the evaluation of goodness of fit for the project allometry is based on a cross-validation statistic, not r^2 . We reported r^2 as well, because stakeholders and other project affiliates are accustomed to seeing it; we believe the cross validation statistic is a better indicator of fit in this case.

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 employed a weighted regression. A discussion of this technique can be found in any regression text, but we used “Applied Regression Including Computing and Graphics” (Cook and Weisberg 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:

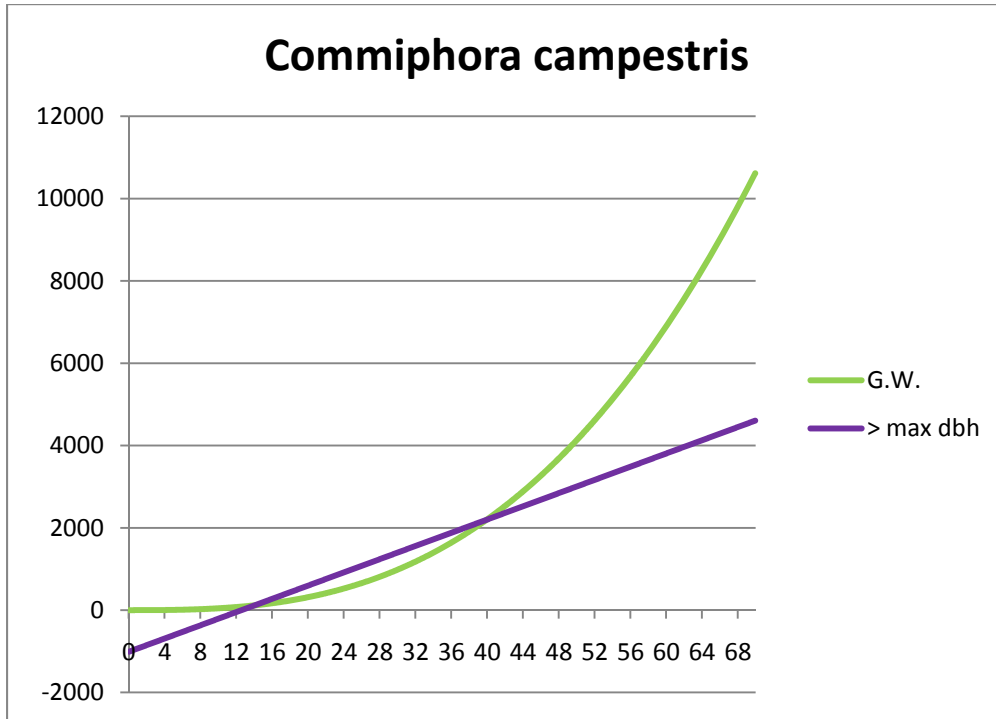
Species	Weight Type	a	b	N	Max DBH	R ²	\bar{E}
<i>Acacia bussei</i>	None	3.3796	1.6416	8	18	.80	7.82
<i>Acacia hockii</i>	None	0.6850	2.1820	17	23	.93	-2.46
<i>Acacia nilotica</i>	None	1.3615	1.9513	10	23	.86	14.83
<i>Acacia tortilis</i>	None	2.6060	1.6175	9	20	.85	0.13
<i>Boscia coriacea</i>	1/BA	0.2033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

Accuracy allometry coefficients for dominant species in Phase II

Upon the suggestion of the validator, rather than utilizing simple power curves relating dbh to green weight, we opted for a more conservative approach to ensure that our allometry was not overestimating biomass, due to the relatively small number of large trees destructively harvested. This approach is described below:

- For all trees smaller than 35cm dbh, we developed a power relationship between dbh and green weight of the form $Green\ Weight = a[DBH]^b$ (see above)
- For trees measured above the maximum destroyed dbh for each species, a linear model was used, the slope of which is equal to the tangent of the line at 35cm dbh for the all-species curve.

This ensures a two-piece approach, with a power curve capturing the variability for all trees of smaller size, and a more conservative linear model for larger trees for which we had less data:



For example, for the most prevalent of the species in the project area, *Commiphora campestris*, the plot of tree green weight to dbh is as demonstrated above. The standard dbh/G.W. power curve was developed from destructively harvested data

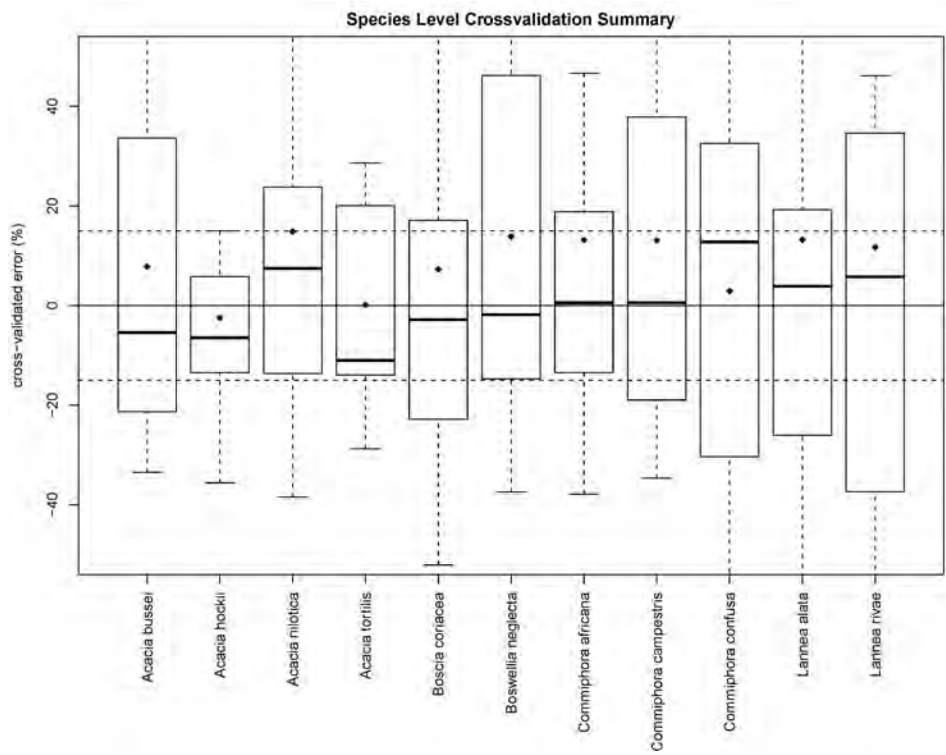
$$\text{Green Weight} = 0.06774[\text{dbh}]^{2.81566}$$

whereas the *linear equation* is used for all *Commiphora campestris* species measured above the maximum dbh that was destructively harvested (40cm).

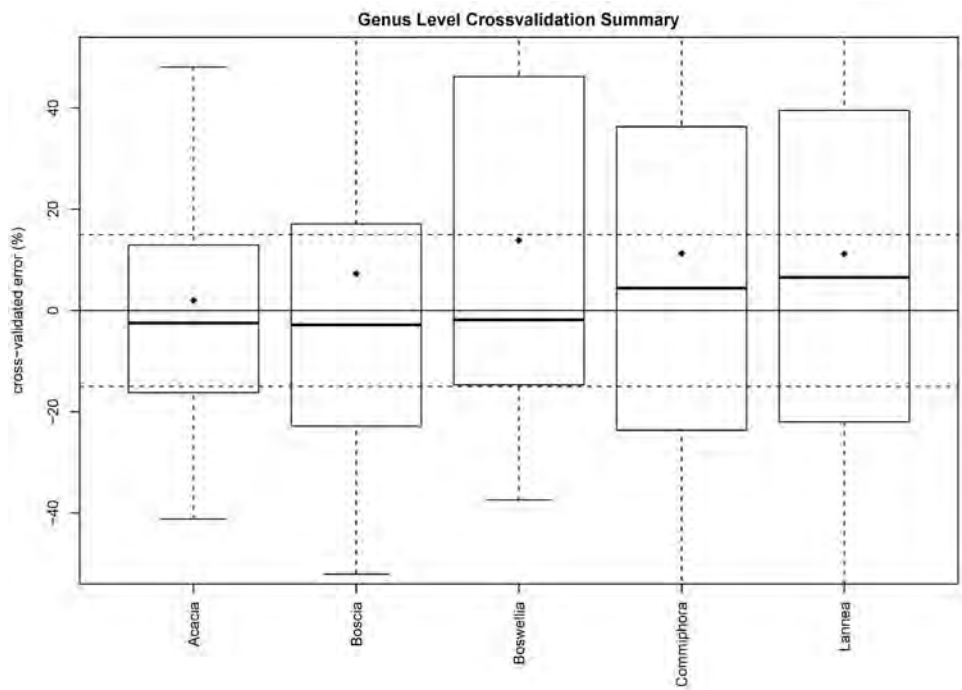
Assessment of Accuracy of Allometry

A summary of the cross validation statistics for species appears below. The black diamond represents 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 methodology.

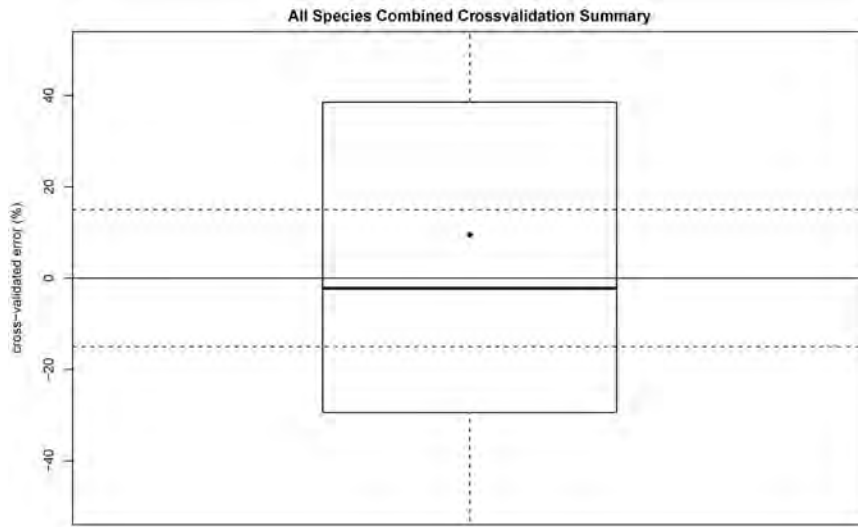
Species level:



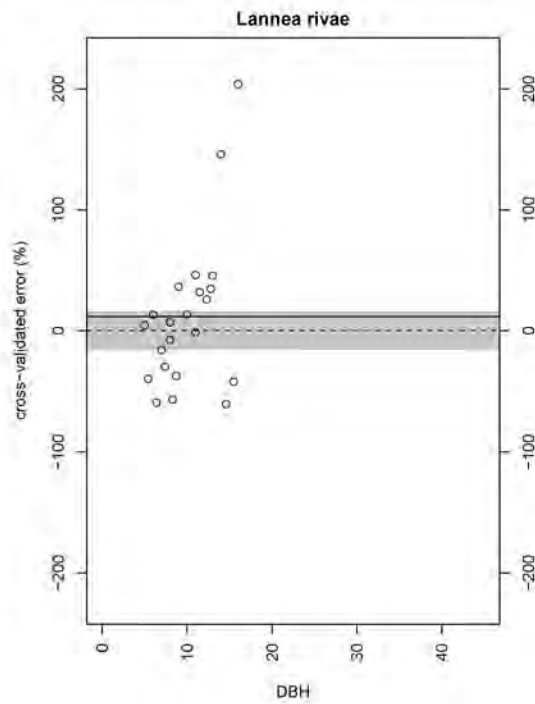
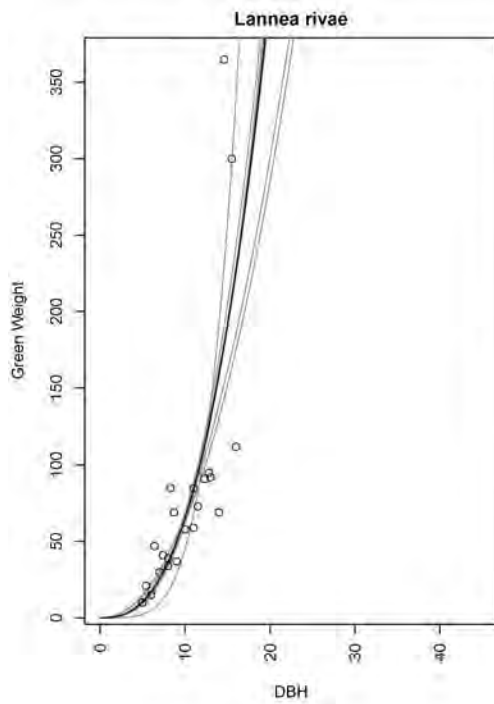
Genus Level:

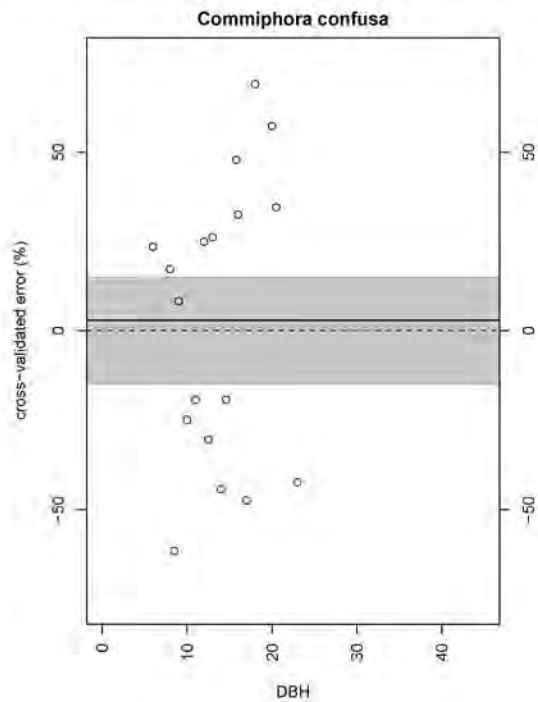
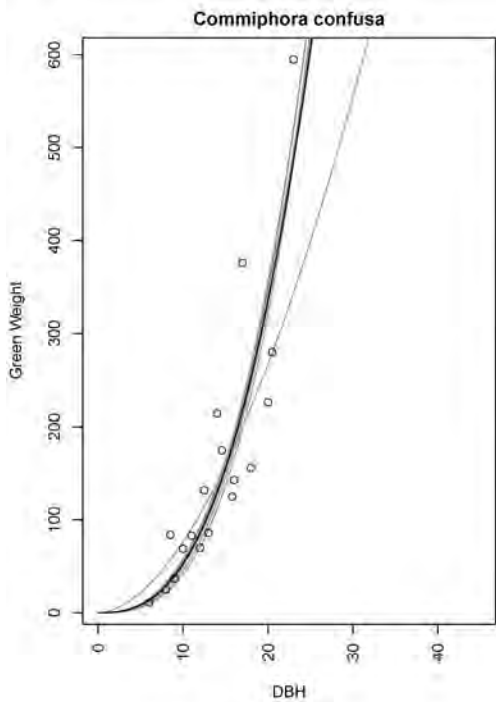
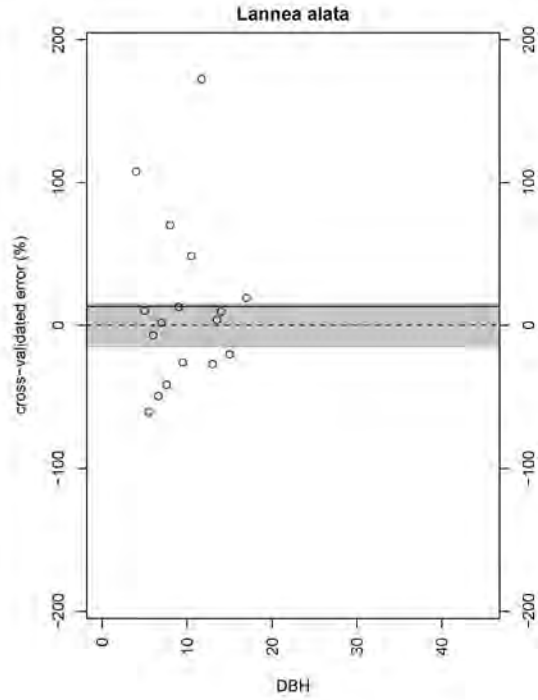
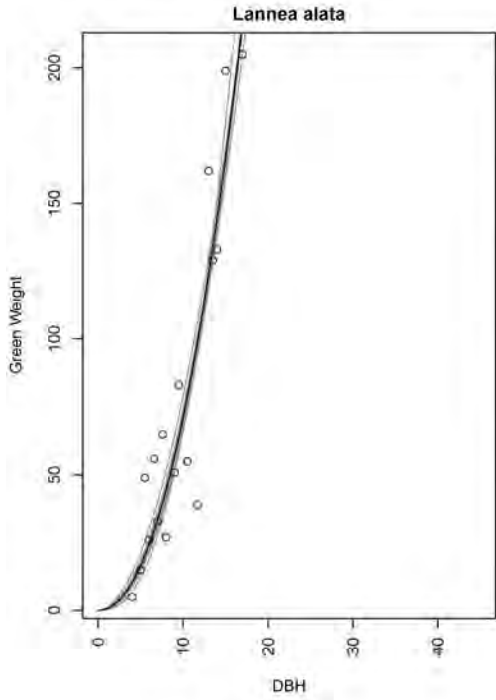


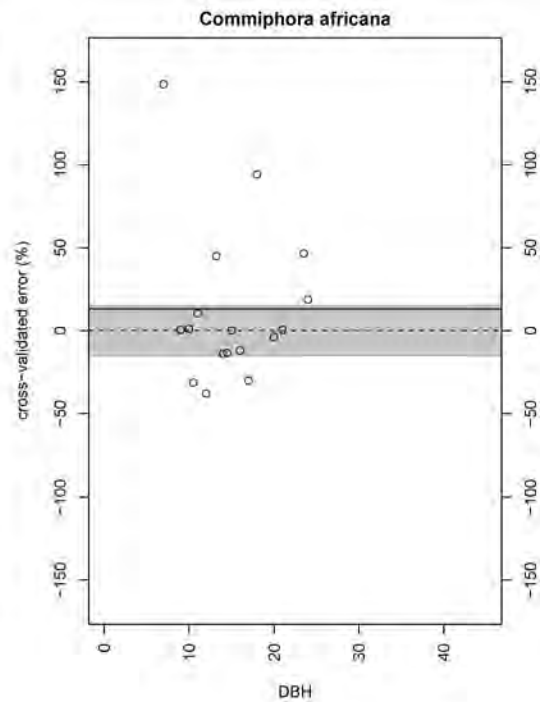
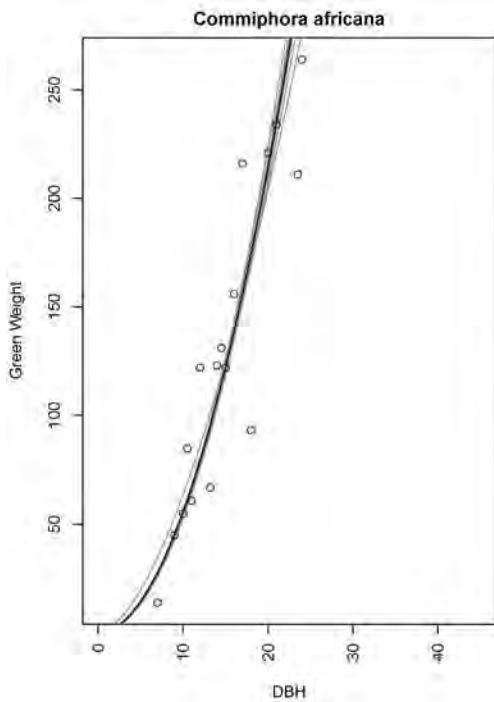
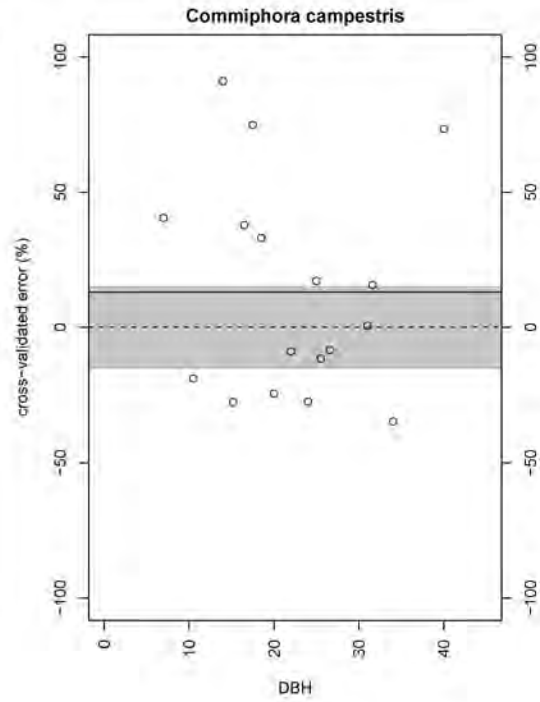
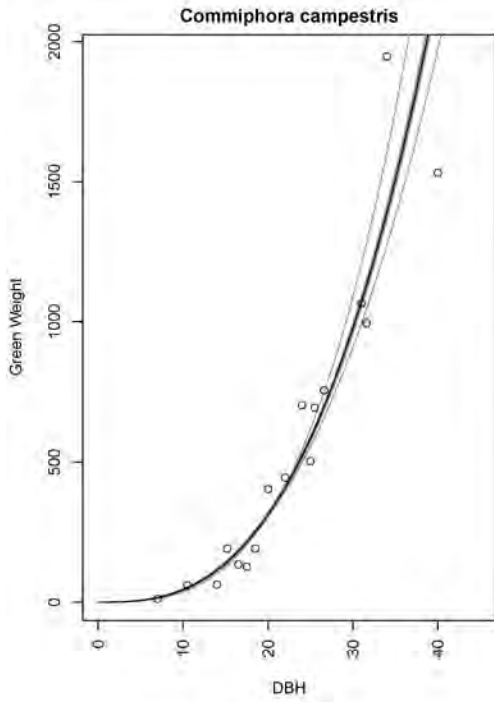
All species combined (<35 cm):

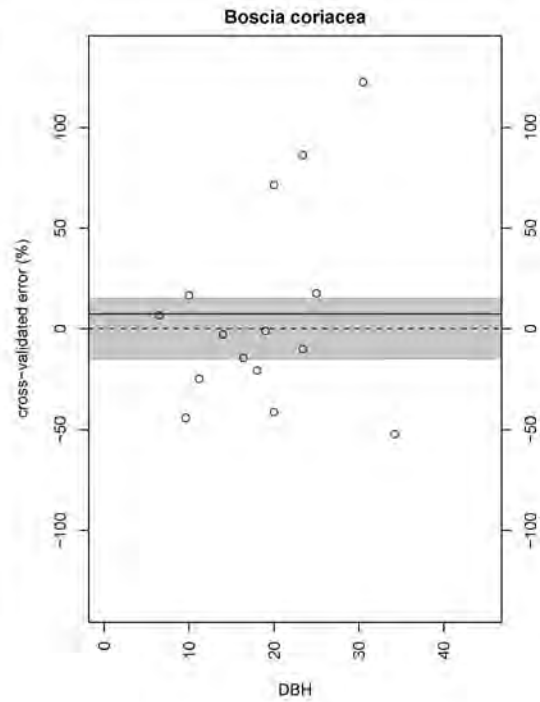
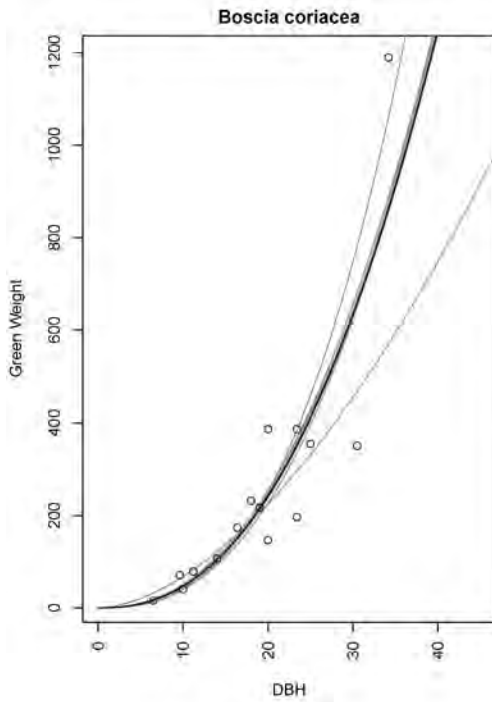
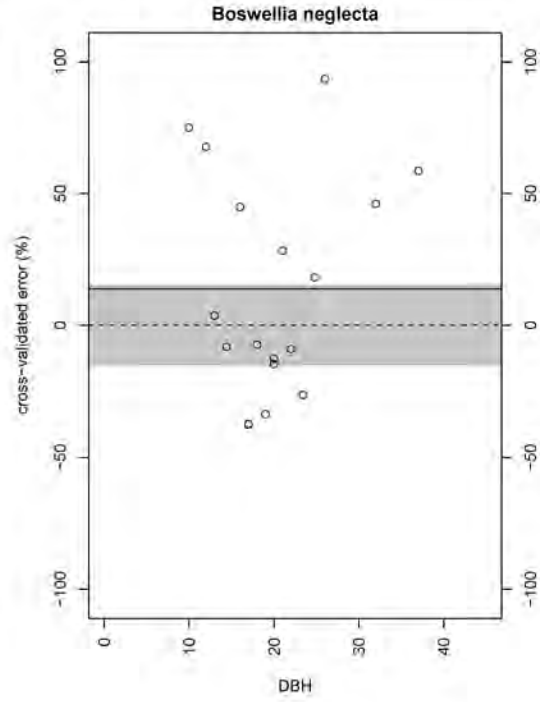
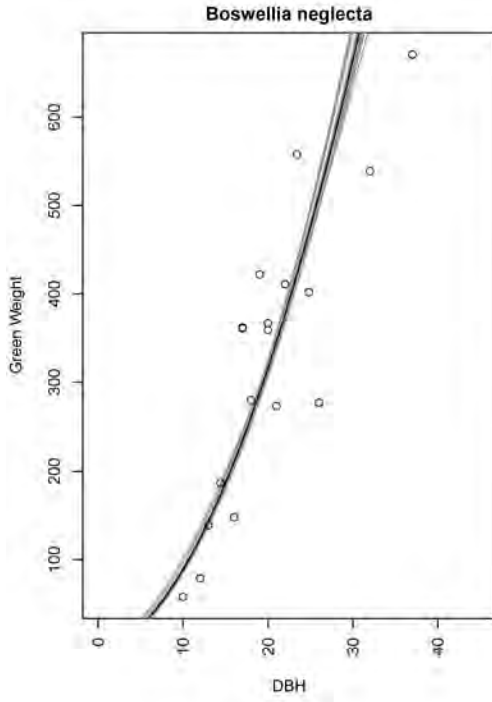


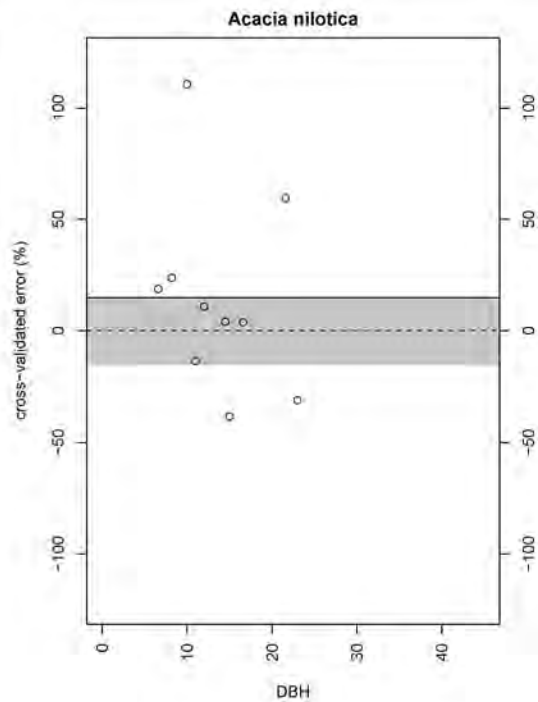
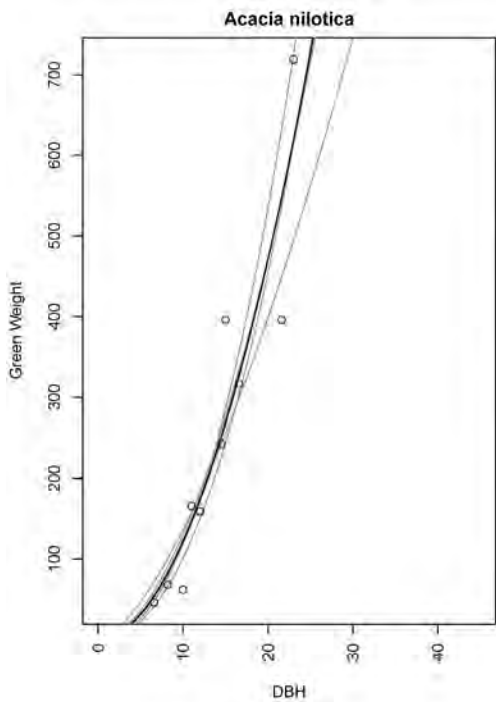
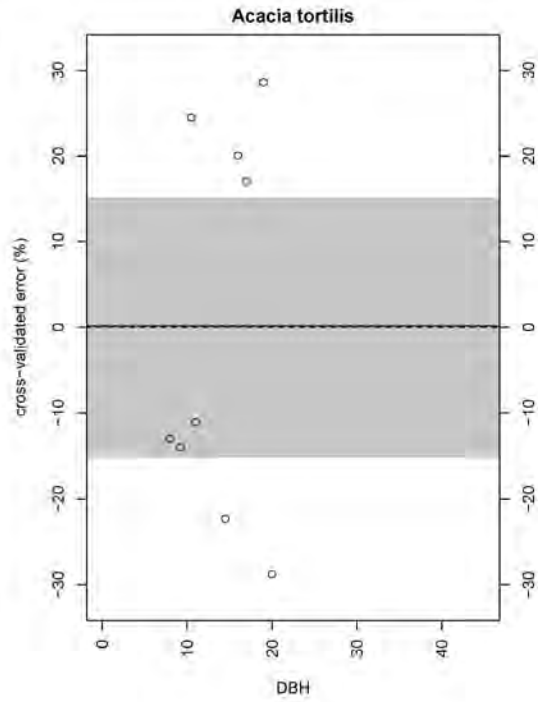
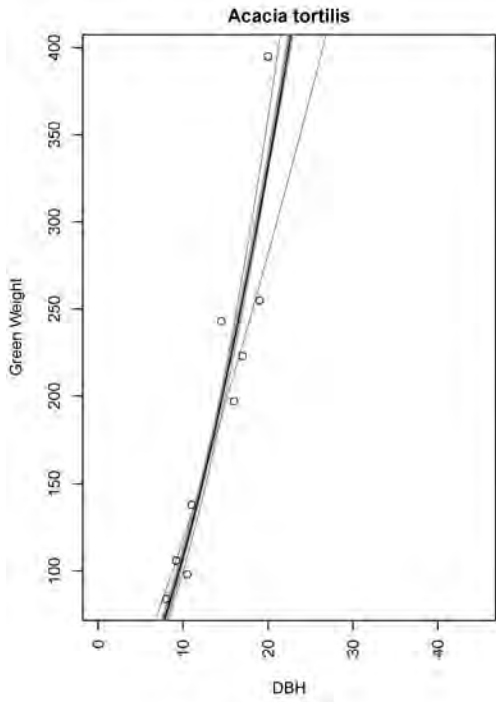
The figures below show the fitted model plotted for each species and the cross validated residuals plotted as a function of DBH. In the plot of fitted models, light grey curves show the f(-i) models fit during cross validation.

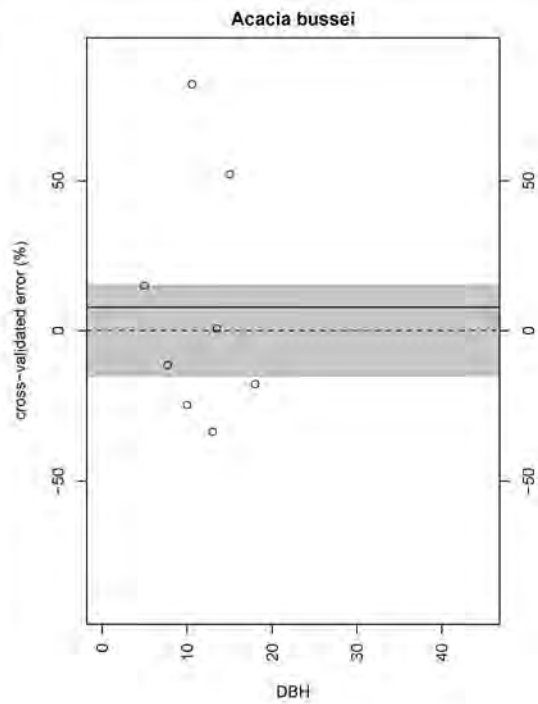
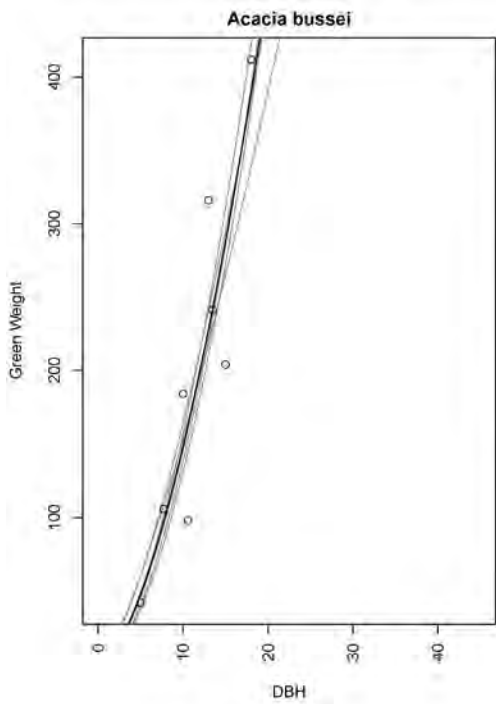
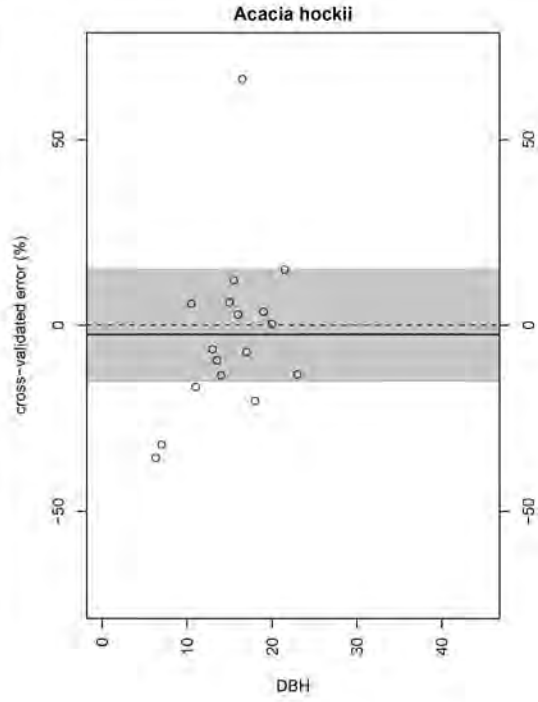
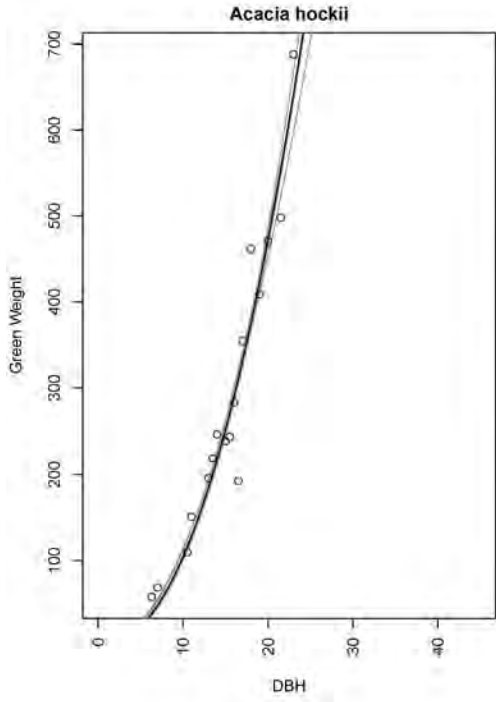




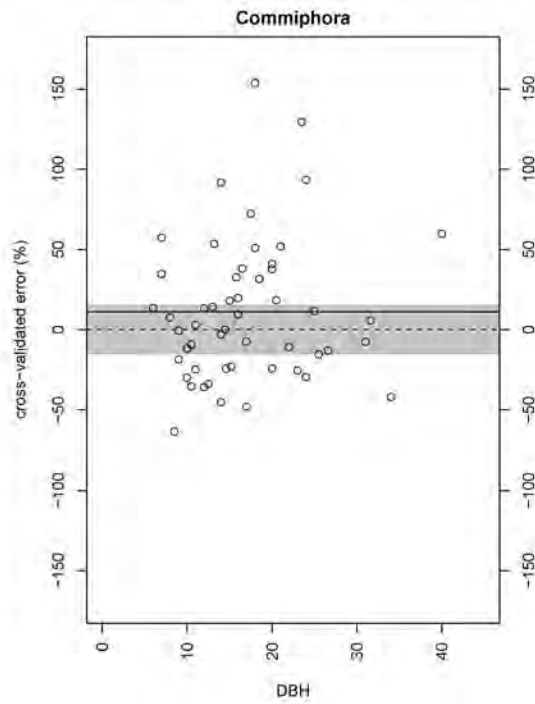
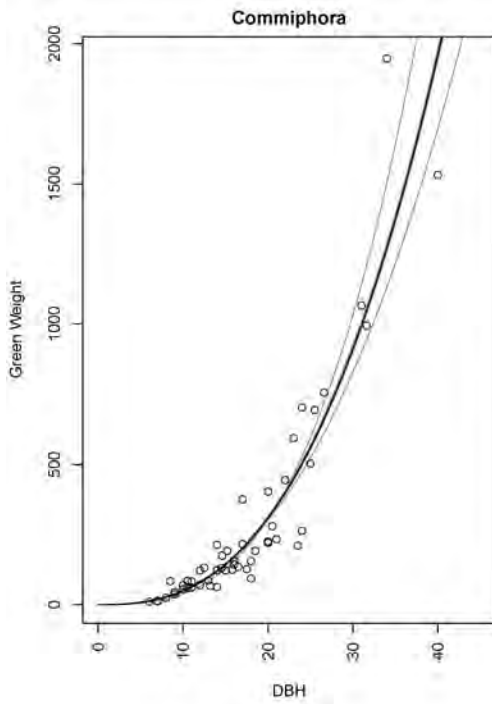
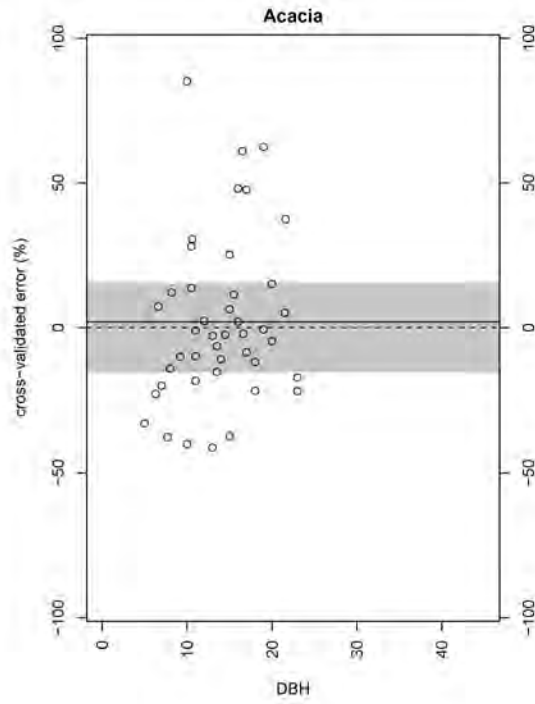
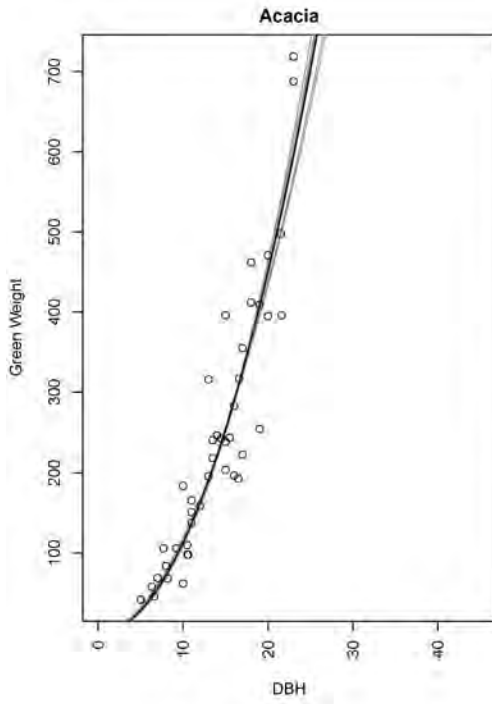


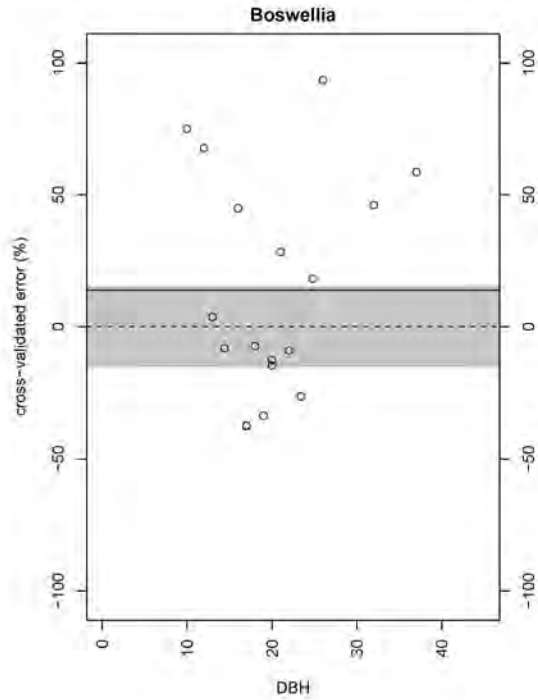
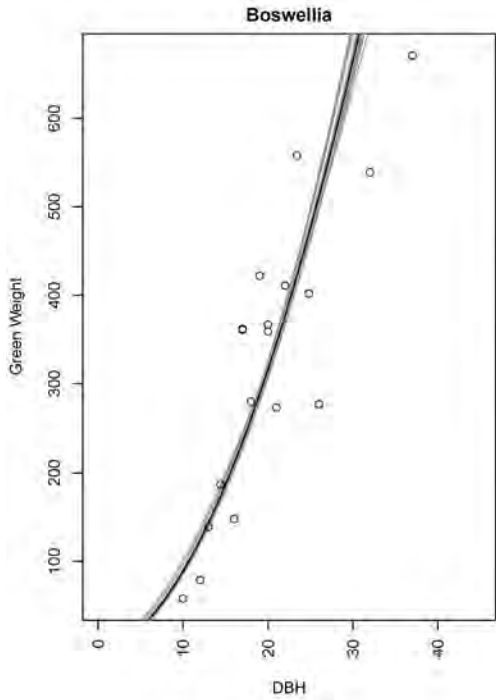
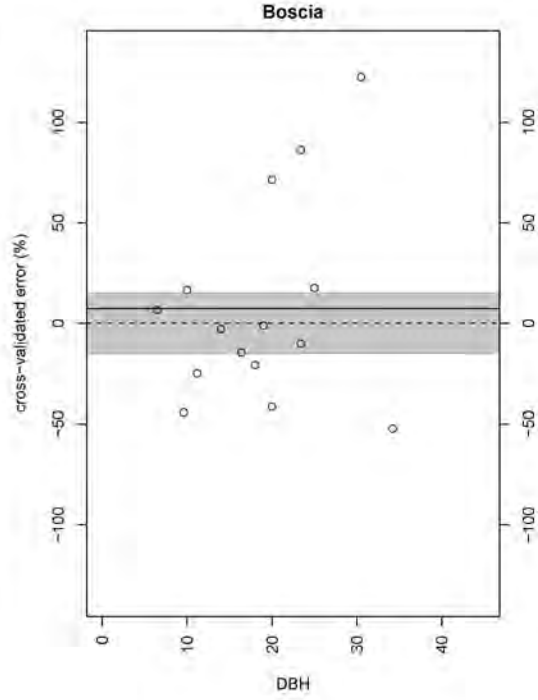
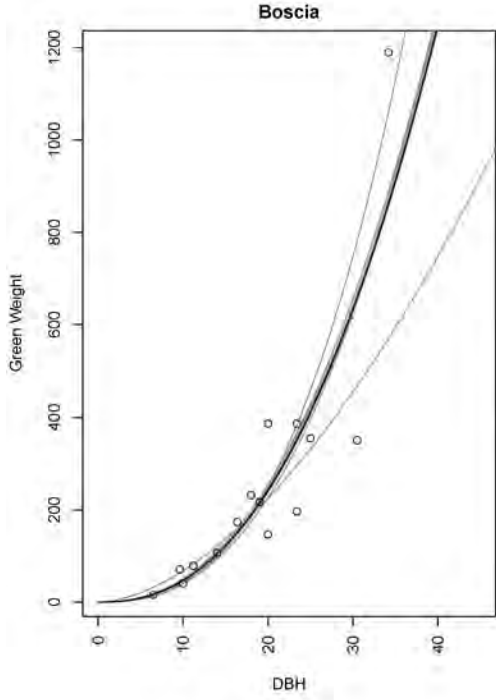


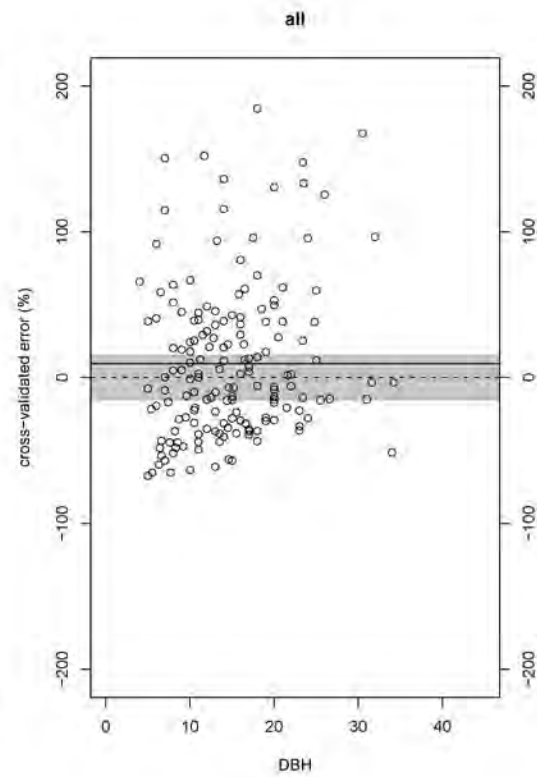
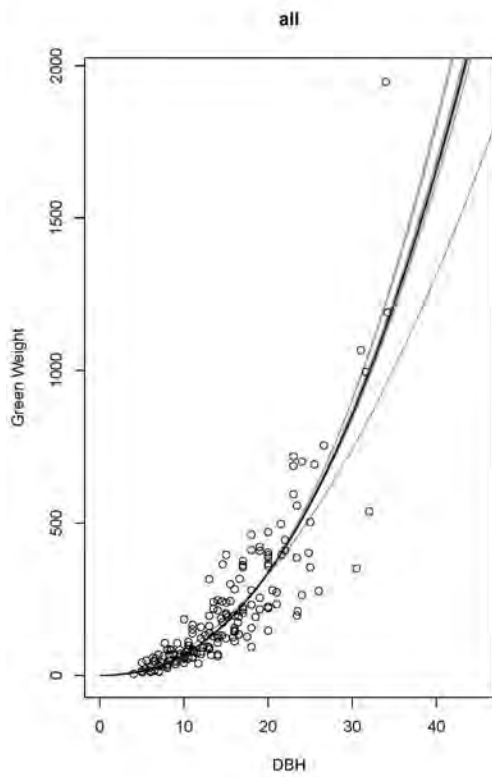
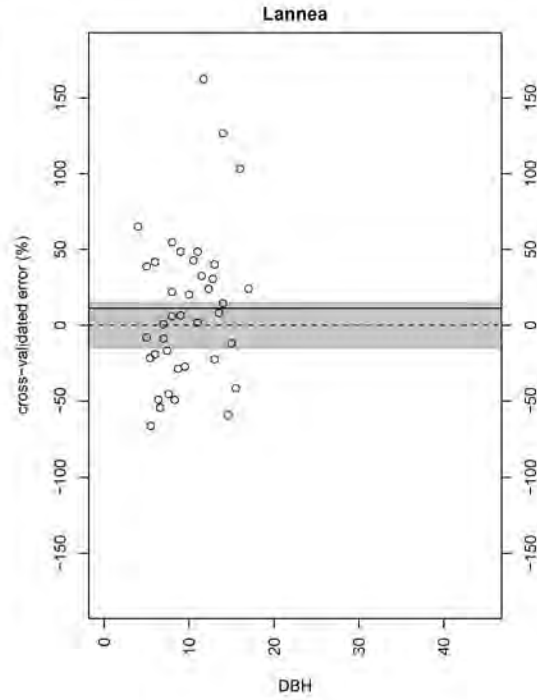
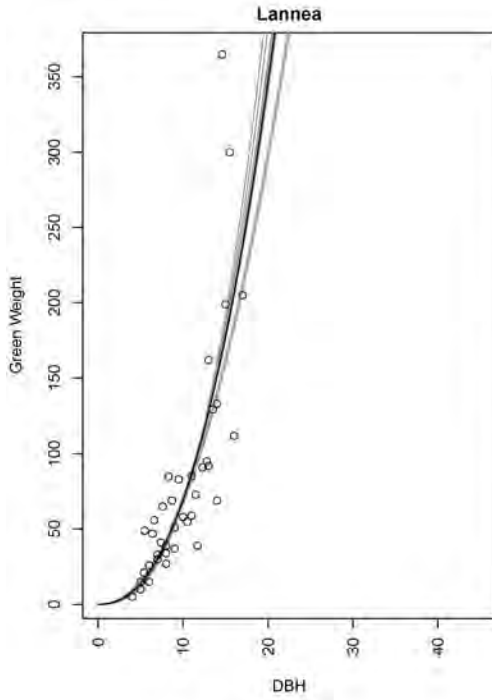




Genus Level:







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 ₂ -e / ha)	Shrubs Carbon Mean (tCO ₂ -e / ha)	Herbaceous Carbon Mean (tCO ₂ -e / ha)	Total Strata Carbon Mean (tCO ₂ -e / ha)	Total Strata Carbon Stock (t CO ₂ -e)
dense Acacia - Commiphora forest	59	15,337.00	81.47	6.92	1.01	89.40	1,401,099.68
grassland / sparse shrubs	52	9,692.96	62.96	8.18	0.89	72.03	689,466.55
high montane forest	0	298.44	85.08	7.01	0.83	92.92	28,562.17
light Acacia - Commiphora forest	126	47,346.60	99.23	5.39	1.07	105.69	4,874,834.95
low montane forest	15	581.15	88.77	7.75	0.58	97.11	55,531.26
medium Acacia - Commiphora forest	101	52,273.92	83.10	7.66	0.85	91.62	5,043,723.17
sparse Acacia - Commiphora forest	76	44,211.34	80.16	6.54	1.64	88.34	4,830,397.68
Total:		169,741.40					15,944,631

Total carbon stocks for trees, shrubs and herbaceous material (forest carbon) for the Phase II project area

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 'Forest Inventory Phase II Summary-Strata2_v4.xlsx, 03/03/2011' spreadsheet.

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
dense Acacia - Commiphora forest	59	93.64	3704.73	1	14770153848.03	121532.52
grassland / sparse shrubs	52	68.56	1644.65	1	2971553143.99	54511.95
light Acacia - Commiphora forest	126	102.25	1573.67	1	27997658055.49	167325.01
low montane forest	15	109.38	2421.57	1	54522589.25	7383.94
medium Acacia - Commiphora forest	101	99.27	1288.03	1	34847877387.21	186675.86
sparse Acacia - Commiphora forest	76	103.56	2823.35	1	72613587109.50	269469.08

Standard Errors for each stratum for all carbon pools for the Phase II project area

Trees, shrubs, grass (forest)	
Standard Error	310658.9705
95% interval	608891.58

Error percentage	3.85%
------------------	--------------

Combined standard error percentage for trees, shrubs and grass (forest inventory)

A detailed standard error analysis for each carbon pool by stratum is available in the database 'PhaseII_PlotLevel_Strata2_v3.xlsx, 03/04/2011'

Soil Carbon measurements were not stratified, as test measurements were made using the strata shown in the soil type plot in Section 6.5 Soil Carbon Loss Model, and it was concluded that as in Phase I, stratification did not improve measurement accuracy. Soil samples were measured both inside the Phase II ranches (the project area) and in the reference region at various shambas (farms). The table below shows a summary for the soil organic carbon measured inside the Phase II project 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
Project	1.34	1.23	49.41	181.18	1.34	0.77	72.11	264.42	121.53	445.60

Mean soil carbon stocks measured inside the Phase II project area and in the reference area

The % soil loss was determined as **0.4973** (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 the Phase II ranches:

Soil Stocks - Phase II Ranches	
Mean Carbon Stock measured in project area	445.60 t CO ₂ e
Standard Error of mean carbon stock	21.91 t CO ₂ e
Percent Error at 95% confidence	9.64%
Soil Crediting Area (conservatively reduced)	169,011.83 ha
Total soil carbon stock measured in Project Area	75,311,455.22 t CO ₂ e
Total Soil "loss"	33,913,804 tonnes

Summary for soil carbon stocks in the Phase II project area

Standard error for soil stocks measured inside Phase II ranches are as follows:

Soil - Phase II	
total stocks	75,311,455.22
Se total	3,702,797.13
95% interval	7,257,482.37
Error percentage	9.64%

Standard error percentage for soil

Details for the soil carbon loss model, including standard error analysis are available in the '*Kasigau Corridor Phase II 1m Soil Analysis.xlsx, 03/03/2011*' spreadsheet.

Estimated Total Carbon Stock and Standard Error for Entire Project Area

The total carbon stocks for trees, shrubs and grass (forest inventory) for the Phase II ranches, above and below ground, is **15,944,631 t CO₂e**.

As it is assumed that soil carbon is not 100% depleted during the deforestation process, soil carbon values are measured inside the project area as well as outside in the reference region at locations that have experienced conversion to agriculture. The percentage soil carbon loss is multiplied by the total carbon stock inside the Phase II project area to yield the carbon "loss" value, and is **33,913,804 t CO₂e**.

The gross project forest loss plus the gross project soil carbon loss yields total gross project carbon loss, which for the Kasigau Corridor Phase II Project is:

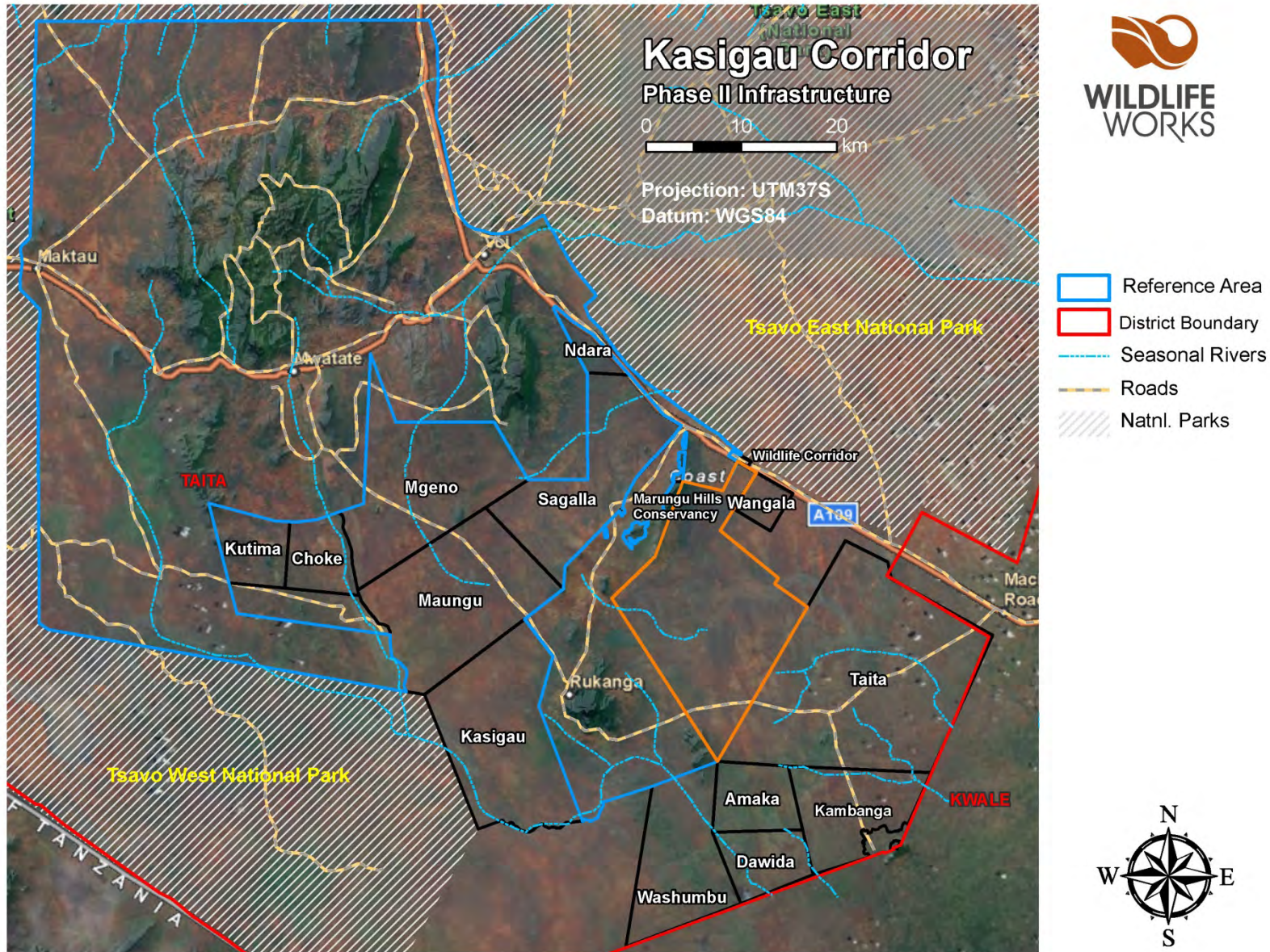
48,448,769 t CO₂e

The total carbon inventory standard error across all pools is the quadratic sum of errors for all pools for all strata, as seen in the file '*PhaseII_PlotLevel_Strata2_v2.xlsx, 03/04/2011*'

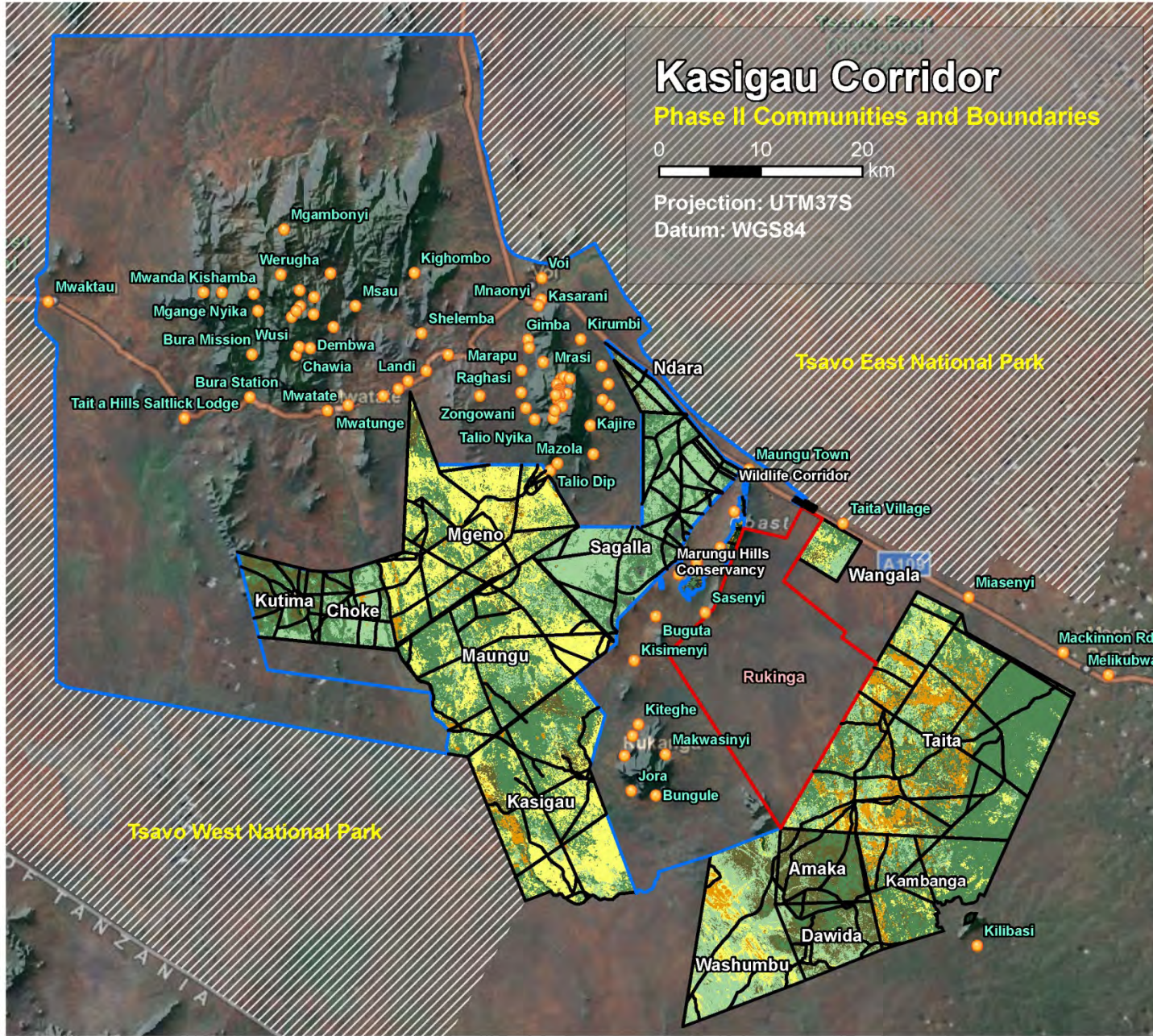
Total inventory error	
total carbon stock	48,448,669
Se total	3,715,806
95% interval	7,282,980
Error percent	7.99%

Total Carbon inventory error

Appendix A Project Maps



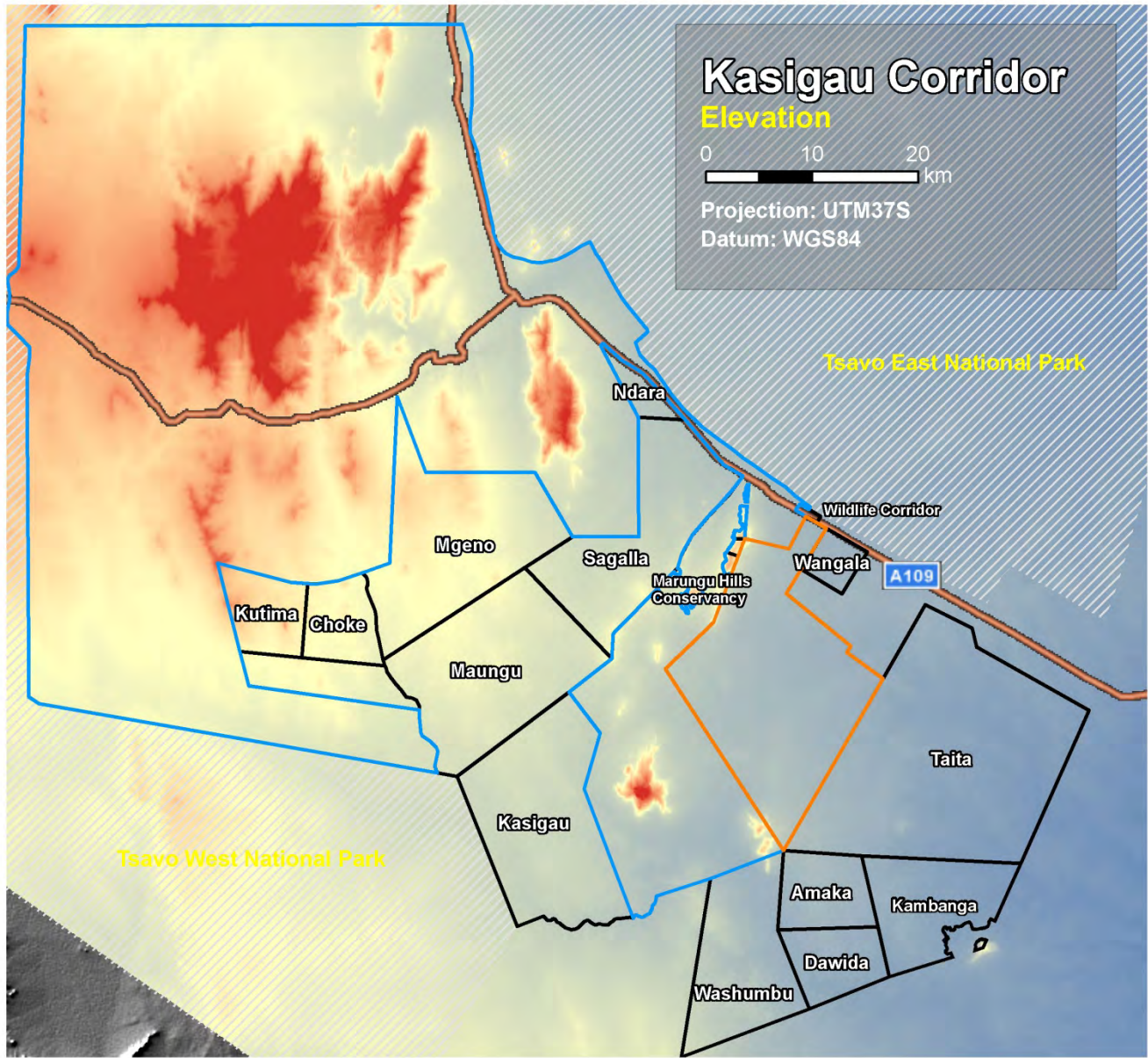
Kasigau Corridor reference area roads, Rivers and Seasonal Rivers / Washes including Major Area Markets



- Roads / Cutlines
- Communities
- ▭ Reference Area
- ▭ Phase II Project
- ▨ Natnl. Parks



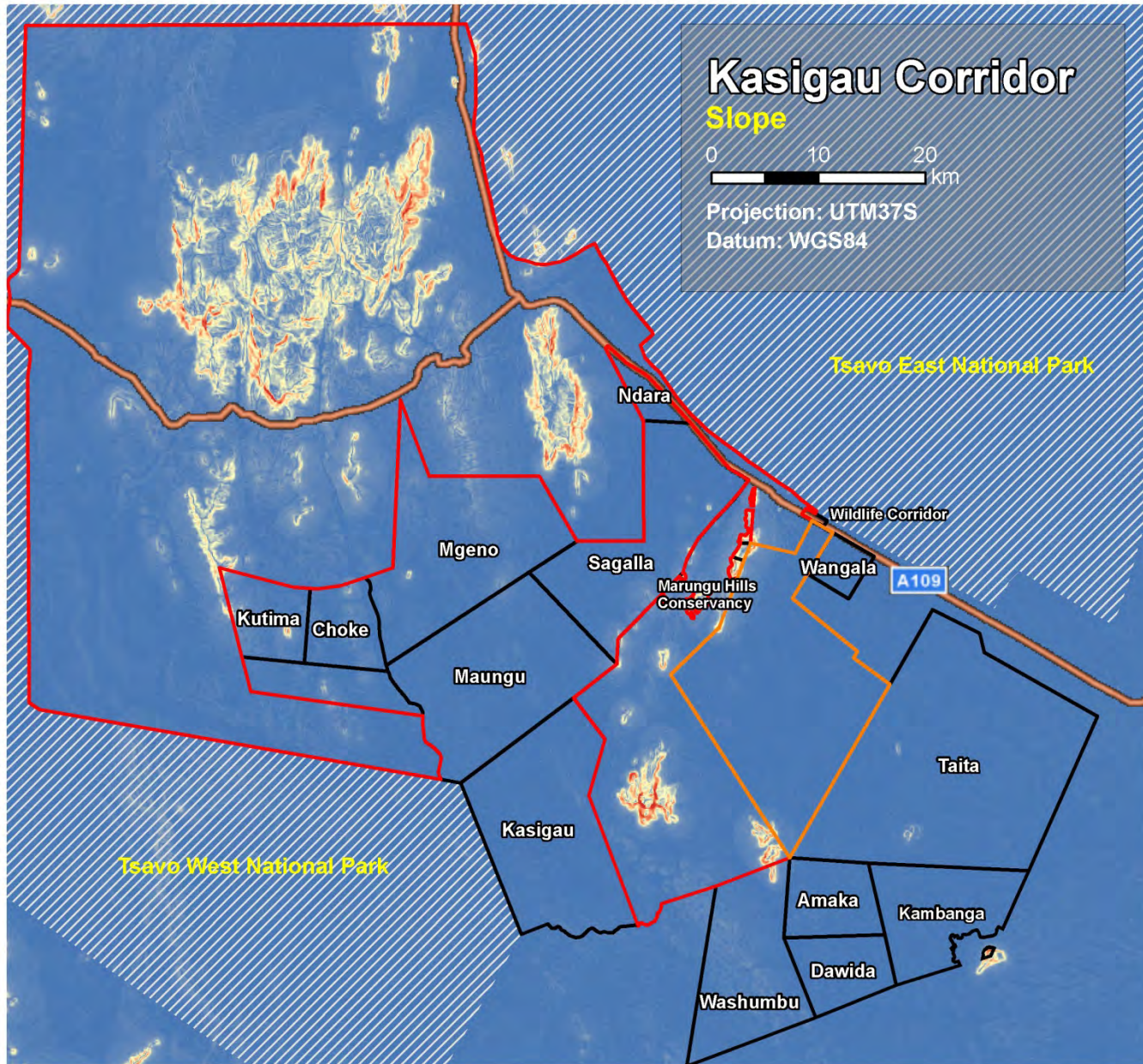
Phase II project area roads (cutlines) and affected communities



- Phase II Project
- Reference Area
- Natnl. Parks
- Elevation (m)**
- High : 4935
- Low : -20



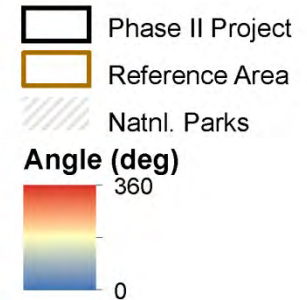
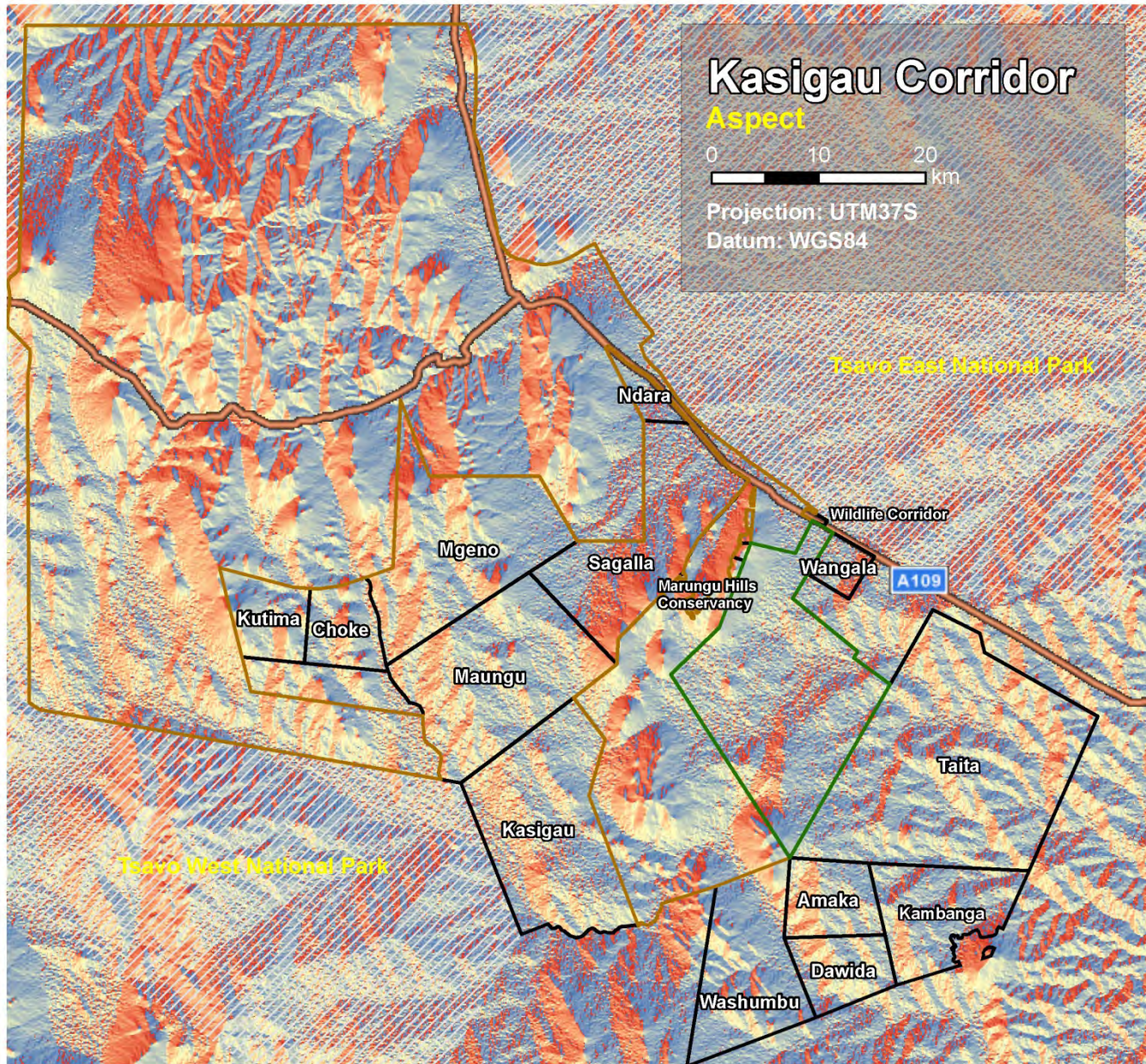
Kasigau Corridor Elevation - Data Source: SRTM 90m DEM



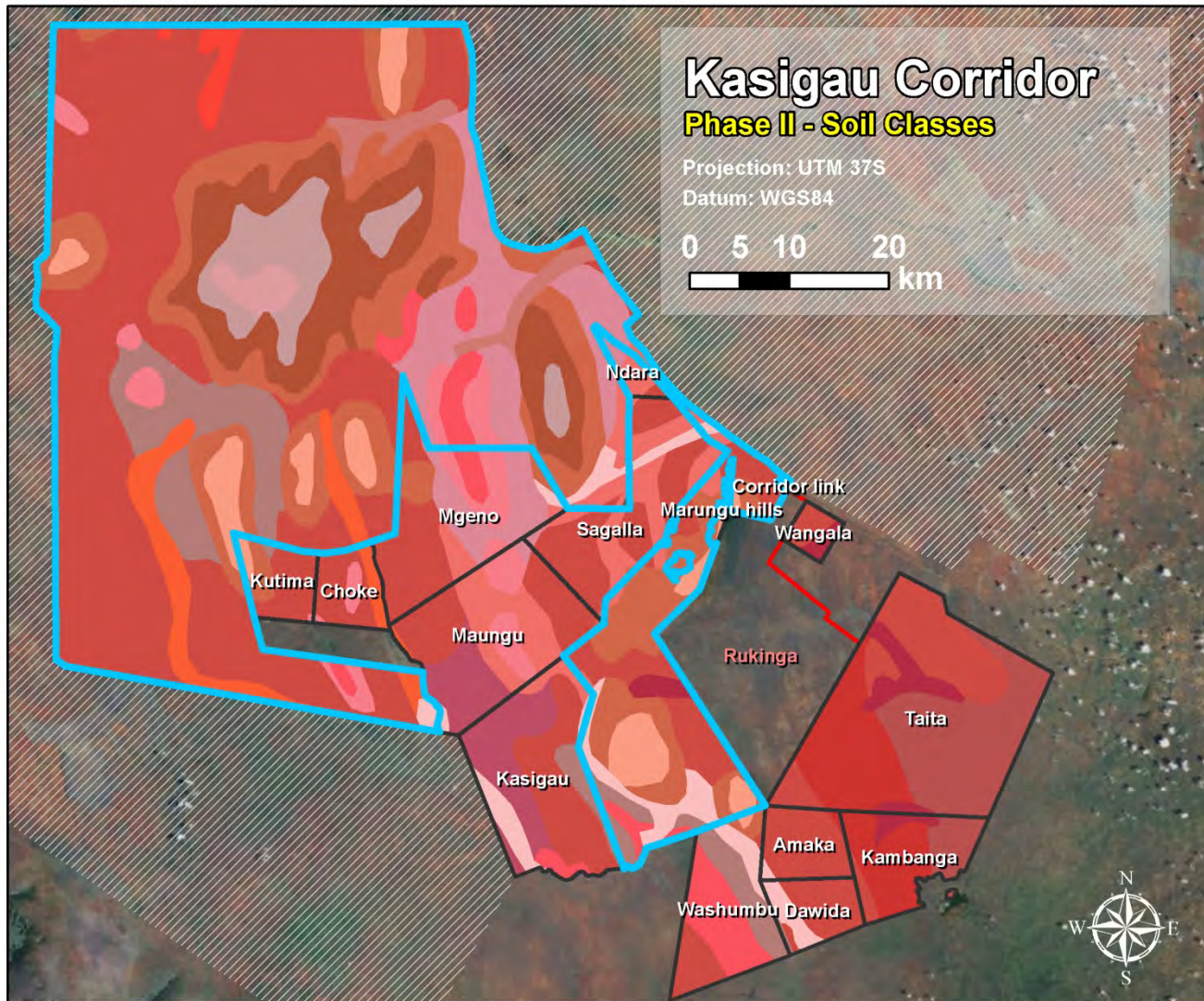
- Phase II Project
- Reference Area
- Natnl. Parks
- Angle (deg)**
- High : 45
- Low : 0



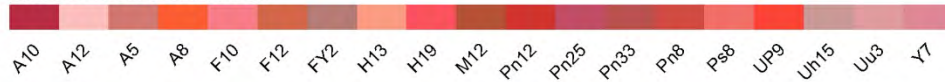
Kasigau Corridor Slope - Data Source: SRTM 90m DEM



Kasigau Corridor Aspect - Data Source: SRTM 90m DEM



Reference Area Soils

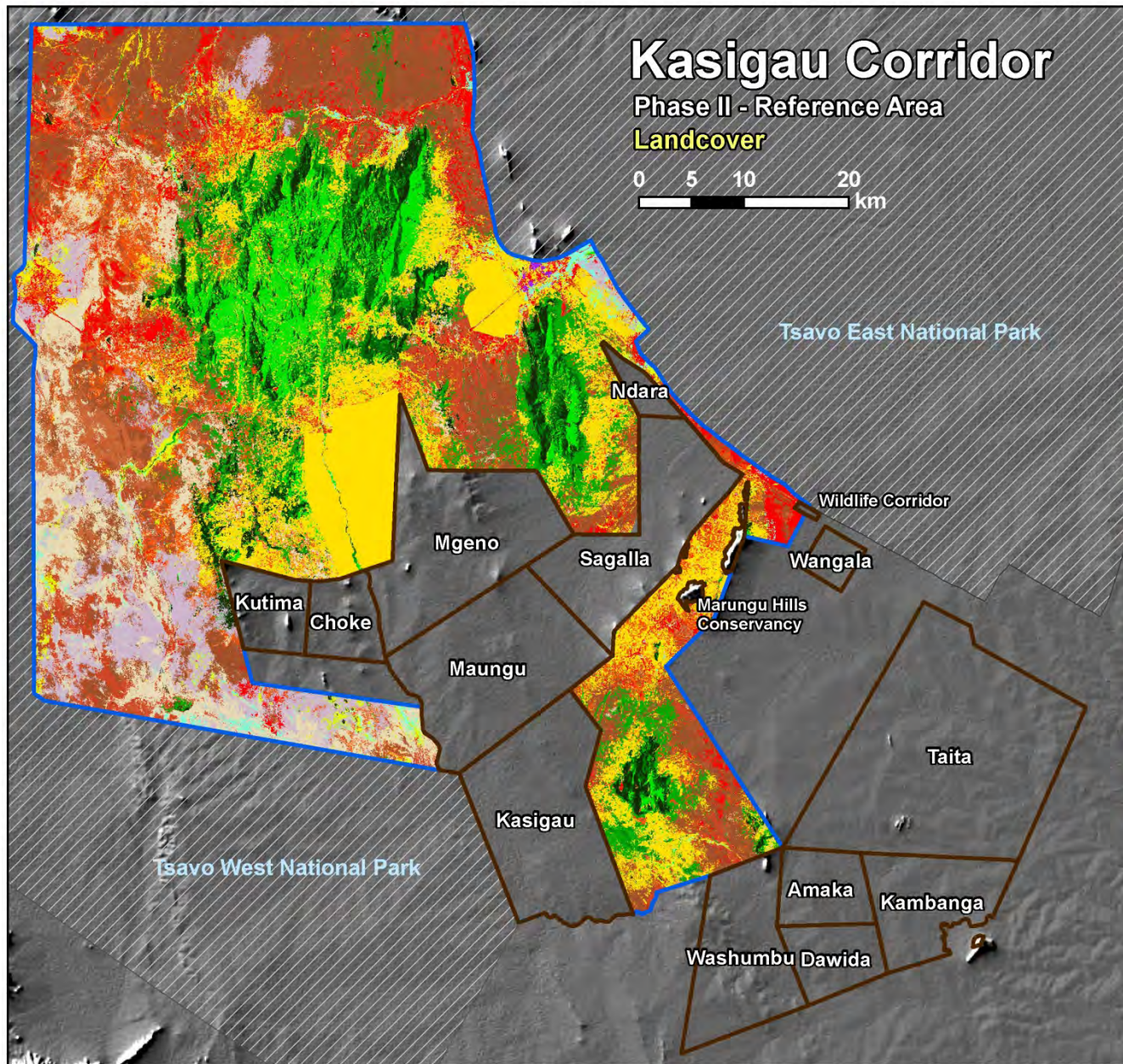


Phase II Project Area Soils



Soil Classes for Phase II Project and Reference Area - Source: International Livestock Research Institute / FAO

Soil Class Analysis										
Reference	Area (ha)	Contib area (ha)	Soil Unit(s)	Soil Sub Type(s)	Soil Type	contrib (%)	Lithology	Area (ha)	Contib area (ha)	Phase II
A10	1173.921642	1,174	BK	Calcic Cambisols	Cambisols	100	I	5197.145989	5,197	A10
A12	5620.683267	5,621	VC	Chromic Vertisols	Vertisols	100	UE	6627.308038	6,627	A12
A5	5933.516119	5,934	JE	Eutric Fluvisols	Fluvisols	100	UF			
A8	10101.17409	10,101	JC	Calcaric Fluvisols	Fluvisols	100	SC2	1271.911055	1,272	A8
F10	6847.822023	6,848	LC	Chromic Luvisols	Luvisols	100	SO1	6946.436722	6,946	F10
F12	60554.92875	30,277	FR	Rodic Ferralsols	Ferralsols	50	MA2	4553.682411	2,277	F12
		18,166	QF	Ferralic Arenosols	Arenosols	30			1,366	
		12,111	LIC	Ferralsol-chromic Luvisols	Luvisols	20			911	
FY2	18239.36256	10,944	LC	Chromic Luvisols	Luvisols	60	MA2	5528.70361	3,317	FY2
		7,296	KH	Haplic Kastanozems	Kastanozems	40			2,211	
H13	13832.11353	8,299	RE	Eutric Regosols	Regosols	60	IA1	922.70311	554	H13
		1,383	DK	Calcic Chernozems	Chernozems	10			92	
		1,383	OK	Distric Histosols	Histosols	10			92	
		2,766	ROCK	Eutric Regosols	Regosols	20			185	
H19	6271.765671	6,272	EC	Cambic Rendzinas	Rendzinas	100	SC3	7594.235273	7,594	H19
M12	30348.07007	21,244	BH	Humic Cambisols	Cambisols	70	MA			
		6,070	RD	Dystric Regosols	Regosols	20				
		3,035	ROCK	Eutric Regosols	Regosols	10				
Pn25	37.165606	37	DC	Calcic Chernozems	Chernozems	100	SO1	12291.55189	12,292	Pn25
Pn8	121166.9486	121,167	FR	Rodic Ferralsols	Ferralsols	100	MA2	64848.9541	64,849	Pn8
Ps8	4069.689618	4,070	LF	Ferric Luvisols	Luvisols	100	MB3	15138.58191	15,139	Ps8
UP9	2913.744959	2,914			Other	100				
Uh15	14188.00868	8,513	AC	Chromic Acrisols	Acrisols	60	MA2			
		2,838	B	Cambisols	Cambisols	20				
		2,838	F	Ferralsols	Ferralsols	20				
Uu3	2893.226313	1,447	U	Rankers	Rankers	50	MA			
		1,447	DH	Calcic Chernozems	Chernozems	50				
Y7	19606.01947	19,606	LIC	Ferralsol-chromic Luvisols	Luvisols	100		6986.123216	6,986	Y7
			FR	Rodic Ferralsols	Ferralsols	50	MA2	16776.1431	8,388	Pn12
			FO	Orthic Ferralsols	Ferralsols	50			8,388	
			LO	Orthic Luvisols	Luvisols	70	SC3	18982.40824	13,288	Pn33
			AO	Orthic Acrisols	Acrisols	30			5,695	



Map

- Phase II Project
- Phase II Reference Area

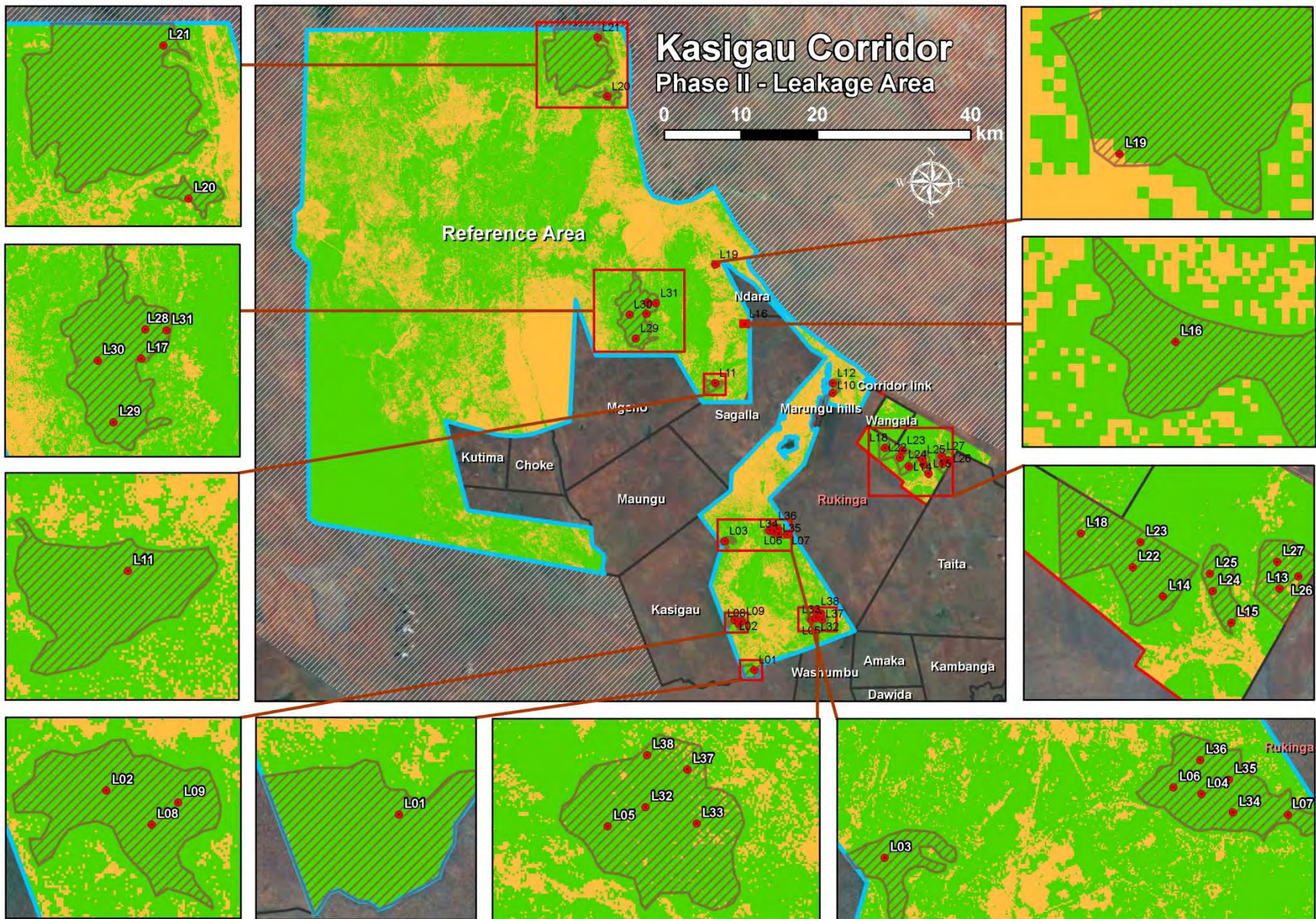
Landcover

- high montane forest
- sloped montane forest
- topo shadow
- grassland
- thick AC Forest
- forest 2 grass understory
- forest 3 bush understory
- riparian
- low montane forest
- non forest 1 red soil
- non forest 2 fallow green soil
- non forest 3 bright brown soil
- urban
- bushland
- forest 4 light

UTM 37S - WGS84



Phase II reference area thematic landcover



Phase II Leakage Areas and Plots