

Cover Page

Project Name: Northern Kenya Grassland Carbon Project

Project Location: Kenya; Samburu, Isiolo, Marsabit, and Laikipia Counties

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Project Timeline: Start Date: December 10, 2012. Project Lifetime: 30 years, Project Implementation Period December 10, 2012 – July 31, 2016.

Project Implementation Period: December 10, 2012 – July 31, 2016

CCB History: Full validation

Standard: CCBA Standard, Third Edition

Project Benefits: Sustainable rotational grazing occurred on more than 90% of the project area in 2014, resulting in removals of more than 1 million tons of CO₂ equivalent greenhouse gases even after accounting for excursions of livestock off the project area. Conservancies with a longer history of a grazing plan and at least partial implementation of rotational grazing in 2012 and 2013 had a significantly lower proportion of people experiencing lower income than the previous year. A field study of biodiversity of five major indicator groups (birds, trees, herbaceous plants, grasshoppers, and dung beetles) in three Conservancies showed that partial protection from continuous grazing was associated with increased diversity of trees, herbaceous plants, and birds.

Gold Level Criteria: Climate, Community, and Biodiversity

Climate Change Adaptation: Past studies in semi-arid rangelands clearly show the benefits of rotational grazing and soil carbon accumulation in enhancing grass production and soil moisture deep into the dry season. The project is too young to demonstrate these benefits directly in the project area.

Community: Conservancies with a longer history of a grazing plan and at least partial implementation of rotational grazing in 2012 and 2013 showed higher employment rates, greater milk consumption and lower rates of sickness for the poorest 25% of people.

Biodiversity: Community-collected wildlife observations indicated an increase in abundance and range of key endangered or endemic species, including elephant, reticulated giraffe, and Grevy's zebra. Project activities reduced livestock impacts in rainforest areas with high endemic biodiversity compared to a baseline, even in a drought year when such impacts are typically high.

Date of Completion: 31 July, 2016

NORTHERN KENYA GRASSLAND CARBON PROJECT

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Table of Contents

1 CONTENTS

1	General.....	5
1.1	Summary Description of the Project.....	5
1.2	Project Location	6
1.3	Conditions Prior to Project Initiation	7
1.3.1	Land use.....	7
1.3.2	Land tenure and resource rights.....	10
1.3.3	Conflicts and disputes	11
1.3.4	Biodiversity.....	11
1.4	Project Proponent.....	12
1.5	Other Entities Involved in the Project	13
1.6	Project Start Date	14
1.7	Project Crediting Period	14
2	Design	15
2.1	Sectoral Scope and Project Type	15
2.2	Description of the Project Activity	15
2.3	Management of Risks to Project Benefits.....	17
2.4	Measures to Maintain High Conservation Values.....	18
2.4.1	Indirect effects of improved rangeland on biodiversity.....	18
2.4.2	Use project revenues to fund game scout program.....	18
2.4.3	Indirect mitigation of livestock impacts on forests.....	18
2.4.4	Community-based monitoring program	18
2.5	Project Financing.....	19
2.6	Employment Opportunities and Worker Safety	19
2.7	Stakeholders	20
2.8	Commercially Sensitive Information	20
3	Legal Status	21
3.1	Compliance with Laws, Statutes, Property Rights and Other Regulatory Frameworks	21
3.2	Evidence of Right of Use.....	21
3.3	Emissions Trading Programs and Other Binding Limits	21
3.4	Participation under Other GHG Programs	21
3.5	Other Forms of Environmental Credit.....	21
3.6	Projects Rejected by Other GHG Programs	22
3.7	Respect for Rights and No Involuntary Relocation	22
3.8	Illegal Activities and Project Benefits.....	22
4	Application of Methodology	22
4.1	Title and Reference of Methodology.....	22
4.2	Applicability of Methodology	22
4.3	Methodology Deviations	24
4.4	Project Boundary.....	24
4.5	Baseline Scenario	27

4.5.1	Baseline Rangeland Conditions	27
4.5.2	Baseline Conditions – Vegetation and Grazing	28
4.5.3	Baseline Methane Emissions	30
4.5.4	Baseline Soil Organic Carbon	33
4.6	Additionality.....	42
5	Quantification of GHG Emission Reductions and REMovals (Climate)	44
5.1	Project Scale and Estimated GHG Emission Reductions or Removals.....	44
5.2	Leakage Management.....	45
5.3	Baseline Emissions	45
5.4	Project Emissions.....	46
5.4.1	Calculation of Project Emissions and Removals	46
5.4.2	Methane Emissions	46
5.4.3	Soil Carbon Removals.....	47
5.4.4	Uncertainty in Project Emissions and Removals	58
5.5	Leakage	61
5.5.1	Displacement leakage	61
5.5.2	Market Leakage.....	62
5.5.3	Total Leakage.....	62
5.6	Summary of GHG Emission Reductions and Removals.....	62
5.7	Exceptional Climate Change Adaptation Benefit.....	64
6	Community	66
6.1	Community Evaluation	66
6.2	Net Positive Community Impacts.....	66
6.3	Negative Offsite Stakeholder Impacts	69
6.4	Exceptional Community Benefits.....	69
7	Biodiversity	70
7.1	Net Positive Biodiversity Impact	70
7.2	Negative Offsite Biodiversity Impacts	72
7.3	Exceptional Biodiversity Benefits	73
8	Monitoring.....	77
8.1	Description of the Monitoring Plan.....	77
8.1.1	Organizational structure, responsibilities and competencies.....	77
8.1.2	Methods for generating, recording, storing, aggregating, collating and reporting data on monitored parameters	79
8.1.3	Describe procedures for handling internal auditing and non-conformities	79
8.1.4	Biodiversity variables and sampling design	79
8.1.5	Community variables and sampling design	83
8.2	Data and Parameters Available at Verification	84
8.3	Data and Parameters Monitored	84
8.3.1	Project greenhouse gases and emissions.....	84
8.3.2	Project impacts on biodiversity	89
8.3.3	Project impacts on communities.....	89
9	References.....	96

1 GENERAL

1.1 Summary Description of the Project

This project aims to remove greenhouse gases from the atmosphere by implementing sustainable grazing management over a large area of northern Kenya savannas and grasslands. Past overgrazing by pastoralists from more than six indigenous ethnic groups in the region, including Maasai, Samburu, Burana, and Turkana, has depleted soils of organic matter, greatly reduced perennial vegetation cover and the potential production of forage for livestock. Marginal livestock production resulting from this degradation has put these pastoralists at risk from further climate change and from inter-ethnic tensions over grazing lands and water. The project proposes to have local communities, oriented around 15 wildlife Conservancies organized under a NGO called the Northern Rangelands Trust, engage in new planned rotational grazing practices, as opposed to repeated, permanent grazing simultaneously on all grazing lands. These new practices, which would not occur without significant carbon revenues to motivate change in herder behaviour, will allow recovery of perennial grasses and the restoration of soil organic carbon.

Soil carbon storage that results from this improved grassland management is expected to result in significant removal of CO₂ from the atmosphere, as will be documented using the VCS ALM – Sustainable Grassland Management through Adjustment of Fire and Grazing methodology, hereafter, VCS VM0032 methodology. This methodology allows VCUs to be earned for the activity of improved grazing management, and thus verified as a consequence of demonstrating such improved management by measuring altered grazing intensities, records of the time, timing and number of livestock grazers using the project area, and vegetation. The project was implemented in stages from portions of 3 Conservancies adopted planned rotational grazing in 2012 to all 14 Conservancies in the project area (2.02 million ha with 1.75 million ha of soils suitable for storing carbon) participating in a region-wide drought response grazing plan by February 2014. With expected annual removals of approximately 1 metric ton CO₂e/ha on average, the project should eventually annually remove more than 1.85 million tons CO₂e.

Improved livestock grazing and cash payments for carbon credits are expected to result in a number of social benefits and very few detriments. Clear long-term benefits will result from restoring perennial grasses as a consequence of rotational grazing will provide grass banks and a lower likelihood of catastrophic livestock loss during drought, sustained meat and milk production through the dry season, and heavier livestock that are saleable in the burgeoning Kenya beef market. Improved soil organic matter should help increase rainfall infiltration and lengthen the time surface water is available for people and livestock. Payments to communities through NRT will also be used to fund health care and bursaries that provide benefits to the poorest community members, such as paying school fees. In the short term, grazing plans have led to a stronger perception of community connection to land, reduced conflicts over grazing, and some re-claiming of Conservancy areas that were previously thought to be unsafe, as revealed by the results of focus group interviews and household surveys. These benefits to both financial, social and natural capital at the level of both communities and individuals have reduced tensions between ethnic groups and fostered better collaboration among different Conservancies, leading to greater physical and social capital. Revenues to communities should help develop infrastructure such as schools, health clinics, water collection and storage facilities, thus increasing human capital by reducing food and water insecurity.

The ecological vegetation and soil changes from the implementation of the project should also enhance the region's role as a High Conservation Area for key endangered species, such as Grevy's zebra (*Equus grevyi*), black rhino (*Dicornis bicerors*), and elephant (*Loxodonta africana*) plus other endemic bird and ungulate species in the project area's biogeographical position connecting species from the Rift Valley to the south to the Sahel to the west. Also, the project activity of implementing planned rotational grazing should improve species diversity across a number of groups of key bio-indicator taxa, including plants, birds, and key insect groups, such as grasshoppers (Orthoptera) and dung beetles (Coleoptera: Scarabeidae). The potential for the project to enhance biodiversity is evident from effects of improved grazing on these groups detected in biodiversity camps. Our baseline comparisons of the diversity of these groups among year-round grazed areas vs protected areas and those with limited grazing use supports the expectations from prior studies and justifies the project monitoring plan for biodiversity in savannas and grasslands. As the project develops isolated "sky island" forests on mountain ranges adjacent to the project area, such as the Mathews and Ngare Ndare Forests, should also have their biodiversity protected because improved grazing management should greatly reduce the need for herders to degrade the forests to provide forage for livestock during drought.

1.2 Project Location

The project area is slightly more than 2 million ha of savanna grassland extending northward from the northern slopes of Mt. Kenya toward the Ethiopia border. The area consists of a series of former Group Ranches organized under the Northern Rangelands Trust to form wildlife Conservancies of various sizes (Fig. 1). The project zone includes the forested mountain ranges, which are protected forest reserves, found in the center of the project area, and other pastoral grazing lands to the east, west, and north. Private ranches on the Laikipia plateau lie to the southwest, and a belt of commercial farms lies to the south between the project area and the forests of Mt. Kenya National Park. The project area is bisected by the Ewaso Nyiro River, which arises from the Aberdare Mountains 600 km to the southwest and flows from west to east, providing the major permanent water source for the project zone.

Annual rainfall varies from 550 mm/yr in the south and west to less than 350 mm/yr in the northeast. Soils are primarily eroded sandy loams (20-30% clay) interspersed with degraded igneous outflows that form heavy clay "black cotton" soils (40-60% clay). The project area is bisected by multiple volcanic intrusions that remain as a series of mountain ranges (Mathews and Mukugodo) exceeding 2500 m elevation, and is interspersed with lava flows of various ages that feature either rocky cinder soils not suitable for storing carbon, or "black cotton" clays which may store significant carbon.

In the project area and in the project zone to the east, north, and west, vegetation of the sandy loam soils consists mostly of *Acacia* – *Commiphora* savannah grassland. In the project zone, seasonal dry forests occupy the slopes of the sky island mountain ranges, and cloud forests occupy the highest elevations of the mountains.

Settlements inside the Conservancies are mostly small villages (< 500 people). Major settlements outside the Conservancies include the towns of Isiolo and Archer's Post, and the region is served by a newly completed (in 2011) tarmac road connecting Nairobi to Marsabit and the Ethiopia and South Sudan borders. The area is a target for energy and tourism development by the recently elected Kenyan government <http://allafrica.com/stories/201303182476.html>.

1.3 Conditions Prior to Project Initiation

1.3.1 Land use

Data specific to NRT were obtained from the recent Ph.D. research of Louise Glew^[1] but the basic baseline conditions reported almost certainly apply elsewhere in northern Kenya^[2].

The northern rangelands are the most under-developed and economically marginalised region of Kenya. The region's multidimensional poverty index is amongst the highest worldwide. Poverty is significantly higher than the national Kenya average and in some Districts more than half the population lives below the Kenyan poverty line. In Samburu District, for example, just less than 50% of adults are illiterate, a third lack access to safe drinking water, and three-quarters lack access to adequate health care. Development is further limited by the near-absence of paved roads. Communities depend almost entirely on livestock for food and currency, and limited income diversity leaves people and livestock highly vulnerable to drought.

The communities of northern Kenya, and even within the NRT Conservancies, are multi-ethnic and include populations of Ariaal, Boran, Gabbra, Maasai, Pokot, Rendille, Samburu and Turkana, each with distinct cultural traditions[3]. However all share a similar socio-economic dynamic and traditional pattern of land use, pastoralism, for at least the last 5,000 years. An estimated 80% of households in the region rely on mixed herds of Cattle (*Bos indicus*), Goats (*Capra hircus*) and Sheep (*Ovis aries*) (collectively called shoats), Donkeys (*Equus asinus*) and Camels (*Camelus dromedarius*) as their main source of wealth and cash income.

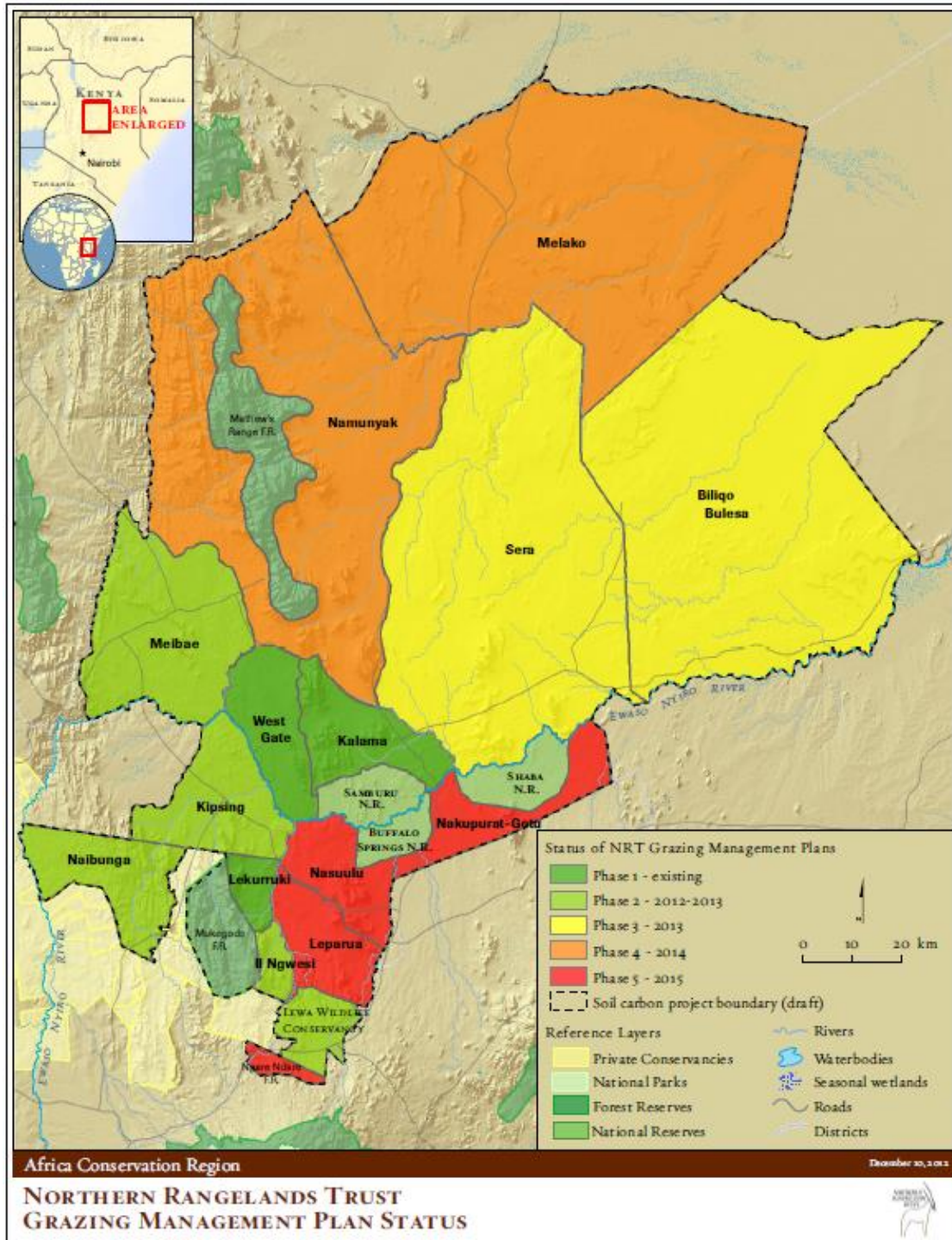


Figure 1. Map of project area and the 14 participating Conservancies. Phase 1 Conservancies implemented rotational grazing in 2012, and Phase 2 in 2013, Phase 3 and 4 ended up implementing grazing in 2014, and Phase 5 are implementing in 2015, along with Naibunga (see Table 2, section 1.7)

Table 1. The 14 participating Conservancies in the Northern Kenya Carbon Project

Conservancy	Number of People	Area (ha)	Ownership	Dominant Ethnic Group
Biliqo Bulesa	4,781	381,385	Community Trust	Borana
Il Ngwesi	1,448	9,497	Group Ranch	Maasai
Kalama	8,162	50,018	Group Ranch	Samburu
Lekurruki	1,682	8,842	Group Ranch	Maasai
Leparua	8,590	33,059	Group Ranch	Ntorobo, Borana, Somali, Turkana
Meibae	10,029	102,319	Group Ranch	Samburu
Melako	13,109	553,300	Community Trust	Rendille
Mpus Kutuk	5,560	54,817	Community Trust	Samburu, Turkana
Naibunga	12,193	47,406	Group Ranch	Maasai
Nakuprat-Gotu	5,520	71,772	Community Trust	Borana, Turkana
Namunyak	26,643	290,240	Group Ranch	Samburu
Nasuulu	4,262	34,839	Community Trust	Samburu, Turkana, Somali, Borana
Sera	6,820	341,798	Community Trust	Samburu
West Gate	3,684	36,498	Group Ranch	Samburu
Totals	112,483	2,015,790		

The pastoralist strategy of moving large, mobile herds opportunistically or seasonally around the landscape produced apparently sustainable interactions with the forage base^[2,4,5]. However, colonial and post-independence policies attempted to regulate livestock numbers, restrict land tenure and provide permanently located infrastructure (schools and health centers). These (dis)incentives reduced pastoralist mobility across the region, leading to the adoption of permanent, year-round grazing of livestock across the landscape, and an increase in the total numbers of people and livestock. Since the 1950's, the immobilization and increase in population size of pastoralists has led to dramatic decline in the herbaceous, and in some cases woody, vegetation from overgrazing. Grazing areas were formerly dominated by perennial grasses, such as from the genera *Sporobolus*, *Pennisetum*, and *Themeda* and a wide variety of perennial forb species. These perennials provided rapidly available, palatable forage after rains, bound the soil with deep, permanent root systems, and provided forage during the dry season by virtue of standing senesced leaves and stems.

Following intense, repeated annual grazing by livestock as a consequence of the settlement of pastoralists, these perennials have disappeared over much of the landscape, leading to dominance by annual forbs and grasses that produce green shoots for a few weeks or less, shallow root systems, and little or no forage during the dry season. Soil carbon losses over this period are estimated to be 30-40 tons/ha, and it is the goal of this project to rebuild this lost soil carbon by restoring a facsimile of the traditional nomadic grazing system that allows grasses to rest and recover following grazing during seasons when soil moisture is available.

Since the year 2000, NRT has worked with most of the project-participating communities to create Conservancies, or designated areas that actively manage livestock to support wildlife and revenues from ecotourism. The approach was to set aside lands that receive no livestock grazing (Core Areas) and surround these with lands that receive only seasonal grazing (often just during the dry season) (Buffer Areas) that then formed the nexus for wildlife-based tourism to occur within the Conservancy. Typically, each Conservancy contracts a lease with a tourism vendor, who builds accommodation in the Core Area and then shares revenues and trains managers during the lease period before eventually turning over the

accommodation to the Conservancy. The establishment of these Core and Buffer areas proves the concept that these communities can successfully administer and govern communal land for a social good with some success. The establishment and success of this Conservancy model, as evidenced by the result that communities with tourism vendors have received revenues and grazing has mostly been successfully regulated^[6,7], suggests that sufficient governance mechanisms and individual and community motivations are in place in these pastoral communities sufficient to achieve large scale changes in grazing practices.

1.3.2 Land tenure and resource rights

Land tenure in northern Kenya is community-based, in which government-owned land allows occupying communities ownership rights to resources. Some communities (Fig. 1) (Il Ngwesi, Kalama, Lekurruki, Leparua, Meibae, Naibunga, Namunyak, Sera, Westgate) exist as or have applied for registration as Group Ranches under the Kenya Land (Group Representatives) Act of 1968¹. This law conferred rights through group representatives are “authorized to hold land and other **assets** on behalf of the group, and to act on behalf of and for the collective benefit of all group members.” (Section II.8.). Soil carbon would be considered an asset for the group members, since it has value in the voluntary carbon market.

Other communities, such as those near Buliqo Bulesa, Melako, Mpus Kutuk, Nasuulu, and Nakuprat Gotu Conservancies are located on Trust lands, which confer rights to grazing and by inference resources that promote grazing (such as water, soil carbon) under customary law conferred by Section VIII item 59 of the Kenya Trust Land Act of 2010².

Unfortunately, all communities have suffered historically from an inability to defend ownership or customary rights from either government initiatives or land use by non-member individuals but NRT efforts and support have helped reduce conflicts and organize governance and management activities in these communities³. As part of this process, all the participating NRT communities are now registering their lands, including settlements, as Conservancies, which are defined by the Kenya Wildlife Conservation and Management Act of 2013⁴ as a “community-owned and community-run institution which aims to improve biodiversity conservation, land management and the livelihoods of its constituents over a defined area of land traditionally owned, or used, by that constituent community.” As Conservancies, communities have the right to benefit financially from conservation activities, which would include restricted, planned and managed grazing and building soils through carbon storage.

All communities await passage of a new law The Kenya Community Land Bill⁵ of 2013. This law would eliminate the prior distinction between Group Ranches and community Trust Lands, and allows communities to register as owners with natural resource rights conferred by long-term past occupancy of

¹ <http://faolex.fao.org/docs/pdf/ken62430.pdf>

² <http://faolex.fao.org/docs/pdf/ken62437.pdf>

³

http://usaidlandtenure.net/sites/default/files/USAID_Land_Tenure_Kenya_Rangeland_Costal_Conservation_Program_Assessment_0.pdf

⁴

http://www.kws.org/export/sites/kws/info/publications/acts_policies/The_wildlife_conservation_and_management_bill_2013.pdf

⁵ <http://kenyalaw.org/kl/fileadmin/pdfdownloads/bills/2014/KenyaGazetteSupplementNo147.pdf>

land. This bill, if passed, would greatly clarify and simplify rights of communities to benefits from natural resources on lands they occupy.

1.3.3 Conflicts and disputes

The decline in traditional governance and wider insecurity in the Horn of Africa have combined to make low-cost illicit firearms readily available. There is a general willingness throughout the region for people to use them to enforce resource access rights. The proliferation of firearms has combined with tribal traditions in which raiding livestock from a neighboring tribe is a male rite of passage and means by which a *moran* (warrior) may obtain social status and marry. However, in recent years, the availability of firearms has led to more frequent raids and inter-tribal killings. In Samburu District, 88% of respondents reported that they had used firearms in their possession for cattle raiding with comparable figures likely elsewhere in the region. Cattle-raiding is estimated to result in the loss of US\$1 million annually in Samburu District, and is a significant factor constraining economic development in the region (Campbell et al. 2009). Insecurity from the threat of cattle-raiding has fed the cycle of increased environmental degradation, which in turn fuels the conflict (Campbell et al. 2009). Because much of the rangeland has become unsafe for grazing livestock and nomadic herders, pastoralists have become further sedentary in secure areas (Campbell et al. 2009). Furthermore, stealing cattle may be the only viable way for many impoverished people to re-build herds lost from droughts. Drought further exacerbates conflict because herders may move to areas distant from their home Conservancies to find water or grass, thus bringing historically antagonistic ethnic groups into proximity with little governance as to how limited resources are allocated.

1.3.4 Biodiversity

The project zone includes multiple High Conservation Value (HCV) areas, including at least 11 established protected areas (Core areas) within Conservancies plus the nationally protected Mathews Forest Reserve, a “sky” island containing many of the same endemic bird, primate and amphibian species as found in the nearby Kenya Mountains Endemic Bird Area^[8] to the south of the project area. Samburu, Buffalo Springs and Shaba National Reserves interdigitate with several participating Conservancies in the south along the permanent Ewaso Nyiro River, and Losai and Marsabit National Reserves border the Melako Conservancy in the north.

The grassland and savanna habitat that dominates most of the participating Conservancies produces food and potential tourism income to supporting the pastoralist livelihoods of multiple ethnic groups. The NRT Conservancies house a large number of ungulate species, including two endangered species, the Grevy’s zebra (*Equus grevyi*) and black rhino (*Dicornis bicerors*), and several other species of conservation interest, such as elephants (*Loxodonta africana*). In addition, several other ungulate species or subspecies are endemic to northern Kenya, southern Ethiopia, northern Uganda, and South Sudan, as this region is a key suture zone between the faunas of the Sahel to the west and those of the Rift Valley to the south^[9].

Savanna habitats in the project zone typically contain a significant diversity of plants, birds, reptiles, and various arthropod groups. Previous studies in the NRT or northern Kenya area^[1,6,7,10,11] strongly suggest that planned rotational grazing and rangeland recovery will enhance numbers of large ungulate and associated carnivore species and increase plant diversity^[12-15]. However, the impacts of rangeland restoration and soil carbon storage on other potential conservation values are poorly documented.

Biodiversity in savanna and grassland habitats, beyond plant and ungulate diversity, is still poorly documented outside major, well-studied protected areas, as conservation interest and biodiversity surveys have been focused mainly on forests^[16]. Simultaneously, most of the species lists for grasslands and savannas were generated during early exploration and natural history surveys when the gradual decline in range condition, e.g., cover of perennial grasses, over the landscape had not yet begun. The large number of potential arthropod groups that could be sampled is beyond daunting, and it is doubtful whether the expertise to identify all groups exists within Kenya. However, two arthropod groups, the Orthoptera (grasshoppers and allies)^[17,18] and dung beetles (Coleoptera, Scarabeidae: Scarabeinae) have important functional roles in savannas^[19-21] and can serve as credible bio-indicators of biodiversity.

Given the HCV of the project zone, and the multiple beneficial effects expected from implementing planned rotational grazing, the project is expected to increase species diversity of multiple taxa, including plants^[11,22,23], birds^[13,24] and arthropods^[12,13,15,25] across the 2 million ha in the project area and elsewhere in the project zone. Our baseline data suggest that project activities in the project zone and during the project lifetime will increase the diversity of herbaceous plants and trees, and definitely exhibit no harm to the arthropod groups and birds. This will allow current or recent past measurements of the baseline 'without project' biodiversity scenario to be compared to the biodiversity in the 'with project' scenario where the difference (i.e., the net biodiversity benefit) is expected to be positive.

1.4 Project Proponent

The project is a joint exercise of **The Nature Conservancy (TNC)**, the **Northern Rangelands Trust (NRT)** and **Soils for the Future, LLC (SftF)** and the 14 Conservancies.

TNC facilitates community-based conservation projects throughout eastern and southern Africa, including two REDD+ projects involving local community protection of forests in Tanzania. They implement a strategy of building local capacity to manage lands and resolve conflicts between competing land uses and conservation.

NRT facilitates and coordinates a governance relationship with multiple indigenous communities across the 2 million ha project zone. NRT helps different communities establish wildlife conservation activities in the form of Conservancies that cooperate with private vendors to benefit from tourism in return for setting aside land from year-round cattle grazing. The communities engaged in these Conservancies are now prepared to collectively participate in planned rotational grazing of livestock in both protected areas of their lands as well as open lands used communally by their members. Consequently, the communities of NRT are full participants and proponents of the carbon project.

SftF is a private for-profit company focused on developing carbon credit offsets through improved grassland management practices to increase the storage of carbon dioxide in soils and grasslands. SFF offers technical expertise in the project organization and design and in monitoring carbon project activities, preparation of technical documents for regulatory organizations in the process of validating carbon projects and verifying claims of carbon credits, and advice and assistance in marketing credits.

The Conservancies are each a set of communities, typically dominated by a particular ethnic group that have joined together to set aside lands for wildlife and other types of conservation. Their goal is to provide

security for livestock and wildlife and make better use of lands to maintain cultural traditions, diversify livelihoods, and reduce poverty.

Key Contacts:

Mark E. Ritchie, Ph.D., Soils for the Future, LLC, +1-315-447-1612, mritchie@soilsforthefuture.com

Dr. Ritchie is the developer of the VCS VM0032 methodology used in this project, as well as the developer of the SNAP soil carbon model used to determine changes in soil carbon as a consequence of planned rotational grazing management. He is the primary author of the PD and the Monitoring and Implementation Report and other project-related documents. He is also the project expert on carbon markets

Matt Brown, Director of Conservation, Africa Region, The Nature Conservancy, +255 758 012834, mbrown@tnc.org

Mr. Brown is the primary responsible person for The Nature Conservancy on this project. In his role as Director of Conservation, he has extensive experience with community-based conservation projects in East Africa, as well as considerable field experience Tanzania, Southern Sudan, and Oman. He has worked extensively with other carbon developers to build projects that protect forests and indigenous people in Tanzania

J.C. Danilovich, Director of Product Development, NatureVest, The Nature Conservancy, +1-646-465-5893, jcdanilovich@tnc.org

J.C.'s role is to refine and maintain the business model for the project and to market carbon credits delivered. He will oversee distribution of revenues to NRT and other partners.

Jeff Worden, Ph.D. Senior Scientist, Northern Rangelands Trust, +254 73 333 3856. jeff.worden@nrt-kenya.org

Dr. Worden is a scientist with extensive field experience in East Africa and has coordinated the large expansion of sustainable grazing within the Conservancies during the first full year of the project.

1.5 Other Entities Involved in the Project

Grevy's Zebra Trust (GZT) has been and will continue to be instrumental in education of pastoralist communities regarding the rotational grazing of bunched herds as a desired management objective. Their training led to adoption of rotational grazing in the first two Conservancies in NRT, and subsequent workshops helped expand rotational grazing concepts to additional Conservancies.

Contact: Belinda Low Mackey, Executive Director, Grevy's Zebra Trust, Nairobi, belinda@grevyszebratrust.org

International Centre for Tropical Agriculture (CIAT). This organization has and will provide the analyses of soil carbon and plant tissue lignin and cellulose for the project. CIAT also conducted some of the soil sampling used to determine the baseline carbon stocks in the project area.

Contact: Dr. Leigh Winowiecki, Soil Scientist I, International Centre for Tropical Agriculture, Nairobi,
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International Centre for Agroforestry (ICRAF) conducted some of the soil sampling used to determine the baseline carbon stocks in the project area and has developed a remote-sensing based model for estimating soil carbon stocks.

Contact: Tor-Gunnar Vagen, Senior Scientist, International Centre for Agroforestry, Nairobi,
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Syracuse University will license the SNAP soil carbon model used in determining greenhouse gas removals as a consequence of changing grazing management.

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1.6 Project Start Date

The project Start Date is December 10, 2012 (Date of TNC/NRT charter).

1.7 Project Crediting Period

The project crediting period is 30 years from the start date: from December 10, 2012 to December 9, 2042. This is the project lifetime. The project is proceeding in five phases (see Fig. 1) and (Table 1), such that all 14 Conservancies will be participating by December 2015. As of December 2014, 11 communities had successfully implemented planned grazing over at least part of their land for at least 8 months.

Table 2. Origination timeline for project participation by the 14 Northern Rangelands Trust Conservancies.

Conservancy	Area ha	Year Started	Phase
Kalama	50,018	2012	I
Lekurruki	8,842	2012	I
West Gate	36,498	2012	I
Il Ngwesi	9,497	2013	II
Sera	341,798	2013	II
Biliqo Bulesa	381,385	2014	III
Meibae	102,319	2014	III
Melako	553,300	2014	III
Mpus Kutuk	54,817	2014	III
Namunyak	290,240	2014	III
Leparua	33,059	2015	IV
Naibunga	47,406	2015	IV
Nakuprat-Gotu	71,772	2015	IV
Nasuulu	34,839	2015	IV
Total	2,015,790		

2 DESIGN

2.1 Sectoral Scope and Project Type

This is an AFOLU project (Sector 14) under the VCS Agricultural Land Management – Sustainable Grassland Management through Adjustment of Fire and Grazing.

2.2 Description of the Project Activity

The principal project activity is a widespread implementation of planned rotational grazing^[26-28] for cattle and shoats within each of the 15 Conservancies. Livestock will be grouped and moved subject to local day-to-day movement decisions by herders within constraints that follow a few simple principles. The management style can be described as “planned rotational grazing” or **PR grazing** (Figure 2), following concepts from both rest-rotation grazing and holistic management^[29]

1. Animals will be actively herded and moved to new forage throughout a day and from day to day.
2. Animals will not graze the same location more than once within a wet season or once within a dry season.
3. Animals will be moved to a new site once available forage has been grazed to an average height of 2.5 cm.
4. Animal herds will be moved across the landscape so as to avoid over-use of areas near settlements or water points.
5. Some areas will be rested for one year to allow recovery from past grazing or to provide grass banks during the dry season or droughts, but different areas will be rested each year in order to provide animal impacts and re-establishment of a diverse plant assemblage in all areas.

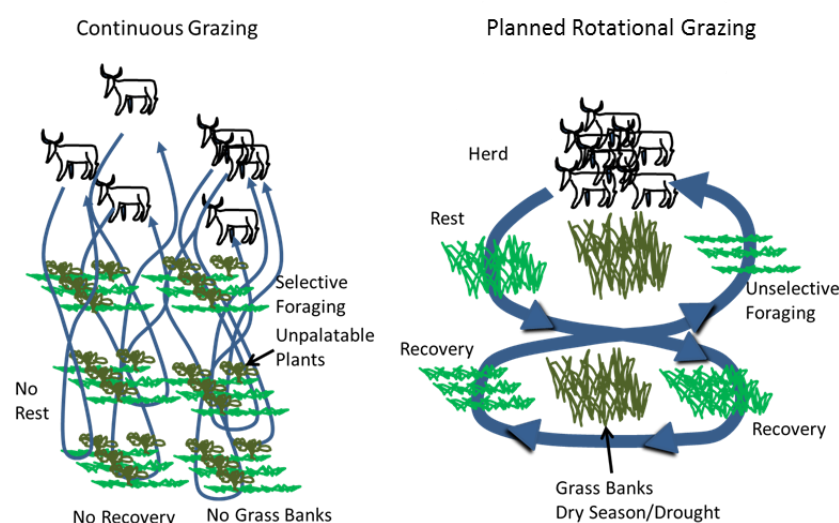


Figure 2. Influence of current baseline “continuous” grazing system in which loose herds repeatedly graze the same ground, resulting in selective foraging, continuous animal impacts and no rest or recovery of forage. In contrast, the proposed project activity of **planned rotational (PR)** grazing employs herds with the same number of livestock that visit the same ground only once per season, providing impacts that encourage seed

germination but allowing rest and recovery of forage. Planned routes allow some areas of grass to completely rest and thus serve as grass banks against forage needs in the dry season or during drought.

6. Herders follow agreed-upon plans for livestock movement from grazing committees headed by community elders. Grazing “assistants” employed by the project in each Conservancy will monitor and advise herders in the field.

This management contrasts with by far the most common current “baseline” practice, **continuous grazing**, whereby animals repeatedly graze the same site in small groups, simply as a consequence of the most convenient and least time and energy demanding deployment of livestock near permanent settlements or persistent water points. Animals are moved to different grazing areas seasonally, but often only after forage is reduced by more than 95%.

The resulting rotation of animals will allow plants time to re-grow following grazing and to produce seed. Animals in herds are generally less selective for forage than those moving in looser smaller groups, which results in a more uniform impact of grazers across different plant species, thus reducing the chance of promoting plant species that increase in the presence of grazing. Larger herds also can produce desirable hoof impacts on soils, thereby breaking up crusts that promote sheet erosion and decrease rainfall infiltration. Previous research has shown that perennial grasses can increase under a shift from continuous to rotational grazing^[27,28]. If so, then decomposition of the extensive and permanent roots of perennials, combined with the return of recalcitrant forms of carbon to the soil from animal dung, can add carbon to the soil, increase water infiltration and soil water holding capacity, increase herbaceous productivity, mitigate climate variability, and enhance pastoralist livelihoods.

Each Conservancy will develop and implement its own annual grazing plan with grazing blocks established separately in both dry and wet season ranges and to include both cattle and other livestock (sheep, goats, donkeys and camels). The expectation is that each Conservancy’s livestock can operate within the boundaries of each Conservancy, and that zoning will include grass banks as well as seasonal grazing areas. However, it is the fundamental nature of the northern Kenya ecosystem that rainfall in any given year is unevenly distributed across space, whereby forage may be available in one Conservancy but not in another. To accommodate this scenario, the livestock within the project area operate within a larger regional grazing system in which scarce surface water areas serve as dry season ranges or “regional grass banks” that are used only under extended dry season or drought conditions. These include large lava plateau areas in Melako, central and eastern areas of Sera, the eastern side of the Mathews Range in Namunyak, far western Naibunga and Meibae, and eastern Nakuprat-Gotu. These areas contain very few villages and historically have attracted livestock from as far away as 100 km. The project amplifies this historical and culturally imbedded system by planning when and how different herds from different Conservancies will use these regional grass banks so as to avoid conflicts over grass and water.

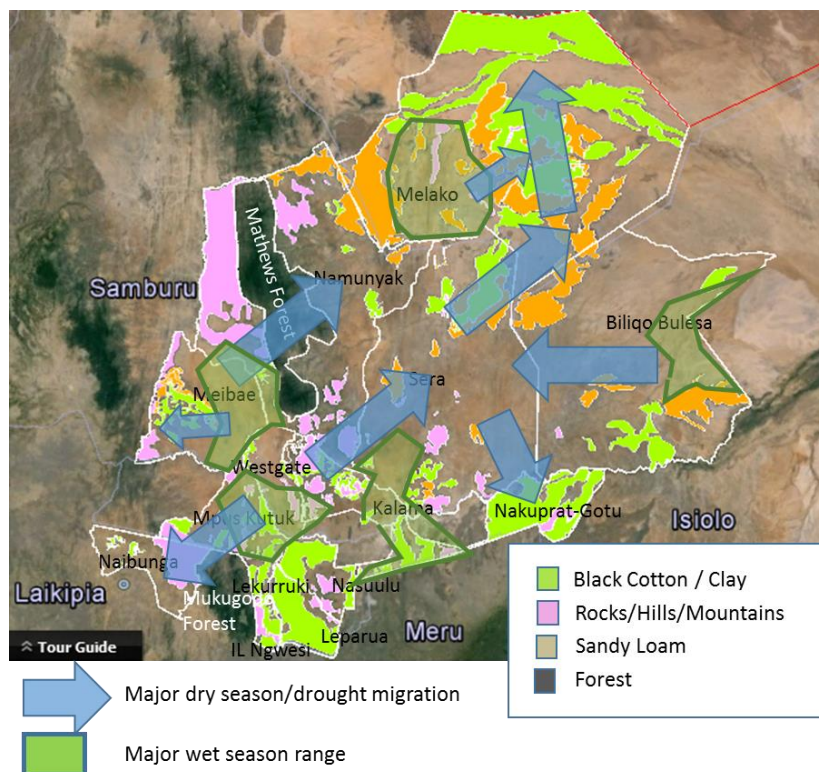


Figure 3. The regional grazing system encompassed by the project area. Shown are the Conservancy boundaries (white borders) and major soil strata for the project area. Light green polygons show major wet season grazing areas with high village concentrations. Blue arrows show major migration routes used when forage in wet season areas is depleted or fails due to lack of rainfall. Note the many options available depending on different spatial patterns of rainfall.

2.3 Management of Risks to Project Benefits

The primary risks for this project are the failure to implement planned rotational grazing. Such failure is most likely if drought is severe, which would cause large-scale movement of livestock outside the project area and other grazing management decisions that might lead to over-use of rangelands and an incremental reversal of accumulated soil carbon stocks.

The principal mitigation strategy for such risk is to

1. Rapidly build grass banks, particularly in extensive unsettled areas typically used only during the dry season, that can be used as forage during droughts,
2. The accumulation of soil carbon will lead to greater infiltration of rainfall, which will make communities progressively less vulnerable to climate variability and drought as the project proceeds,
3. Further build the livestock-to-market program instituted by NRT to provide cash compensation for de-stocking in advance of intense droughts, where droughts can be anticipated by using early warning systems such as the USDA FEWS network <http://www.fews.net/>,
4. Through education associated with monitoring social benefits of the project, continue to convey the community and personal revenue advantages linked to continued participation in the project,

5. Progressively entrain sustainable livestock management processes as a new “tradition” of planned rotational grazing, and
6. Continue to demonstrate the indirect positive influence of rangeland vegetation and soil recovery on biodiversity and the concomitant benefits of biodiversity to people.

2.4 Measures to Maintain High Conservation Values

2.4.1 Indirect effects of improved rangeland on biodiversity

Under the new planned rotational grazing management practices promoted by the project, perennial grasses should be restored across more than 1 million ha of rangeland. The increased cover of palatable forage, the increased water-holding capacity produced by storing soil carbon, and likely the availability of dispersed surface water for longer into the dry season will likely benefit species in all nodes in the savannah-grassland food web. Consequently, the project activities should enhance biodiversity of multiple taxa across virtually the entire project area.

The baseline monitoring data (Fig. 3) on biodiversity of plants, birds, dung beetles (Coleoptera, Scarabaeidae) and grasshoppers (Orthoptera) show clearly that relaxation of intense (> 95% forage removal) grazing leads to greater herbaceous plant and tree diversity and possibly insect diversity. With a biodiversity monitoring plan expanded from three to six sites, the project will be able to more clearly demonstrate the linkage between grazing practice, range condition, general biodiversity, and populations of threatened or endemic species like Grevy’s zebras, gerenuk, elephant, reticulated giraffe, and others.

2.4.2 Use project revenues to fund game scout program

NRT has worked with Conservancies to develop crews of game scouts that are responsible for patrolling Conservancy borders looking to prevent wildlife poaching and unfriendly incursions from potential cattle thieves. The project would provide community-level revenues for expanding the frequency of patrols and the quality of equipment and further increase the physical security of Conservancy members.

2.4.3 Indirect mitigation of livestock impacts on forests

Traditionally, local pastoralist groups during severe droughts would take livestock into nearby forests associated with mountain ranges like the Mathews Range, where herders would cut trees to feed livestock. The project activities would develop extensive grass banks within Conservancies and in regional dry season ranges (in Sera, Melako and Biliqo Bulesa), which would provide superior dry season and drought refuge range for livestock than forest trees. The presence of such banks and refugia is expected to reduce impacts of livestock and resulting forest degradation.

2.4.4 Community-based monitoring program

NRT has recently developed a community-based wildlife monitoring program in which Conservancy members and game scouts in particular record observations of key wildlife species during their normal activities. This program, called “Wildlife CoMMs,” has provided important data on population sizes of various wildlife species of interest, such as Grevy’s zebra, elephants, and lions^[7]. Project revenues would

amplify this effort as revenues will be used to employ more game scouts, which would increase both the intensity and extent of the surveys.

2.5 Project Financing

All anticipated funding needs to start the project have been met, largely from grants from the USAID and DANIDA (US and Danish international aid agencies). The cost of continuing to implement the project through December 2015 will be met with a grant from NRT to DANIDA.

Anticipated revenues and operating and monitoring costs are summarized in Table 3. Revenues assume a below long-term average voluntary market price (since 2008) for voluntary credits (VCUs) of \$3 per ton CO₂e. Operating profit margins are expected to be on the order of 65-75%, which would provide plenty of revenue to implement new grazing practices, conduct monitoring, and expand biodiversity and social monitoring. We view these estimates as conservative, as during 20011-2012, AFOLU projects receiving both VCS and CCBA certification sold credits for USD\$ 5-9 per ton CO₂e, based on recent sales of voluntary credits on the Carbon Trade Exchange (<http://ctxglobal.com>). Improved rangelands and rotational grazing practices will lead to expansion of other sources of revenue, such as livestock sales to individual herders on the NRT livestock to market program <http://www.naturevesttnc.org/Livestock-to-Markets.html> , may indirectly result from project activities.

The expansion of the project was almost complete by the end of 2014, as only four Conservancies of the anticipated 14, Leparua, Nasuulu, Nakpurat-Gotu, and Naibunga remained. In the first quarter of 2015, these four Conservancies hired grazing coordinators and began to implement planned rotational grazing management. This new activity was funded by a grant of USD\$500,000 from the Danish international aid organization DANIDA.

The principal implementing partner in this project is NRT, whose annual budget is approximately \$3 million from both donor and commercial sources. (For more details see NRT 2013 Annual Report⁶) NRT has grown substantially since its inception in 2004 and has a sustainable network of donors for livestock management and rangeland restoration featuring USAID, DANIDA, and The Nature Conservancy (TNC). TNC provides more than US\$1 million annually in support of NRT management, and recently arranged \$7 million in low interest loans to support the livestock-to-market program operated by NRT Trading, a commercial adjunct of NRT <http://www.nrt-kenya.org/nrt-trading/>.

2.6 Employment Opportunities and Worker Safety

The project will provide numerous employment opportunities for Conservancy members. 45% of NRT staff come from the local Conservancies, and searches for grazing coordinator, monitoring specialist, field assistant, driver, interviewer, data entry, accountant and other positions will actively seek Conservancy members. Some project revenues will be used by village or Conservancy administration to hire other Conservancy members as game scouts or other non-project jobs.

All NRT and Conservancy endeavors are required by their charter to follow the 2007 Kenya Occupational Safety Act ⁷. Compliance is monitored by NRT human resources staff. Field employees are provided with

⁶ http://www.nrt-kenya.org/wp-content/uploads/2014/04/NRT_2013_AnnualReport1.pdf

⁷ <http://www.ilo.org/dyn/natlex/docs/SERIAL/78264/83534/F789589155/KEN78264.pdf>

functioning 4WD vehicles with licensed, trained drivers and/or motorcycles for navigating on and off road with helmets and other protective gear. Staff work in pairs for safety and the ability of a partner to transport another to health care providers distributed among different Conservancies. Game scouts are highly trained and provided uniforms, rifles, operating radios, and other appropriate field gear, and also work in teams transported, if necessary by trained and licensed drivers.

2.7 Stakeholders

The NRT has identified all of the major community areas that are registering as Conservancies and will participate in the carbon project (Table 1). All Conservancies are dominated by households whose majority income is from livestock sales or products (eg, milk, meat). In addition, there are other stakeholders including government offices and communities outside the project area.

NRT Communities

Buliqo Bulesa, Il Ngwesi, Kalama, Lekurruki, Leparua, Meibae, Melako, Mpus Kutuk, Naibunga, Nakuprat Gotu, Namunyak, Nasuulu, Sera, West Gate

Communities outside NRT

Longopito, Ol Donyiro

Other government offices

Samburu County Ministry of Agriculture, Livestock, Veterinary and Fishes

Samburu County Ministry of Environment and Natural Resources

Isiolo County Ministry of Lands, Livestock Agriculture, and Fisheries

Isiolo County Ministry of Water, Environment, and Natural Resources

County Government of Laikipia

Kenya National Land Commission

Kenya National Environmental Management Authority

Kenya Forest Service (managers of Mathews, Mukugodo and other forests in the project zone)

2.8 Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of this Project Description.

3 LEGAL STATUS

3.1 Compliance with Laws, Statutes, Property Rights and Other Regulatory Frameworks

Grazing and grazing resource (water, soil) rights are conferred by land ownership associated with Group Ranch status via Kenya Land Act of 1968 (revised in 1970) or by Africa customary law for communities on Trust lands via the Kenya Trust Land Act of 2010. Rights to benefit from soil conservation are conferred by the right to register lands as Conservancies by the Kenya Wildlife Conservation and Management Act of 2013 (see also section 1.3.2).

The relevant labour laws include the Employment Act (Cap.226); the Regulation of Wages and Conditions of Employment Act (Cap. 229); the Trade Unions Act (Cap. 233), the Trade Disputes Act (Cap. 234), the Workmen's Compensation Act (Cap. 236), These have been and will continue to be implemented in the project through implementation of NRT's hiring policies, which include

1. Open announcements of jobs associated with NRT and carbon project positions⁸.
2. Coverage of all employees under Workmen's Compensation

The project has been registered with and reviewed by the National Environmental Management Authority.

3.2 Evidence of Right of Use

Rights to benefit from soil conservation as a component of wildlife conservation are conferred by the right to register lands as Conservancies by the Kenya **Wildlife Conservation and Management Act of 2013**.

3.3 Emissions Trading Programs and Other Binding Limits

Carbon offsets earned through AFOLU sector 14, Agricultural Land Management, are not allowed on any compliance carbon trading program. Consequently, the credits earned through the project cannot be traded on such a program.

3.4 Participation under Other GHG Programs

The project will only be registered under the VCS and CCBA Standards.

3.5 Other Forms of Environmental Credit

The project currently has, and will not seek any other credit from any other greenhouse gas accrediting program. The VCS is the only standard that allows carbon credits under agricultural land management to adjust grazing.

⁸ <http://www.nrt-kenya.org/wp-content/uploads/2012/11/NRT-North-JOB-ADVERTS.pdf>

3.6 Projects Rejected by Other GHG Programs

The project has not applied for or been rejected by any other greenhouse gas accrediting program. The VCS is the only standard that allows carbon credits under agricultural land management to adjust grazing.

3.7 Respect for Rights and No Involuntary Relocation

Participation in this project is completely voluntary. Participation by community members is presumably motivated by the prospect of benefits to forage availability, livestock health and marketability in addition to benefits to community infrastructure and retention of land rights. The decision about where and when to move livestock will be made by community decision-making process through existing mechanisms of livestock management, and not by NRT, TNC, or other project proponents. The voluntary nature of the decision has been made clear by the announcement of the project during the public comment period during consultations with key informants, opinion leaders, and community administrative leaders.

Individual conservancies may, on their own volition, choose to relocate settlements within their Conservancy, but this will follow established mechanisms of decision-making within the community. At no time will NRT, SFF, or TNC request community members to relocate. This will be made clear by the announcement of the project during the public comment period through consultations with key informants, opinion leaders, and community administrative leaders.

3.8 Illegal Activities and Project Benefits

The project depends on voluntary actions by community members to herd livestock according to planned rotational grazing principles. By communal grazing rights afforded to each Group Ranch, altered grazing management is a legal activity. Monitoring of biodiversity involves no capturing or handling of vertebrates, and sampling of plants and insects is not covered under Institutional Animal Care regulations. Human surveys by NRT staff are covered under research methods approved by an external Institution Review Board covering TNC and NRT-sponsored social science research.

4 APPLICATION OF METHODOLOGY

4.1 Title and Reference of Methodology

The methodology used in this project is the VCS VM0032 methodology⁹

4.2 Applicability of Methodology

The **applicability conditions and allowable activities** of the VCS VM0032 methodology are all met by the project.

(1) The project area must be classified as grasslands. The project zone is broadly classified as Commiphora- Acacia savanna. Mean tree canopy cover is less than 30%, and the area outside Forest Reserves is not classified by the FAO as forest (Fig. 4)

⁹ <http://www.v-c-s.org/methodologies/alm-adoption-sustainable-grassland-management-through-adjustment-fire-and-grazing>

(2) Allowable project activities include adjustment of the number, type, and husbandry of grazing animals, the frequency and intensity of planned or unplanned fires, and/or introduction of herbaceous grassland species as potential forage for grazing animals or to restore degraded soils. However, restoration activities cannot involve mechanical vegetation removal or soil tillage due to their potential reductions in SOC from soil erosion;

The project will adjust the husbandry (herding) practices used with livestock. Fire is not very frequent in the project area because fine fuels are kept at a low biomass by grazing. There are restoration activities ongoing in the project area, but these involve only seeding followed by the trampling impacts of animals.

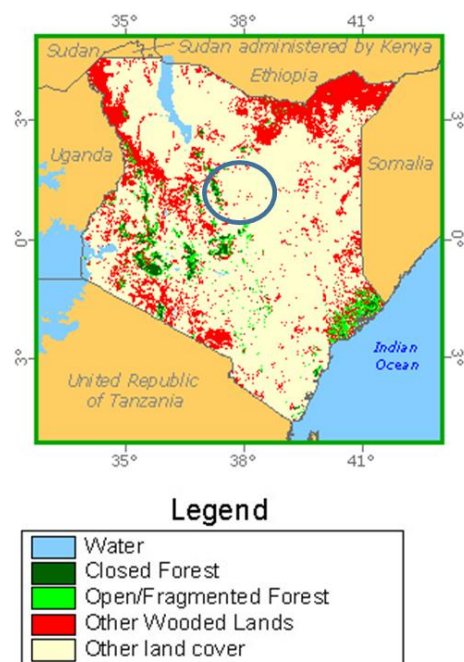


Figure 4. Land cover classified as forest in Kenya, showing that, other than the forest associated with the Mathews range, the project zone (circled) is not classified as forest <http://www.fao.org/forestry/country/en/ken/>, except for the Ngare Ndare, Mukugodo and Mathews Forests, which are not included in the project area

(3) Land receives no net import of inorganic or organically-derived fertilizer. Lands may be grazed or ungrazed and subject to fires or not.

The people in the project area are virtually all pastoralists using unimproved rangeland and do not import fertilizer from outside the project area. People generally lack the finances, land ownership, or access to irrigation water to foster the establishment of improved pastures. The unimproved rangelands are used for grazing by livestock and wildlife and for gathering honey or other foodstuffs.

(4) There is no net displacement of livestock from inside the project area to lands outside the project area, and the project proponents must be able to enforce the boundaries of the project area. If project activities involve livestock reductions, animals are to be sold for meat or for production of animal products.

The project area was chosen to be a largely self-contained grazing ecosystem. Once grazing management plans are in place, there will be no general incentive for herders to take livestock outside the project area. There is no planned net reduction in livestock for the project area, as this is unnecessary to achieve the project goals. During drought, communities may choose to reduce herds by selling animals for meat under existing livestock-to-market programs sponsored by NRT. However, the establishment of grass banks and residual biomass following regrowth should present options for drought mitigation within the project area. The establishment of community elder-based grazing plans and management and the recognition of clear boundaries between Conservancies and other Group Ranches outside the project area are sufficient to keep livestock within the project boundaries. Herders from communities outside the project area may seek to move their animals inside the project area, and these incursions will be negotiated using the traditional elder system, as advised by NRT to sustain project goals.

(5) The project will result in no net increase in activities that promote anaerobic fermentation of dung, such as an increase in the number of livestock aggregated, e.g., kept in corrals or pens, in a number or for a time that would result in more than 50% of the ground area covered by dung. This criterion is conservative relative to the conditions of dung accumulation that would result in significant anaerobic decomposition^[30].

The project holds no expectations that livestock numbers will change either positively or negatively as a consequence of project activities. However, the goal of the project is for communities to achieve greater sustainability in animal numbers and to begin to sell excess animals in the NRT livestock-to-market program rather than accumulate more animals in poorer condition that stress forage and provide little cash value. Success in this endeavor will satisfy the requirement for no net increase in the quantity of anaerobic dung decomposition because animal biomass (and therefore dung deposition) should hold to its current level or decrease.

(6) Emissions derived from livelihood-driven human impacts on aboveground woody biomass, e.g., cutting for fuel wood, charcoal, or timber sales, must be negligible (not included in the cumulative 95% of total GHG emissions) of both the total baseline scenario and project scenario emissions.

The dominant source of emissions from woody plants in the project area is wood harvesting for fuel wood (charcoal). While there is some cutting of savanna trees for locally used fuel wood, estimated population densities are less than one family per 100 ha. Typical carbon densities for savannas in northern Kenya and southern Sudan exceed 1 ton/ha^[31], and typical charcoal carbon use by a pastoralist family not engaged in commercial charcoal enterprises is approximately 2.5 tons C/yr^[32], which amounts to less than 5% of aboveground C stocks.

(7) For projects that propose to modify grazing, maximum individual project size is 3 million ha or 5% of a country's grassland or savanna land area used for grazing.

Kenya's total land area is 58,130,900 ha of which all but 3,522,000 ha <http://rainforests.mongabay.com/deforestation/kenya.html> is savanna and grassland. The total project area is 2.03 million ha, which is less than 3 million ha and amounts to less than 3.6% of the savanna and grassland area of Kenya.

4.3 Methodology Deviations

There are no methodology deviations needed.

4.4 Project Boundary

There is only one major pool of carbon, soil organic carbon, considered by the methodology, since changes in carbon stocks from changes in woody biomass are assumed to be negligible because of a lack of fire in the baseline conditions and project scenarios and because people use a negligible amount of woody carbon for fuel.

Table 3. Selected carbon pools (N = No, Y= Yes, O = Optional)

Pool	Selected (Y/N/O)?	Explanation/Justification
------	-------------------	---------------------------

Soil organic carbon (SOC)	Y	Major sink for GHG covered by VM0032
Aboveground non-woody biomass	N	High carbon turnover - not a major sink and reflects balance with CO ₂ uptake, respiration by plants, and annual decomposition ^[33]
Belowground biomass	N	High carbon turnover - not a major sink in grasslands and reflects balance with CO ₂ uptake, respiration by plants, and annual decomposition ^[33] . Since tillage is not allowed according applicability conditions, any increase from project activities can be conservatively excluded.
Aboveground woody biomass	N	The project activities should not affect fire, which currently is very rare in the project area, and so should not affect aboveground woody biomass. Furthermore, change in woody biomass is assumed to be negligible or conservatively excluded because human harvesting of wood reduces aboveground woody carbon stocks by less than 5%.
Aboveground non-woody litter biomass	N	In grasslands, litter exhibits high turnover which further reflects balance with CO ₂ uptake, respiration by plants, and annual decomposition ^[33]
Aboveground dead wood biomass	N	Negligible in grasslands, particularly those with fire
Wood products	N	An optional pool for VCS ALM projects, it is considered negligible for untilled grasslands

This methodology has applicability conditions for no tillage and activities that do not include avoided conversion of grasslands. **Consequently, aboveground non-woody biomass, aboveground non-woody litter biomass, and belowground biomass are considered negligible sinks because they turnover considerably through the year, sometimes by as much as 100%.** They may later be used as potential parameters for soil carbon models because they influence the input of carbon to the soil, but they conservatively do not represent significant, permanent sinks or reservoirs of GHG in grasslands.

Table 4. Sources of GHG and their applicability (N = No, Y = Yes, O= Optional)

Phase	Source	Gas	Included	Justification
Baseline	Grazing animals	CO ₂	N	balance with CO ₂ uptake, respiration by plants, and annual decomposition ^[33]
		CH ₄	Y	Target removal for methodology
		N ₂ O	N	No increase in concentration of dung and forage is not fertilized (applicability conditions)

Baseline	Burning biomass	CO ₂	N	Balance with CO ₂ uptake by plants
		CH ₄	N	The project activities should not affect fire, which currently is very rare in the project area, and so should not affect aboveground woody biomass. Furthermore, change in woody biomass is assumed to be negligible or conservatively excluded because human harvesting of wood reduces aboveground woody carbon stocks by less than 5%.
		N ₂ O	N	Negligible under applicability conditions
Baseline	Soil emissions	CO ₂	N	Assumed to be in balance with C inputs to SOC (SOC at equilibrium)
		CH ₄	N	Negligible since project is not in wetland
		N ₂ O	N	Negligible under applicability conditions
Project	Grazing animals	CO ₂	N	Balance with CO ₂ uptake by plants
		CH ₄	Y	Removals conservatively excluded, Increases from baseline must be counted
		N ₂ O	N	No increase in concentration of dung (applicability conditions) and forage is low in N
Project	Burning biomass	CO ₂	N	Balance with CO ₂ uptake by plants ^[33]
		CH ₄	N	The project activities should not affect fire, which currently is very rare in the project area, and so should not affect aboveground woody biomass. Furthermore, change in woody biomass is assumed to be negligible or conservatively excluded because human harvesting of wood reduces aboveground woody carbon stocks by less than 5%.
		N ₂ O	N	Negligible under applicability conditions
Project	Soil emissions	CO ₂	N	Accounted for in measured ΔSOC
		CH ₄	N	Negligible since project not in wetland
		N ₂ O	N	Negligible under applicability conditions

4.5 Baseline Scenario

4.5.1 Baseline Rangeland Conditions

The project area was stratified according to soil type and by Conservancy. Each Conservancy is subject to independent management by a grazing committee, as guided by a Conservancy-specific grazing coordinator, that directs where grazing is allowed and to which households. The major soil types were either sandy loam, covering 65.5%, “black cotton” (poorly drained and very clayey), covering 18.3%, lava plateau (coarse sand, small pebbles, and clay), covering 9.3%, and rocky hillslopes or mountains, covering 6.8% of the project area respectively. Rocky, hilly or mountainous areas, as well as areas with exposed lava, were not included as “participating” in the project, as these soils were often too shallow to store appreciable carbon. Consequently, the project area was composed of 28 strata, comprised of each Conservancy and its areas of black versus sandy loam soils (Fig. 5). Rainfall, another potential axis of stratification varied across the project area (Fig. 5), and was interpolated for each sampling station rather than used as a basis for stratification.

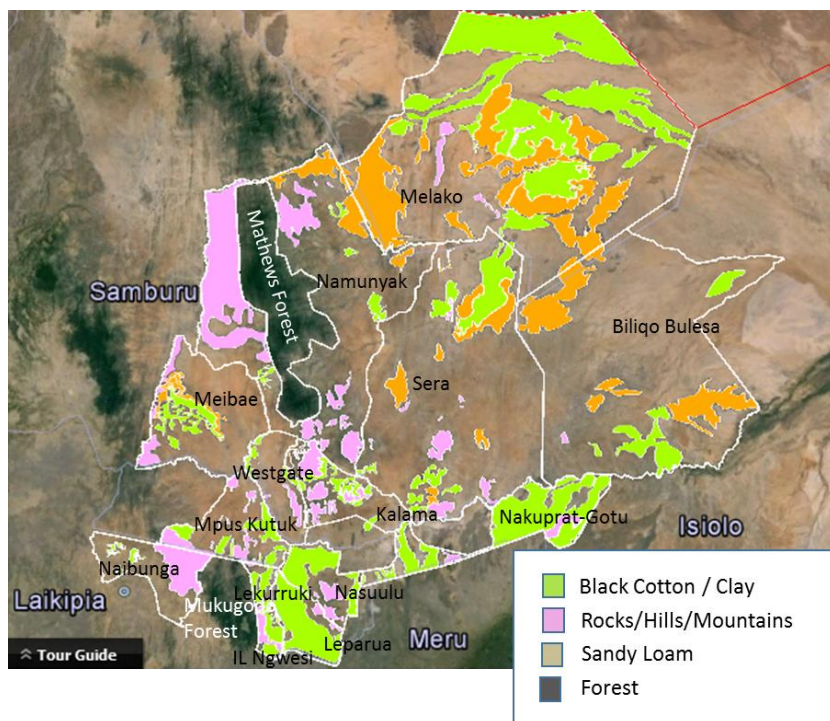


Figure 5. Stratification of the project area by soil type (sandy loam (no color), black cotton (green), lava plateaus (orange) and rocky hills or mountains (pink)) and by Conservancy (white borders), set against a Landsat 8 image of the project area.

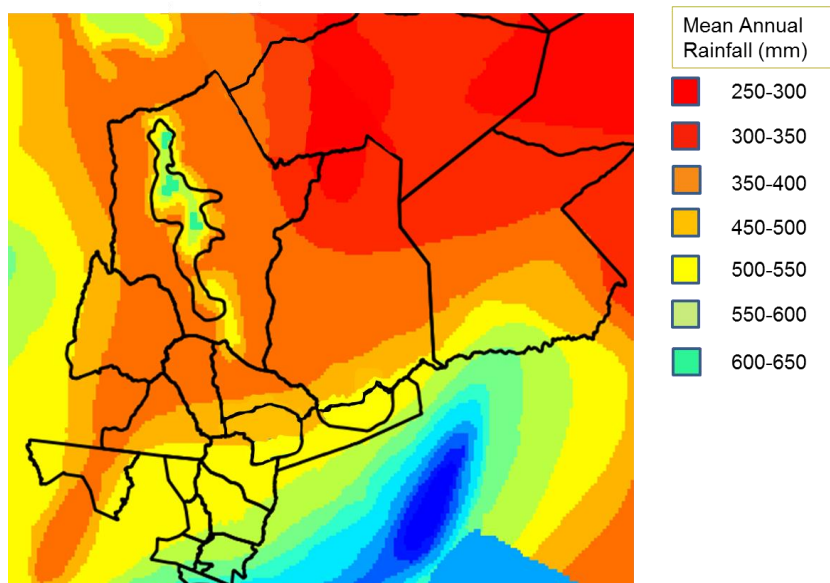


Figure 6. Digital map of annual rainfall for the project zone, showing the boundaries of all the Conservancies and showing the basis for interpolating rainfall at a specific location.

4.5.2 Baseline Conditions – Vegetation and Grazing

Baseline grazing impacts and overall vegetation condition were assessed in the project zone in by comparing remotely-sensed estimates that incorporated canopy structural variations, including leaf area index (LAI), canopy type, plant physiognomy, and canopy architecture, from February 2000- December 2012, using the Normalized Difference Vegetation Index (NDVI) product from MODIS satellite imagery. NDVI was found in our analyses to be more sensitive to impacts of grazing^[34] at low ranges of production of 0-200 g/m² typical of NRT under high levels of continuous grazing. The metric is also sensitive to differences in restrictions to grazing use from complete rest, grazing for 1/3 – 1/2 the year, versus continuous grazing (Fig. 6 below)^[1]. Higher EVI scores are associated with greater perennial grass cover during grazing use as well as overall grazing intensity^[34]. These data, which reflect seasonal variation, annual variation in rainfall, and long-term trends in vegetation, clearly show that

- (1) Vegetation conditions in continuously grazed areas, accounting for land use in 95% of the Conservancies during the baseline period, yielded very low mean NDVI scores (0. of a maximum of 1 typically associated with a large proportion of bare ground) over the entire 12 year period, with no significant trend relative (Fig. 7).
- (2) Vegetation conditions in areas receiving restricted grazing such as in Core areas or on top of escarpments where livestock access is difficult (< 5% of the total project area over the 12-year baseline period) yielded 2x higher NDVI scores than settlement areas with continuous grazing (Fig. 6). These differences were robust despite four different “droughts,” or annual periods with below-average rainfall in 2001-2, 2005-2006, and 2008-2009 and in 2010-2011, and suggest the long-term impact of chronically intense continuous grazing.

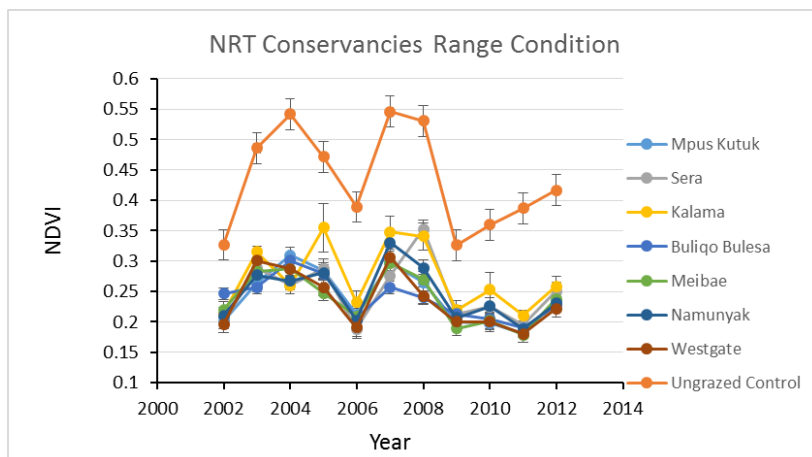
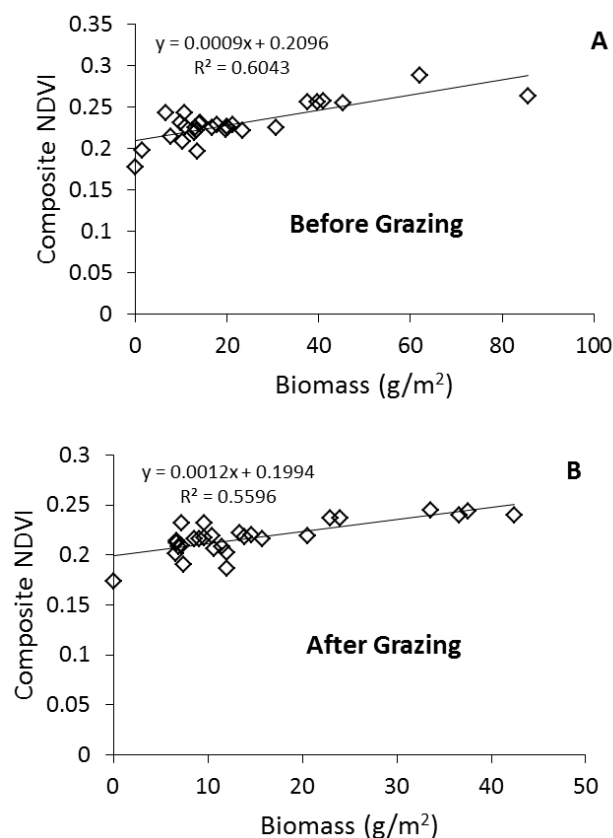


Figure 7. Mean Normalized Difference Vegetation Index (NDVI) for 7 Conservancies in the project (Note that the other 7 Conservancies showed virtually identical temporal patterns, but are not shown to reduce clutter. Note the similarity in temporal pattern across the Conservancies, driven by annual variation in rainfall. The Ungrazed Control is the mean NDVI at the top of steep-sided but low elevation

plateaus in Kalama, Namunyak and Sera Conservancies that have seldom been grazed in the past 40 years due to their inaccessibility to livestock. These NDVI values reflect the influence of annual variation in rainfall on production and the potential production in the ecosystem if chronically intense continuous grazing was absent.

(3) Consequently the satellite images strongly suggest that vegetation conditions throughout virtually all of the project area have been degraded over the previous 12 years. This satellite database can serve as a baseline for evaluating impacts of the project activity, **planned rotational grazing**, per the requirements of the VCS VM0032 methodology.



A Figure 8. Relationships between NDVI measurements from individual pixels (250 x 250 m) of 15-day composite MODIS NDVI and measured mean forage biomass (shrub leaves and herbaceous plant biomass) of thirty 0.125 m² quadrats placed randomly inside each pixel. Measurements were made in August 2014 in Kalama and Westgate Conservancies. Relationships are shown for A. before grazing by a herd of 30 or more cattle and/or additional sheep and goats, and B. immediately after grazing. These relationships demonstrate the strong connection between satellite-based measures and actual forage biomass and support the use of satellite imagery in monitoring range condition and grazing impact. The relationships imply that a reduction in forage biomass from grazing results in a detectable reduction in NDVI as predicted by the regression lines in each graph, which are very similar. The y-intercepts in each relationship reflect the NDVI signal of trees and shrubs, since forage biomass = 0.

NDVI measurements indicate that, where rotational grazing has been implemented for more than 2 years (Kalama and Westgate Conservancies), significant increases in NDVI have resulted despite dry conditions in 2009, 2011 and 2014.

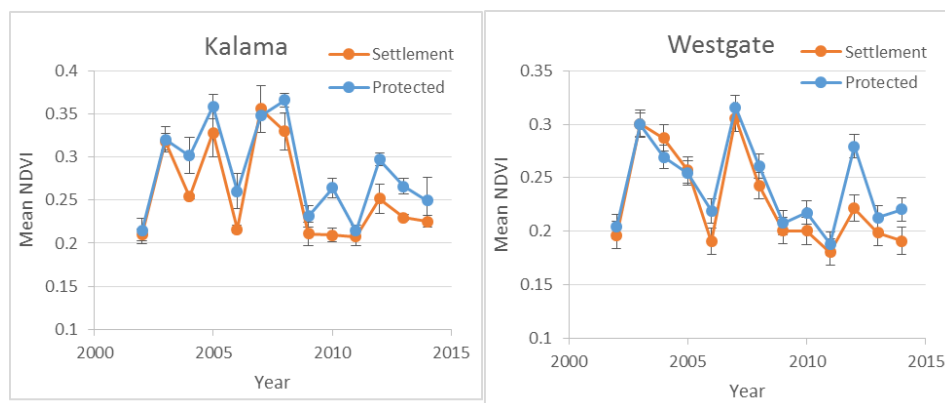


Figure 9. Comparison of mean ($\pm$ SE) NDVI measures at project sampling stations ($N > 6$) in buffer areas subject to restricted, dry season only grazing (Protected Buffer Areas, blue lines) versus Settlement areas with chronically intense continuous grazing (Settlement, orange lines). Note the increasingly persistent separation and significantly ($P < 0.05$) higher NDVI in Protected areas during the period of planned rotational grazing in each of the two Conservancies (2012-2014).

Most Conservancies were not consistent in their enforcement of grazing restrictions in Core and Buffer areas, and only began to implement planned rotational grazing in 2014. Two Conservancies, Kalama and Westgate, began implementation of dry season rotational grazing in Buffer (protected) areas in 2012. Comparison of mean 15-day composite NDVI measures for multiple sampling sites in Buffer and Settlement areas shows persistently and significantly greater NDVI, and thus forage biomass, in Buffer areas during the last three years (2012-2014), despite extremely dry conditions during 2014.

Combined, these results indicate the chronic degradation of forage production in the project area over the past 12 or more years (Fig. 7), the ability of satellite measures such as NDVI to assess potential and realized forage production (Fig. 8) under different annual rainfall amounts (Fig. 6), and evidence that rotational grazing can improve forage production even under low rainfall conditions (Fig. 9).

4.5.3 Baseline Methane Emissions

4.5.3.1 Calculation of Baseline Emissions

Baseline methane emissions from grazing animals will be estimated from data on total numbers for different livestock categories that reflect species, age, sex and their respective sizes, in the project area. Calculations are based on estimating daily methane emissions as a function of the body weight (kg) of each major animal category^[35] (Table 5) and then multiplied by the number of animals in each animal category and 365 days in a year. Emissions from all categories can then be summed to provide the total annual methane emissions for the project area.

Per methodology requirements, equation (1) was followed to obtain the annual methane emissions in year t from grazing animals of category c of each of three animal types: ruminants (sheep, goats, cattle, buffalo, and camelids (camels), and non-ruminants (donkeys) and pigs.

$$BEM = 365 \cdot 21 \cdot 44/16 \cdot 2.6 \times 10^{-7} \sum_{c=1}^k BN_c DME_c \quad (1)$$

Where 365 reflects days in a year, 21 is the heating equivalent of methane to CO_2 , 44/16 converts mass of methane to mass of CO_2 , and 2.6×10^{-7} converts liters CH_4/day into tons $CH_4 day^{-1}$. Further, DME_c is the daily emission factor (liters $CH_4 day^{-1}$) as a function of animal weight for category c , and BN_c is the harmonic mean number of animals of each category during the ten years prior to the project start date. The harmonic mean conservatively weights lower values of methane emissions in a sample^[36].

Table 5. Allometric equations, with uncertainty, for daily methane emissions (DME, L/day) for three animal types: ruminants and camelids, equids, and pigs.

Animal Type	Equation (1)	n	R ²	Uncertainty%
Ruminants	$0.66 W^{0.97}$	62	0.88	9.5%
Equids	$0.18 W^{0.97}$	23	0.76	28.2%
Pigs	$0.07 W^{0.99}$	12	0.93	18.6%

Based on three different social surveys, the following baseline animal numbers for each of the 14 participating Conservancies were obtained for 6 different years during 2004-2011. The first survey was a Kenya government population census conducted in 2009. The second was a survey of 168 livestock owning households from four different Conservancies in October and November 2014 to assess past livestock holdings and thus obtain a historical estimate of livestock per household. The third was a survey of 910 households from four different Conservancies conducted in October 2014 as part of NRT's Social CoMMs program to determine baseline socio-economic indicators for the project area, but which also provided mean household size.

Population sizes for each Conservancy are reported in Table 1 (section 1.1) and 6. Mean household size was found to be 5.59 (± 0.09 SE, uncertainty 0.06). The number of households N_{HH} in the project area was calculated N_P was divided by the mean number of people per household, MHHN to determine

$$N_{HH} = N_P / MHHN \quad (2)$$

N_P = The total number of people in the NRT Conservancies measured during the Kenya 2009 census

$MHHN$ = the mean number of people per household in the NRT 2014 Social CoMMs household survey, where

$$MHHN = 5.59$$

Table 6. Kenya Government census of the participating conservancies in 2009 and estimated number of households based on an average 5.59 people per household in the NRT 2014 Social CoMMs household survey.

Conservancy	People	Households ¹
Biliqo Bulesa	4,781	855
IlNgwesi	1,448	259
Kalama	8,162	1,460
Lekurruki	1,682	301
Leparua	8,590	1,537
Meibae	10,029	1,794
Melako	13,109	2,345
Mpus Kutuk	5,560	995
Naibunga	12,193	2,181
Nakuprat-Gotu	5,520	987
Namunyak	26,643	4,766
Nasuulu	4,262	762
Sera	6,820	1,220
Westgate	3,684	659
Total	112,483	20,122
1. Based on estimated 5.59 people per household		

Next we calculated the mean number of livestock of different classes c (cattle, shoats, donkeys, camels) per household. Livestock numbers per household obtained from the herder survey are biased upward because herders with larger numbers of animals are probably more likely to be interviewed, and the survey would automatically exclude households with no livestock. A correction factor, $CF_{N,c}$ for numbers of livestock of class c per household was derived from the following formula

$$CF_{N,c} = HHSN_c / HSN_{c, 2014} \quad (3)$$

Where

$HHSN_c$ = the average number of livestock of class c per household in the NRT 2014 Social CoMMs

$HSN_{c,2014}$ = the mean number of livestock of class c per household in the 2014 herder's survey.

The total livestock of class c in year t is given by

$$BN_{c,t} = CF_{N,c} \times HSN_t \times N_{HH} \quad (4)$$

where

$BN_{c,t}$ = total number of livestock of class c in year t

$CF_{N,c}$ = correction factor for livestock of class c , = 0.708 for cattle, 0.5 for shoats, 0.37 for camels.

HSN_t = the mean number of livestock of class c per household in the 2014 herder's survey for year t

N_{HH} = number of households in the project area.

Unfortunately, the 2014 herder's survey did not request information on donkeys. Donkey numbers were therefore estimated as a fixed fraction of cattle numbers from the following

$$BN_{donkeys,t} = BN_{cattle,t} \times HHSN_{donkeys,2014} / HSN_{cattle,2014} \quad (5)$$

Where

$BN_{donkeys,t}$ = Number of donkeys in the project area in year t

$BN_{cattle,t}$ = Number of cattle in the project area in year t

$HHSN_{donkeys,2014}$ = Mean number of donkeys per household on the NRT 2014 Social CoMMs household survey

$HSN_{cattle,2014}$ = Mean number of cattle per household on the NRT 2014 Social CoMMs household survey.

4.5.4 Baseline Soil Organic Carbon

4.5.4.1 Soil Carbon Dynamic Model

Baseline soil organic carbon for the proposed activity-based **Modeled** approach, per the VCS SGMAFG methodology requires the measurement of the necessary model parameters to test a model. The project will use the SNAP model of soil carbon dynamics^[37], a carbon mass balance model developed from the grassland savanna – grazing system in Serengeti National Park^[38] (see executable file provided with PD).

4.5.4.2 Parameters for the Model

The SNAP model has five parameters:

GI (grazing Intensity) = % of biomass removed by grazing as a historical average.

MAPLC = lignin and cellulose content of aboveground biomass

SAND% = percent of the soil comprised of sand

MAP = mean annual precipitation (mm) over time period for which baseline management conditions have been employed

FIRE = frequency of fire as mean percent of project stratum area covered by fire in previous 10 years.

However, because fire is very rare in the project ecosystem and grazing animal reduction in potential fuel loads is likely to be strong even under new grazing management, FIRE was set equal to zero in simulations with the model. The project will therefore measure the following parameters:

Data Unit / Parameter:	$MAP_{j,m}$
Data unit:	mm/yr
Description:	Mean annual precipitation in stratum m at station j
Source of data:	Precipitation maps or nearby weather stations
Justification of choice of data or description of measurement methods and procedures applied	A key variable that affects a number of processes driving SOC
Any comment:	

Data Unit / Parameter:	$SAND\%_{j,m}$
Data unit:	Dimensionless proportion expressed as percent
Description:	Proportion of soil that is sand, at station j in stratum m
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	Soil collected to desired depth at each sampling station should be mixed, and a subsample analyzed for clay, silt, and sand fractions in a professional laboratory. SAND% for soils was estimated by ICRAF laboratories Nairobi using a MIR reflectance method calibrated for Kenya soils.
Any comment:	

Data Unit / Parameter:	$GI_{j,m}$
Data unit:	Dimensionless proportion
Description:	Mean annual grazing intensity at station j in stratum m
Source of data:	Measured
Justification of choice of data or description of measurement methods and procedures applied	Measured at each sampling station by visually estimating historical grazing intensity from a calibrated observation method based on species composition, bare ground, and vegetation height. Observational method was corroborated by comparing using NDVI to estimate herbaceous (forage) biomass at the sampling point relative to

	ungrazed control for the month the vegetation was sampled on the ground
Any comment:	

Data Unit / Parameter:	MAPLC _{j,m}
Data unit:	Dimensionless proportion
Description:	n aboveground plant cellulose plus lignin at sampling plot j in stratum m
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	SOC is often closely related to inputs of these forms of carbon because they resist microbial decomposition. Lignin and cellulose content for each sampling station was estimated on the basis of cover of different plant functional types: annual grass, forb (herbaceous dicot), or perennial grass. Five leaf and stem samples from each of the five most common species of each plant functional type were collected from 30 different sampling stations in Il Ngwesi, Lekurruki, Kalama, Sera and Westgate Conservancies. To measure lignin plus cellulose fraction, dried plant material from the entire clipped quadrat was ground through a 0.9 mm (40 mesh) screen in a Wiley mill. Ground material was then subjected to a sulfuric acid hydrolysis method[37], i.e., sequential digestion in first neutral detergent manufactured by Ankom Technology Corp.,Macedon, New York, USA (sodium lauryl sulfate, 50.02%, EDTA disodium, dehydrate, 31.03%, sodium borate, decahydrate 11.35%, and sodium phosphate, dibasic, anhydrous, 7.6%), followed by Ankom manufactured acid detergent (20 g cetyl trimethylammonium bromide (CTAB) diluted in 1 L 1.00 NH₂SO₄), and then in 72% sulfuric acid, followed finally by ashing in a muffle furnace at 500°C for 24 h. Lignin and cellulose fractions were inferred by the mass lost between the remainder following neutral detergent digestion and the remainder after ashing, expressed as a proportion of the original sample mass.
Any comment:	

4.5.4.3 Model Validation

To estimate baseline soil carbon stocks and validate this model, soils and vegetation were sampled at 233 permanent sampling stations across all 14 Conservancies, and distributed to include 65 stations (27%) on black cotton soils, and the remaining 168 stations on sandy loam soils, reflecting roughly proportional stratification within each Conservancy. the two major soil strata in the project area. Black cotton soils occur on approximately 18% of the project area, but were At each site, three 5 cm diameter cores were taken to a depth of 20 cm and mixed to form a composite sample, which was then dried and weighed and analysed for total organic carbon using MIR (Mid Infra-Red) spectroscopy at the ICRAF laboratories in Nairobi^[39]. Of the original 233 samples taken, 196 have been analysed to date. A subset of 30 of the 196 samples was analysed for total organic carbon using standard combustion methods method^[40] to calibrate the MIR method. The MIR predicted the combustion estimate with $R^2 = 0.91$, which exceeds the necessary level of precision required by the VCS VM0032 methodology ($R^2 > 0.90$) A separate soil core (5 cm diameter x 20 cm depth) was taken at each station to obtain a known volume and then dried and weighed after removing rocks and pebbles to obtain bulk density (g/cm^3)^[41]. Raw data are available as Excel files.

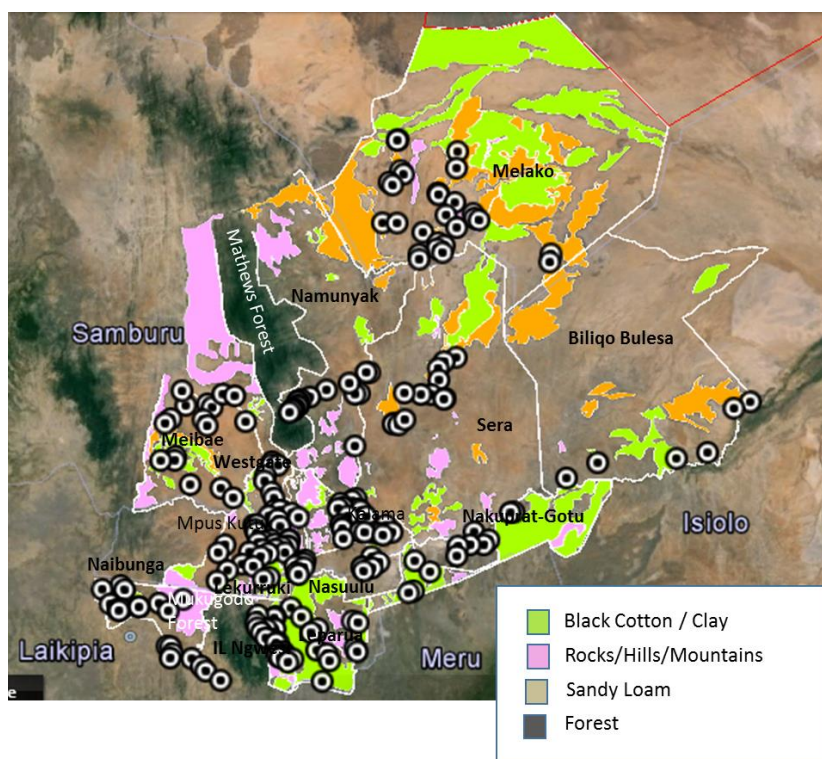


Figure 10. Distribution of soil and vegetation sampling stations among the strata in the project area (see Figure 5). Stations were selected to encompass all the Conservancies and soil types in the project area and test the SNAP soil carbon model, rather than estimate a mean SOC for each stratum and/or Conservancy. Stations were therefore located for accessibility rather than at random across the project area.

The parameters measured to validate the model were

Data Unit / Parameter:

SOC%_{0,j,m,0}

PROJECT IMPLEMENTATION REPORT:

VCS Version 3; CCB Standards Third Edition

Data unit:	Dimensionless proportion
Description:	Proportion soil organic carbon at station j in stratum m at time (year) = 0, i.e., at the start of the project or since the last verification
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	Baseline for performance based removals based on increasing SOC. Tracked at the level of j = 1 to z _m individual sampling stations in each stratum because net removals will be based on demonstrating how a soil carbon dynamic model, in this case, SNAP, can successfully predict current SOC from past conditions at individual stations.
Any comment:	

Data Unit / Parameter:	BULK _{m,j}
Data unit:	g/cm ³
Description:	Soil density
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	Necessary to convert proportion of SOC in soil to mass of SOC/area. Measured by taking a 20 cm soil core (known volume) at each sampling station, spreading the contents on a flat surface to identify and remove any stones or gravel, drying the soil core at 45°C to a constant weight, and weighing dried soil.
Any comment:	

Soil texture of a subset of 30 samples was analysed using a Horiba Model LA 950A2 particle size analyzer at the ICRAF laboratory in order to find the mean percent sand associated with each of the major strata. The mean percent sand from the stratum in which each station was located was used as the SAND% parameter in the model.

Historical grazing intensity at each station was measured by an expert assessment method at each station using the following protocol in February and early December 2012:

1. Is grass present? If Yes – Go to 2. If No. Grazing Intensity = 99%
2. Is grass predominantly Perennials? If Yes Go to 4. If No, Go to 3.
3. Grazing Intensity = Percent Bare Ground
4. Is Bare Ground greater than 50%? If Yes, Go to 5. If No, Go to 6.
5. Grazing Intensity = 55% + (1/2)*Percent Bare Ground
6. Grazing Intensity = (1- Height of Grass/Maximum Height of Grass under Shrub)

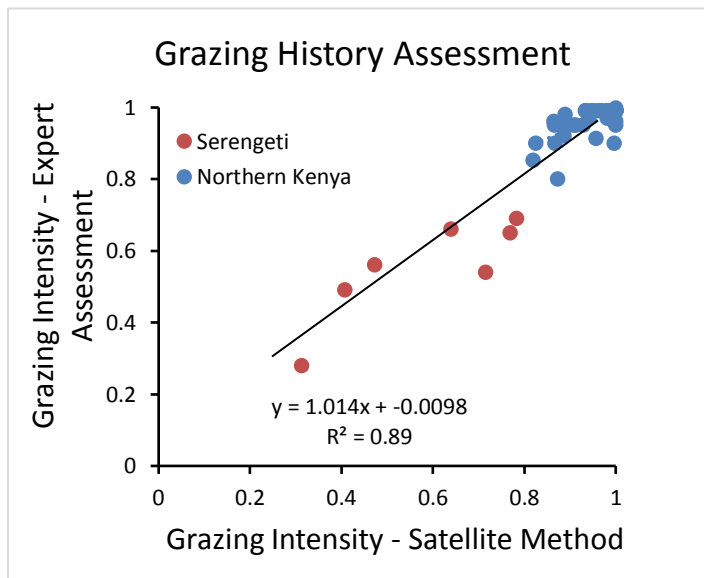


Figure 11. Calibration of the expert assessment method for assessing historical grazing intensity used in this project with outcomes of satellite-based assessment of grazing intensity using NDVI-forage biomass regressions (Fig. 8) to estimate grazing intensity. Data are from the project area (blue points) and from application of the expert assessment in a long-term grazing exclosure experiment in Serengeti National Park^[37,42] to expand the range of grazing intensities.

This expert assessment method was calibrated with NDVI measurements from MODIS 16 day composite images (see section 4.5.2. **Baseline Vegetation and Grazing**) taken at the time the sampling stations were assessed for historical grazing intensity. NDVI observed at the sampling station and the mean NDVI of four randomly sampled pixels within a very lightly grazed area in the same soil stratum and mean annual rainfall that was lightly grazed because of its inaccessibility (atop an escarpment or more than 20 km from water). Satellite-based grazing intensity (SGI) at a site was calculated as

$$SGI_j = 1 - f(NDVI_i)/f(NDVI_{UG}) \quad (6)$$

Where

SGI_j = grazing intensity (proportion)

$f(NDVI)$ = function converting NDVI into forage biomass (g/m^2) based on regression in Fig. 8

$$= -282.88 + 1111.11 \times NDVI_i \quad (7)$$

were then regressed against estimates of $GI_{m,j}$ using the expert assessment method at the sampling station in the same MODIS pixel (Fig. 11). Similar expert assessments and satellite estimates of $GI_{m,j}$ were made at each of 8 sites in Serengeti National Park in Tanzania to expand the range of grazing intensities in the calibration. This was necessary because lightly grazed vegetation at the scale of MODIS satellite pixels (250 x 250 m) in northern Kenya is so rare.

Lignin and cellulose content (MAPLC) of aboveground vegetation was estimated by collecting samples of the four most common species of the dominant types of herbaceous vegetation: perennial grass, annual grass, legume or forb. Samples for analysis of each type of plant were collected from 58 sampling stations from across five different Conservancies (Lekurruki, Kalama, Namunyak, Sera, and Westgate) by clipping, drying (at 45°C for four days) and weighing the vegetation two 0.125 m² quadrats clipped to the ground surface, followed by combining samples, grinding through a 0.9 mm sieve with a Wiley Mill, from digestion in acid detergent and sulfuric acid^[43] performed at Syracuse University (see parameter table for MAPLC).

Mean Annual Precipitation (MAP) was estimated by interpolating rainfall maps from digital maps created by scanning and geo-referencing paper maps issued by the Kenyan government (Figure 6)

http://kenya_lgp_aez.asc

The SNAP soil and vegetation parameters (i.e., soil texture, lignin and cellulose content, historic average grazing intensity) along with interpolated average annual rainfall, were entered into a predictive soil carbon dynamic model called SNAP. The SNAP model^[37] was used to predict current soil organic carbon (SOC) stocks based on the estimated history of grazing. The mean predicted SOC stocks were then compared with mean observed SOC stocks for each type of management, and predicted SOC stock at a particular site was compared against observed SOC at the same site. The results suggested that within the NRT Conservancies, the model predicted mean and individual site SOC values with more than 90% accuracy. The SNAP model results suggest that prolonged, heavy, continuous grazing in the NRT Conservancies over the past 30 years has greatly depleted SOC stocks, but that reduction in grazing intensity will lead to recovery of SOC at a potential rate of 0.3-0.7 tons C/ha/yr across a variety of soil types. Because of past degradation, there is a large capacity for recovering SOC stocks in the Conservancies. These results suggest that planned grazing management beginning in the NRT Conservancies should help restore SOC and productivity in these semi-arid grasslands, and could result in an economically viable carbon offset project.

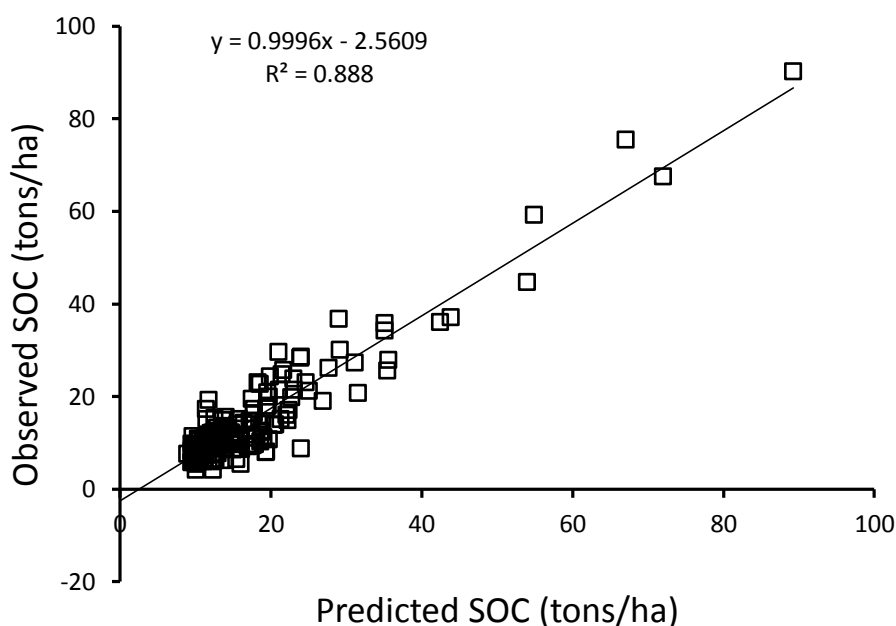


Figure 12. Regression of observed SOC density at each of the survey sites versus the predicted SOC density from the SNAP model based on rainfall, historical grazing intensity, soil texture, and plant lignin and cellulose at each site.

As required by the VCS VM0032 Methodology, the model must generate a coefficient of determination $R^2 > 0.80$ across all strata. The slope of the regression line must have a 95 percent confidence interval that overlaps 1 and the 95 percent confidence interval of the intercept must overlap zero. Bias must be determined by evaluating the percent bias of a simulation (carbon model) relative to observed data^[44].

$$MBIAS = \frac{\sum_{i=1}^n (Y^{obs}_i - Y^{pred}_i)}{\sum_{i=1}^n Y^{obs}_i}$$

Where,

MBIAS = Percent bias of carbon model predictions relative to observed data

n = number of sampling stations tested

Y^{obs}_i = observed SOC density at station i

Y^{pred}_i = SOC density predicted at station i

Bias of the model chosen for this methodology must be between -20% and +20%.

The SNAP model meets these criteria (Fig. 12). The slope of the regression line is 0.997 (± 0.027 SE) a value not significantly different from 1 ($t = 0.11$, $N = 174$, $P = 0.85$). The intercept is -2.67 (± 0.55 SE). While technically this is significantly less than 0 ($t = 4.864$, $N = 174$, $P < 0.001$), and indicates a weak tendency for the model to over-predict SOC on very low C soils. However, the model meets the criteria for being unbiased, as MBIAS = 19.4% which is under the criterion of 20%. *The SNAP model therefore meets the criteria for sufficient accuracy for a modeling approach to calculating soil carbon removals from implementing planned rotational grazing practices.*

4.5.4.4 Estimation of Baseline SOC

The SNAP model conservative estimate of SOC at each station j in stratum m for 10 years prior to the project start date SOC, $MBSOC_{m,j,0}$ was calculated by back-casting the model 10 years from current assumed equilibrium SOC ($BSOC_{m,j,0}$) validated in section 4.5.3 under the same parameter values used in the validation of the model.

4.5.4.5 Uncertainty in Baseline Emissions

$$UBEM = \frac{(\sum_{c=1}^k (BEM_c \times UBEM_c)^2)^{\frac{1}{2}}}{\sum_{c=1}^k BEM_c} \quad (9)$$

Where:

$UBEM$ = Uncertainty in baseline methane emissions from grazing animals (%)
 $UBEM_c$ = Uncertainty in baseline methane emissions from animals in category c (%)
 BEM_c = Baseline emissions from animals in category c (tCO₂e)

$UBEM_c$ is the uncertainty in methane emissions from animals in category c , as dictated by whether the animals are ruminants, equids, or pigs (see Section **Error! Reference source not found.**),. $UBEM_c$ is calculated from the uncertainty, for each animal category, in the regression equations predicting per animal daily methane emission (DME_c) based on the mean body weight ($UDME_c$, **Error! Reference source not found.**) and the uncertainty in the harmonic mean of animal counts (UBN_c) during the baseline period.

To obtain UBN_c , first find $SEBN_c$, the standard error^[45] of the harmonic mean BN_c of the series' $N_{c,i}$ of animals in category c in count i of n counts or censuses.

$$SEBN_c = (BN_c)^2 \times \frac{SD\left(\frac{1}{N_{c,i}}\right)}{(n-1)^{1/2}} \quad (10)$$

Where:

$SEBN_c$ = Standard error of the harmonic mean of animal counts in category c
 $SD(1/N_{c,i})$ = Standard deviation of the inverses of the count i of animals in category c
 $N_{c,i}$ = Animals in category c in census i (head)
 BN_c = Harmonic mean number of animals in category c (head) during the baseline period (head)
 n = Number of censuses

The 95 percent confidence interval-based uncertainty in the estimated number of animals in category c is:

$$UBN_c = 3.84 \times 100 \times \frac{SEBN_c}{BN_c} \quad (11)$$

Where:

UBN_c = Uncertainty in the harmonic mean of animal counts (%)

$SEBN_c$	= Standard error of the harmonic mean of animal counts
BN_c	= Baseline number of animals of category c (head)
3.84	= Multiplier converts expression into a 95% confidence interval
100	= Multiplier converts expression into percent

$$UBEM_c = (UBN_c^2 + UDME_c^2)^{1/2} \quad (12)$$

Where:

$UBEM_c$	= Uncertainty in baseline methane emissions from animals in category c (%)
UBN_c	= Uncertainty in the baseline harmonic mean of animals of category c (%)
$UDME_c$	= Uncertainty in the regression for predicting daily methane emissions for animals of category c (%)

These uncertainty calculations are contained within Table 8

4.5.4.6 Estimation of Baseline Emissions and Uncertainty

Following the above calculation protocols, the net baseline emissions and removals BER and their uncertainty, UBER, are shown for each of the 14 participating Conservancies in the project $\Delta SOC = 0$

$$BER = BEM \quad (13)$$

4.6 Additionality

STEP 1. Identification of alternative land use scenarios to the AFOLU project activity;

Scenario 1: **Continuous, unplanned grazing.** This is the scenario that has occurred in the project area for the past 40 years. Each family is responsible for the livestock they own and makes its own decisions about where to graze and find water. Grazing committees of the Conservancies set general guidelines about which zones are available for grazing, but livestock are moved according to family-determined thresholds of forage availability. Security risks to human life and livestock incentivize grazing near permanent settlements during the wet season and only migrating herds during the dry season.

Scenario 2: **Planned rotational grazing:** Animals will be grouped into herds of mixed ownership of 50-200 animals. Herds will be actively guided and moved throughout a day and from day to day by a trained herder, either one of the owners or a hired herder. Animals will not graze the same location more than once within a wet season or once within a dry season and will be moved to a new site once available forage has been grazed to a height of 2.5 cm. Areas near settlements or water points will be used similarly to other areas in the grazing plan. Some areas will be rested to allow recovery from past grazing or to provide grass banks during the dry season or droughts, but different areas will be rested each year in order to provide animal impacts and re-establishment of a diverse plant assemblage in all areas. Herder groups will trade off herding duties and follow agreed-upon plans for livestock movement from grazing committees headed by community elders. Grazing “assistants” employed by the project will monitor and advise herders in the field.

No other scenarios are feasible as the region is too dry with too infertile soils to support crop agriculture or forestry.

b) STEP 2. Investment analysis will be skipped as barriers and common practice analysis provide a better basis for additionality.

c) STEP 3. Barriers analysis;

Scenario 1 has no significant barriers as each family chooses to acquire and herd livestock in whatever way they choose within broad constraints of seasonal shifts in available grazing areas. There is no coordinated plan that exposes all community members to the same risks of livestock theft or personal assault.

Scenario 2 has significant barriers in the form of (1) necessary cash payments to pay professional herders to move large herds of livestock over large distances > 100 km across the landscape, (2) cultural traditions that discourage mixing of animals from herds of multiple unrelated families, (3) lack of confidence in the safety of animals kept far from permanent bomas, due to risks of wildlife predation and cattle theft. Without carbon finance to pay grazing assistants and coordinators to provide guidance and discourage theft and grazing of grass banks or other conservation areas, this management practice would not be adopted

d) STEP 4. Common practice analysis.

Planned rotational grazing is practiced in the region, but only on private lands such as the Ol Pejeta Conservancy in Laikipia Province. On communal lands, virtually all pastoralists currently lack the physical security and financial resources to coordinate such planned grazing as in scenario 2.

Consequently, the project meets the criteria that scenario 2 would not occur in the absence of revenues from the proposed grassland management soil carbon project.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS (CLIMATE)**5.1 Project Scale and Estimated GHG Emission Reductions or Removals****Table 7. Net project removals over the 30 project crediting years**

Year	Baseline Emissions (t CO ₂ e)	Project Emissions (t CO ₂ e)	Net Change in Carbon Stocks (t CO ₂ e)	Leakage (tCO ₂ e)	Total Net Emissions and Removals
2013	509,750	429,291	69,112	0	69,112
2014	509,750	429,291	1,781,041	445,260	1,335,781
2015	509,750	429,291	2,007,130	501,782	1,505,347
2016	509,750	429,291	2,007,130	418,152	1,588,978
2017	509,750	429,291	2,007,130	334,522	1,672,608
2018	509,750	429,291	2,007,130	250,891	1,756,239
2019	509,750	429,291	2,007,130	167,261	1,839,869
2020	509,750	429,291	2,007,130	167,261	1,839,869
2021	509,750	429,291	2,007,130	167,261	1,839,869
2022	509,750	429,291	2,007,130	167,261	1,839,869
2023	509,750	429,291	2,007,130	167,261	1,839,869
2024	509,750	429,291	2,007,130	167,261	1,839,869
2025	509,750	429,291	2,007,130	167,261	1,839,869
2026	509,750	429,291	2,007,130	167,261	1,839,869
2027	509,750	429,291	2,007,130	167,261	1,839,869
2028	509,750	429,291	2,007,130	167,261	1,839,869
2029	509,750	429,291	2,007,130	167,261	1,839,869
2030	509,750	429,291	2,007,130	167,261	1,839,869
2031	509,750	429,291	2,007,130	167,261	1,839,869
2032	509,750	429,291	2,007,130	167,261	1,839,869
2033	509,750	429,291	2,007,130	167,261	1,839,869
2034	509,750	429,291	2,007,130	167,261	1,839,869
2035	509,750	429,291	2,007,130	167,261	1,839,869
2036	509,750	429,291	2,007,130	167,261	1,839,869
2037	509,750	429,291	2,007,130	167,261	1,839,869
2038	509,750	429,291	2,007,130	167,261	1,839,869
2039	509,750	429,291	2,007,130	167,261	1,839,869
2040	509,750	429,291	2,007,130	167,261	1,839,869
2041	509,750	429,291	2,007,130	167,261	1,839,869
2042	509,750	429,291	2,007,130	167,261	1,839,869
2043	509,750	429,291	2,007,130	167,261	1,839,869
Total	15,802,250	13,308,021	60,056,915	6,132,128	53,924,788

5.2 Leakage Management

Leakage is mainly possible from net transfers of livestock out of the project area, which is not allowed by the applicability conditions but nevertheless should be monitored by inventorying livestock shipping depots and from censuses and interviews with inhabitants of the project area. Such livestock excursions are most likely if drought is severe, which would, under baseline conditions, cause large-scale movement of livestock outside the project area. Close monitoring and census efforts are especially needed during dry seasons or other periods when there may be strong motivation to move animals off the project area. Grazing coordinators and scouts will be contacted frequently during the season with the greatest risk of animal movement, e.g., during the late dry season, to have the greatest chance to track any possible leakage.

Other specific steps to mitigate leakage that will be taken by the project:

1. Rapidly build grass banks that can be used as forage during droughts,
2. The accumulation of soil carbon will lead to greater infiltration of rainfall, which will make communities progressively less vulnerable to climate variability and drought as the project proceeds,
3. Further build the livestock-to-market program instituted by NRT to provide cash compensation for destocking in advance of intense droughts,
4. Through education associated with monitoring social benefits of the project, continue to convey the community and personal revenue advantages linked to project success (and thus participation),
5. Project will progressively entrain sustainable livestock management processes as a new “tradition” of planned rotational grazing.

In the event that major livestock excursions do occur onto grasslands outside the project area, such excursions will be monitored for number of livestock and duration by grazing coordinators and project grazing assistants, and the appropriate deduction taken from soil carbon removals, as prescribed in the VCS VM0032 methodology.

5.3 Baseline Emissions

The calculation of baseline emissions and removals is presented in detail in **section 4.5.3**. The results are presented here in Table 8. AS reviewed in **section 4.5.3-4.5.4**, SOC is assumed to be at equilibrium and woody biomass and methane emissions from burning biomass are *de minimis* because fire frequency in the system is near zero and human impacts are negligible, per applicability conditions.

Table 8. Baseline livestock animal censuses and baseline methane emissions.

Grazing Animal Category					Animal Census (Number of Animals)								Methane Emissions		
Species	Sex/Age	Weight (kg)	Annual Methane Emissions / Animal, tCO ₂ e	Per Animal Uncertainty% ¹	2004	2005	2007	2008	2009	2011	Harmonic Mean	Uncertainty in Animal Counts %	Methane Emissions for Category (tCO ₂ e)	Uncertainty in Methane Emissions %	Weighted Uncertainty
Cattle ¹	Adult	255	0.684	9.5	618,790	679,677	648,894	659,664	251,688	225,146	412,114	98.24	281,833	98.70	7.73812E+14
	Juvenile	175	0.475	9.5	209,966	209,712	199,027	124,853	31,764	45,035	78,687	154.06	37,349	154.35	3.32352E+13
Shoats ²	Adult	35	0.100	9.5	1,291,473	1,391,006	1,301,594	1,442,090	1,093,724	1,058,331	1,246,331	22.16	124,168	24.11	8.96586E+12
	Juvenile	18	0.052	9.5	439,274	412,744	387,532	439,574	267,577	419,871	382,810	36.98	20,009	38.18	5.83656E+11
Donkeys ⁴	Adult	220	0.162	27.6	35,346	38,824	37,065	37,681	14,377	12,861	23,540	98.24	3,805	102.05	1.50745E+11
	Juvenile														
Camels ³	Adult	452	1.192	9.5	39,087	39,132	39,265	43,071	38,910	37,802	29,011	5.46	34,568	10.96	1.43415E+11
	Juvenile	249	0.668	9.5	16,752	11,397	11,330	11,765	10,929	11,731	11,999	23.93	8,018	25.75	4.2622491077
Total Animals											2,184,491	Total Emissions	509,750	Total Uncertainty	56.07 %

1. http://agtr.liri.cgiar.org/index.php?option=com_content&view=article&id=137:red-maasai-&catid=32:sheep-breeds&Itemid=147

2. <http://www.fao.org/docrep/015/an470e/an470e08.pdf>

3. Mukasa-Mugerwa, E. 1981. *The Camel (Camelus Dromedarius): A Bibliographical Review*. International Livestock Centre for Africa, Addis Ababa.

4. Twerda et al 1997 Trop Anim Health Prod. 1997 Feb;29(1):48-54. <http://www.ncbi.nlm.nih.gov/pubmed/9090018>

5.4 Project Emissions

5.4.1 Calculation of Project Emissions and Removals

Net GHG emissions and removals under the project scenario, NPR_t is determined by the sum of methane emissions, PEM_t , and net removals from SOC sequestration, PRS_t :

$$NPR_t = PEM_t + PRS_t \quad (14)$$

5.4.2 Methane Emissions

If project activities will include reduction in livestock numbers, then accompanying removals from reduced methane emissions must be conservatively excluded from project removals. This avoids potential leakage from shifting of animals to adjacent grasslands or from market leakage whereby other producers increase livestock numbers to replace project livestock reductions and meet market demand. However, whether or not methane emissions from livestock are reduced, calculations must be based on project data from animal counts or censuses and emission factor data based on project area-applicable body weight of each category from the equations in Table 5 and Equation **Error! Reference source not found.** (Section 5.3).

$$PEM_t = \sum_{c=1}^K (PN_{c,t} \times DMEf(W_{c,t})) \times GWP_{CH_4} \times 365 \times 6.26 \times 10^{-7} \quad (15)$$

Where,

PEM_t = Project emissions of CH₄ from grazing animals at year t (tCO₂e)

$PN_{c,t}$ = Number of animals of each category c in year t (head)

$DMEf(W_{c,t})$ = Daily emission factor as a function of animal weight for category c (L CH₄ / day)

$W_{c,t}$ = Average body weight during year t for animals of category c (kg)

GWP_{CH_4} = Global warming potential for methane (tCO₂e / tCH₄)
365 = Conversion factor for days to years
 6.26×10^{-7} = Conversion factor for L CH₄ / day to tCH₄ / day

The parameters are similar to those used for calculating baseline methane emissions. The number of grazing animal must be measured, because new animal categories may result due to project activities (eg, there is a shift to using different breeds or species of livestock).

The estimated project methane emissions, based on livestock censuses from 2014 (see section 4.5.2) are shown in Table 9.

Table 9. Methane emissions from animals under the project scenario.

Grazing Animal Category					Animal Census (Number of Animals)		Methane Emissions		
Species	Sex/Age	Weight (kg)	Annual Methane Emission s/ Animal, tCO ₂ e	Per Animal Uncertainty in Methane Emissions %	2014	Uncertainty in Animal Counts	Methane Emissions for Category (tCO ₂ e)	Uncertainty in Methane Emissions %	Weighted Uncertainty
Cattle ¹	Adult	255	0.68	9.5	276,535	98.24	189,114	98.70	348418518614512.000
	Juvenile	175	0.47	9.5	59,504	154.06	28,244	154.35	19005906222667.100
Shoats ²	Adult	35	0.10	9.5	1,264,703	22.16	125,998	24.11	9232146809808.990
	Juvenile	18	0.05	9.5	513,834	36.98	26,858	38.18	1051567892188.680
Donkeys	Adult	225	0.17	27.6	15,796	98.24	2,609	102.05	70899469513.261
Camels ³	Adult	452	1.19	9.5	38,467	5.46	45,835	10.96	252141940711.172
	Juvenile	249	0.67	9.5	15,910	23.93	10,632	25.75	74935700301.724
						Total Emissions	429,291	Total Uncertainty %	45.30
1. http://www.fao.org/docrep/015/an470e/an470e08.pdf									
2. http://agtr.iliro.cgiar.org/index.php?option=com_content&view=article&id=137:red-maasai-&catid=32:sheep-breeds&Itemid=147									
3. http://camelides.cirad.fr/fr/actualites/Docs/ICAR_Budapest_Pres.pdf									

5.4.3 Soil Carbon Removals

The Northern Kenya project follows the VCS SGMAFG methodology, which allows emissions reductions and greenhouse gas removals to be credited on the basis of activity. Activity (altered grazing practices) determines emissions reductions and removals on the basis of a model. First a soil carbon model developed using East African parameters and ecological descriptions is validated for use, per the requirements of methodology VCS VM0032. Then the model is used to estimate the future equilibrium soil carbon under the assumption of long-term execution of altered grazing practices.

5.4.3.1 Calculation of greenhouse gas removals to soil carbon.

The SNAP soil carbon model was used to simulate anticipated project equilibrium soil carbon under the proposed project activities for each stratum. Carbon typically accrues in response to management

changes with decreasing increments over time as equilibrium is approached^[46-48]. Thus conservatively, the annual increment in SOC is determined by the difference in SOC between the conservative baseline maximum from 10 years prior to the project start ($MSOC_{m,j,0}$) and project equilibrium, ($PSOC_{m,j,t}^{eq}$) divided by the model-estimated time necessary to achieve project equilibrium, D .

$$PRS_{m,t} = 44/12 \times \left(\frac{\sum_{j=1}^{z_m} (PSOC_{m,j}^{eq} - MSOC_{m,j,0})}{z_m} \right) \times \frac{1}{D} \quad (16)$$

Where,

$PRS_{m,t}$ = Annual project removals due to changes in SOC stocks in stratum m in year t (tCO₂e /ha)

$PSOC_{m,j}^{eq}$ = Project modeled equilibrium SOC at station j in stratum m (tC/ha) based on parameter values from z_m sampling stations in stratum m

$MSOC_{m,j,0}$ = Modeled baseline SOC at station j for stratum m at time $t=0$ (tC/ha) (see section 8.1.3.3)

D = Years required to achieve equilibrium

44/12 = Conversion factor from tC to tCO₂e

$$PRS_t = \sum_m^s (PA_{m,t} \times PRS_{m,t}) \quad (17)$$

Where,

PRS_t = Project removals due to changes in SOC stocks in year t (tCO₂e)

$PA_{m,t}$ = Project area of stratum m in year t (ha)

s = Number of strata in the project area

z_m = Number of sampling stations in stratum m

$PRS_{m,t}$ = Annual project removals due to changes in SOC stocks at station j in stratum m in year t (tCO₂e / ha)

The parameters used for the project scenario were largely the same as for the baseline, such as mean annual rainfall and soil texture and fire frequency (=0). We also assumed that forage plants would still be dominated by annual grasses and forbs, so plant lignin and cellulose content would remain the same. Thus the only parameter that was altered for the project scenario was grazing intensity ($GI_{m,j,t}$), which as assumed to shift uniformly across the project area to a still high but more moderate value of 0.85. Soil carbon removals per unit area by strata are in Table 10.

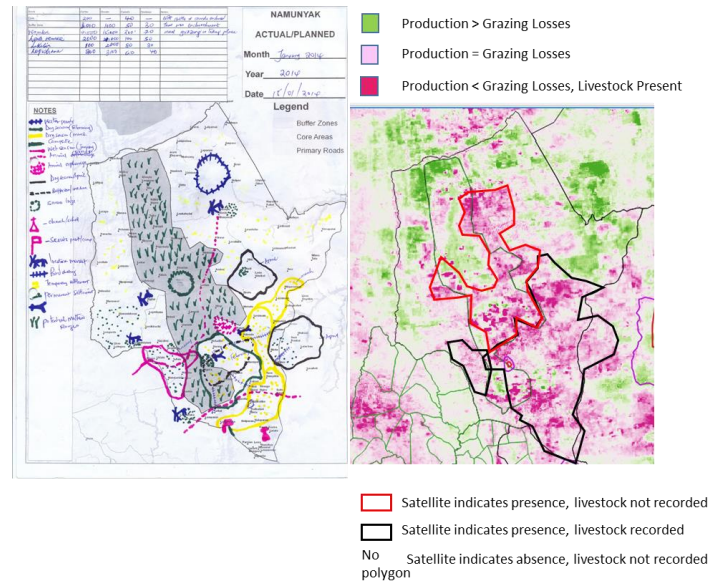
Table 10. Estimated soil carbon removals per hectare in the project scenario, sorted by Conservancy and soil type (project strata).

Conservancy	Soil Strata	SNAP Model Generated Soil Removals (t CO ₂ e/yr)
Biliqo Bulesa	Black Cotton	1.366
Biliqo Bulesa	Sandy Loam	0.387
IINgwesi	Black Cotton	0.569
IINgwesi	Sandy Loam	0.990
Kalama	Black Cotton	0.892
Kalama	Sandy Loam	0.871
Lekurruki	Black Cotton	1.191
Lekurruki	Sandy Loam	0.860
Leparua	Black Cotton	1.470
Leparua	Sandy Loam	1.866
Meibae	Black Cotton	1.306
Meibae	Sandy Loam	1.125
Melako	Black Cotton	1.628
Melako	Sandy Loam	1.637
Mpus Kutuk	Black Cotton	1.075
Mpus Kutuk	Sandy Loam	1.050
Naibunga	Black Cotton	1.536
Naibunga	Sandy Loam	1.880
Nakuprat-Gotu	Black Cotton	1.509
Nakuprat-Gotu	Sandy Loam	1.758
Namunyak	Black Cotton	1.471
Namunyak	Sandy Loam	1.060
Nasuulu	Black Cotton	1.518
Nasuulu	Sandy Loam	1.729
Sera	Black Cotton	1.735
Sera	Sandy Loam	1.251
Westgate	Black Cotton	-1.142
Westgate	Sandy Loam	1.079

A final component in the calculation of total removals to soil carbon is the area in which project activities occurred within each stratum in year t , $PA_{m,t}$. This area was determined by a satellite-based monitoring procedure to calculate $\Delta NDVI$ for each 250 x 250 m MODIS pixel for the difference in NDVI values between 16-day composite images. $\Delta NDVI$ was then summed over two 16-day composite comparisons to arrive at a monthly $\Delta NDVI$. Monthly $\Delta NDVI$ was corroborated with observed distributions of livestock by Conservancy Grazing Coordinators (CGCs). Random points were selected from monthly $\Delta NDVI$ maps to obtain estimates of $\Delta NDVI$. These points were then located on maps of livestock occurrence across a Conservancy and then assigned a value of 0, for livestock absent and 1 for livestock. These binary data do not account for variation in density; though the CGCs knew the overall sizes of herds within delineated occupied areas on their maps, they were unable to determine local livestock numbers within these areas.

Therefore the only available corroboration of livestock visitation to an area was from a logistic model in which $\Delta NDVI$ predicted absence/presence (Fig. 14).

A. Wet Season, Namunyak Conservancy January 2014



B. Dry Season – Biliqo Bulesa Conservancy July 2014

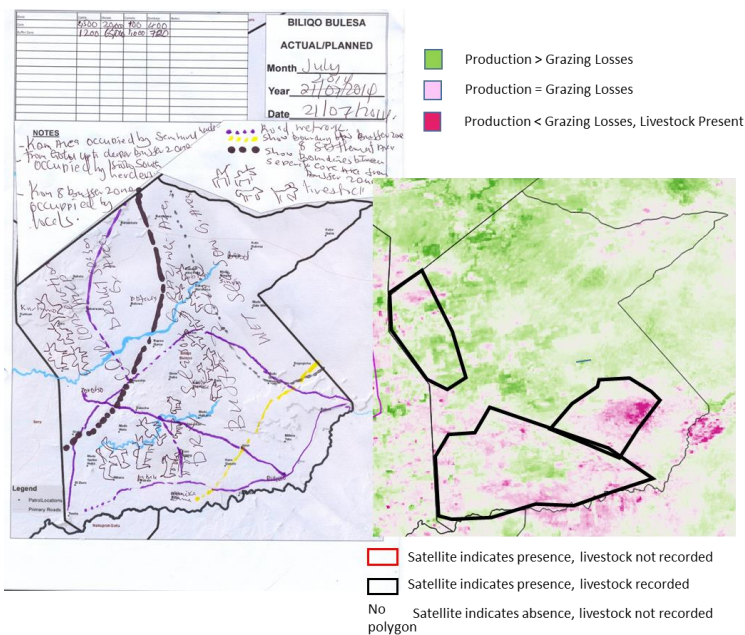


Figure 13. Example correspondence between recorded livestock use (left hand map) and the $\Delta NDVI$ measured by MODIS satellite (right hand map) for grazing in the wet season (A. Namunyak Conservancy) and in the dry season (B. Biliqo Bulesa Conservancy). Black outlined polygons indicate major areas where livestock were reported by CGCs and $\Delta NDVI$ indicated significant livestock impacts. Red outlined polygons indicate areas where no livestock were reported but

Δ NDVI indicates significant impacts. Areas without polygons showed no impacts as detected by Δ NDVI and no livestock were reported.

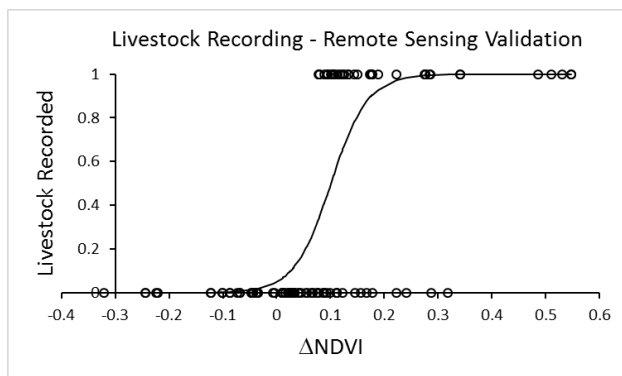


Figure 14. Logistic regression of livestock recorded presence by Conservancy Grazing Coordinators in the project area against measured Δ NDVI, our proposed indicator of grazing impact. The logistic regression function of probability of livestock use $P_L = 1/(1 + \exp(2.95 - 29.25 \cdot \Delta$ NDVI)), $R^2 = 0.48$, $N = 116$ random points, $P < 0.0001$.

Given the many potential sources of error in reporting by CGCs, such as mismatch in the

period of days assessed by CGCs relative to satellite analysis, imprecision in the drawing of polygons relative to MODIS pixel sizes (Fig. 13B), lack of knowledge of livestock distributions in relatively inaccessible areas, e.g. northern Namunyak Conservancy (Fig. 13A), and the possibility of encroachment by herders from communities outside the project area, the strength of the logistic regression indicated the strong signal of livestock grazing impacts detected by the Δ NDVI measurement.

Finally, in our ground truthing study in July 2014 in Kalama and Westgate Conservancies (see section 4.5.1), Δ NDVI was reasonably well correlated with biomass removals by a single livestock grazing event during the dry season (Figure 16). Consequently, it was concluded that Δ NDVI sufficiently represented a measure of grazing impacts by livestock to determine success or lack thereof in implementing rotational grazing. For further details, methods, statistics, and justification, see the supporting document *SftF NRT livestock monitoring 2014.pdf*

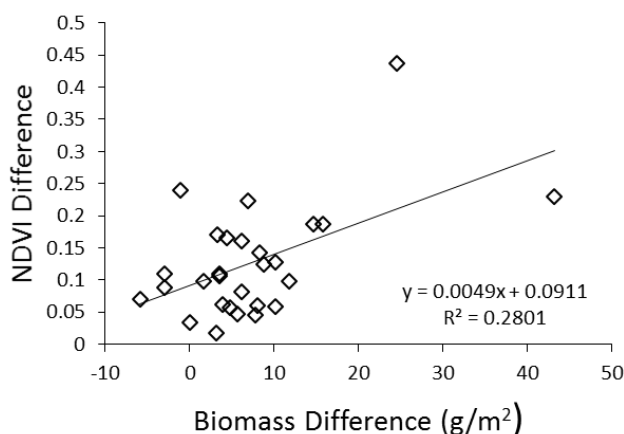


Figure 15. Regression of monthly difference in NDVI scores (Δ NDVI) versus difference in mean biomass before vs. after a single grazing event, passage of a herd of 50 or more cattle, in Kalama and Westgate Conservancies, Kenya July and August, 2014.

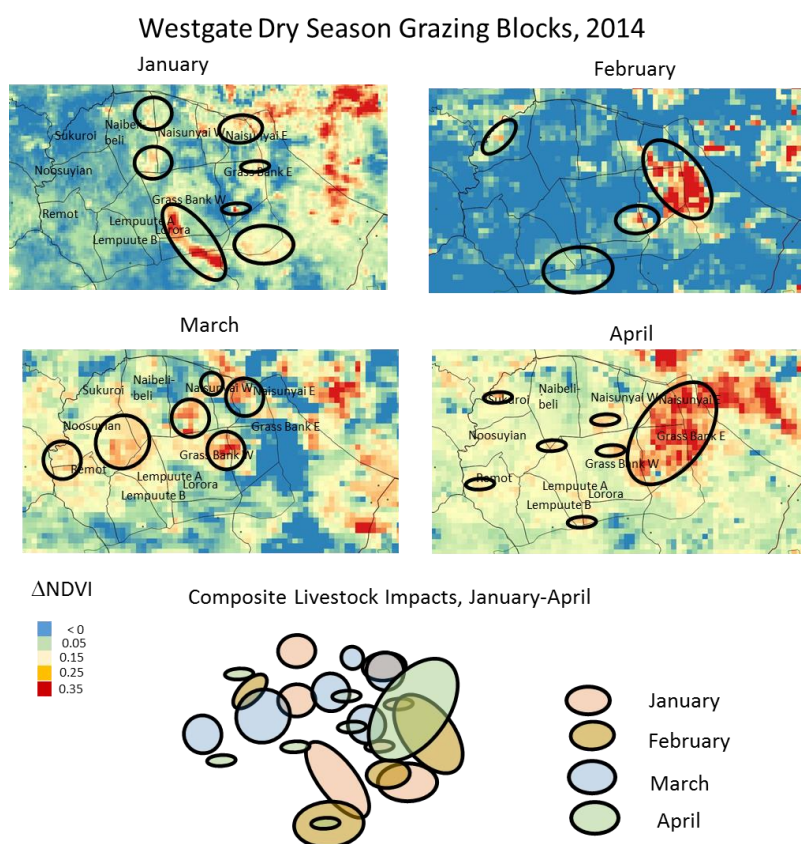


Figure 16. Example of shifting grazing impacts ($\Delta NDVI$) during livestock movements in the first third of 2014 in Westgate Conservancy, northern Kenya. Ellipses indicate areas of grazing impact ($\Delta NDVI > 0.1$, conferring a probability of livestock presence $> 50\%$). These same ellipses are overlaid and color-coded for each grazing month and indicate significant overlap only in the far northeastern portion of Westgate.

As an example of how $\Delta NDVI$ was used to assess rotational grazing, the delineated grazing blocks in northern Westgate Conservancy were further subdivided into quarters and then the mean $\Delta NDVI$ was calculated for January, February, March, and April before

virtually all livestock were moved off of Westgate to Namunyak and Sera Conservancies due to extremely dry conditions (Fig. 17). Grazing impacts shifted spatially each month, so that over the Jan-April period, principal areas of livestock impact did not overlap except in one set of grazing block quarters at the northeastern end corner of Westgate, which was a plateau used only infrequently for grazing due to its long distance from water and relative inaccessibility to livestock (thus effectively acting as a grass bank). This overlap indicated that these grazing block quarters were grazed twice during the Jan-April period, a result of unsuccessful implementation of rotational grazing. Given that virtually all livestock left Westgate with a small portion that returned briefly only in August, the remaining grazing block quarters were judged to have successfully implemented rotational grazing.

For Meibae, Westgate, Kalama and southern Namunyak Conservancies, monthly grazing impact $\Delta NDVI$ was calculated for grazing block quarters ($N = 176$) for each month of 2014 (see examples in Fig. 17). Monthly $\Delta NDVI$ patterns exhibited two properties in over 90% of cases:

- (1) coefficient of variation in grazing impacts: positive $\Delta NDVI > 1.5$ (Fig. 17) and
- (2) $SUM\Delta NDVI$, the sum of $\Delta NDVI$, was less than $RAINSUM\Delta NDVI$, the overall sum of $\Delta NDVI$ in the ungrazed plateaus used as a reference for estimating grazing intensity (see Fig. 7 section 4.5.2),

In 2014 average $RAINSUM\Delta NDVI = 0.21$. Recall that negative $\Delta NDVI$ implies an *increase* in NDVI from one month to the next, and thus represents gains in forage biomass, so even large grazing impacts in one month can be offset by gains in forage biomass in other months. The positive value for $RAINSUM\Delta NDVI$ was consistent with the dry conditions.

$$SUM\Delta NDVI > RAINSUM\Delta NDVI \quad (18)$$

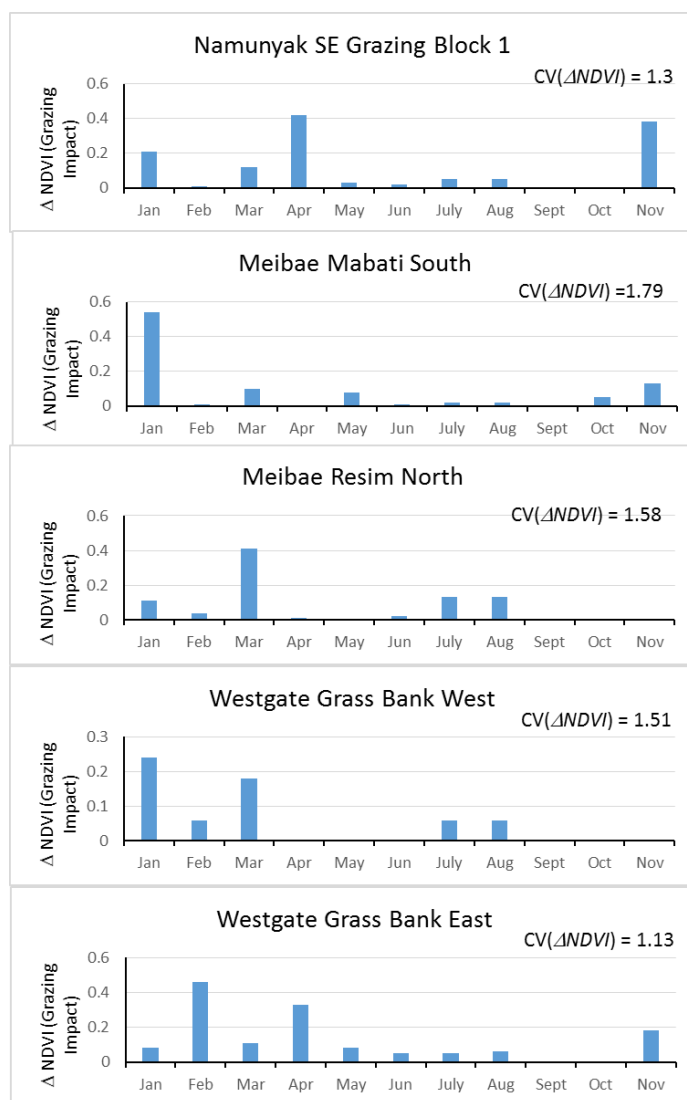


Figure 17. Example temporal pattern of monthly grazing impacts, measured as the mean decrease in NDVI from the previous month (ΔNDVI), on selected grazing blocks in southern Samburu County, Kenya from Meibae, Westgate, and Namunyak Conservancies for 2014. These examples clearly show the difference in temporal pattern between unsuccessful and successful rotational grazing practices. Unsuccessful patterns include Namunyak SE Grazing Block 1 and Westgate Grass Bank East, which were grazed ($\Delta\text{NDVI} > 0.1$, see Fig. 14 and 16) three times during the year, and especially twice during the wet season. Successful patterns included Meibae Mabati South and Meibae Resim North, which were grazed only once, and Westgate Grass Bank West.

Consequently, we used the criterion in Equation (18) to identify areas where rotational grazing practices were unsuccessful in 2014. Where pixels that met these criteria were aggregated within areas larger than 10 x10 pixels (2.5 x 2.5 km), a polygon proscribing the aggregation was

made, and the area of that polygon was deducted from the participating area of the Conservancy in which the polygon was located. The area removed was apportioned to either black cotton or sandy soils based on the approximate coverage of the two soil types by the polygon. Areas of unsuccessful implementation of rotational grazing practices are shown in Fig. 18 and provided in Table 11.

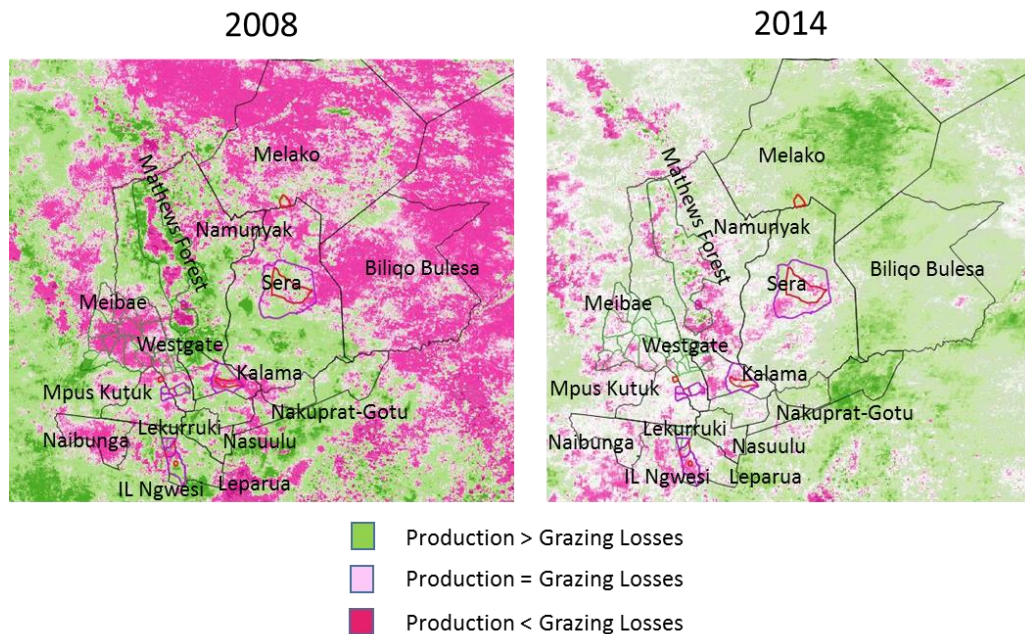
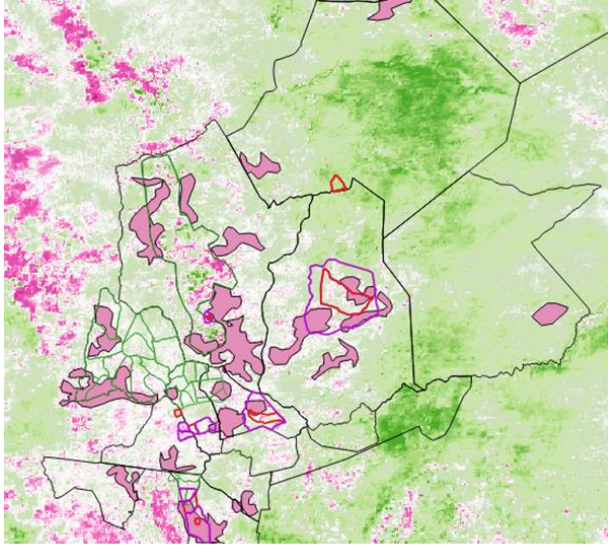


Figure 18. Areas of unsuccessful grazing management in the Northern Kenya Grasslands Project area for 2008 an above average rainfall year, and 2014, the first year of large-scale successful rotational grazing management, despite below-normal rainfall, especially in the western half of the project area.. Note the widespread negative net impact of grazing in 2008 in Naibunga, Westgate, Meibae, northeastern Sera, Melako and Biliqo Bulesa Conservancies. Note for 2014, the dispersed, mostly isolated areas of unsuccessful management, and thus the preponderance of successful management, indicating successful management across more than 90% of the participating project area.



- Production > Grazing Losses
- Production = Grazing Losses
- Production < Grazing Losses, Livestock Present

Figure 19. Polygons of the areas of unsuccessful grazing management in the Northern Kenya Grasslands Project area (see Fig. 18). The areas of these polygons, where they overlapped with participating areas and Conservancies, was subtracted from the participating areas within each stratum in calculating removals to soil carbon from project activities.

Table 11. Estimated areas of unsuccessful grazing management in the participating project area (not including Leparua, Naibunga, Nakuprat-Gotu, and Nasuulu Conservancies) during 2014.

Conservancy	Soil Type	Unsuccessful Area ha
Biliqo Bulesa	Black	0
Biliqo Bulesa	Sandy	567
Il Ngwesi	Black	3,557
Il Ngwesi	Sandy	833
Kalama	Black	1,217
Kalama	Sandy	10,785
Lekurruki	Black	667
Lekurruki	Sandy	621
Leparua	Black	
Leparua	Sandy	
Meibae	Black	2,326
Meibae	Sandy	18,611
Melako	Black	6,161
Melako	Sandy	0
Mpus Kutuk	Black	1,244
Mpus Kutuk	Sandy	0
Naibunga	Black	
Naibunga	Sandy	
Nakuprat-Gotu	Black	
Nakuprat-Gotu	Sandy	
Namunyak	Black	334
Namunyak	Sandy	31,958
Nasuulu	Black	
Nasuulu	Sandy	
Sera	Black	0
Sera	Sandy	30,073
Westgate	Black	995
Westgate	Sandy	817
Total Unsuccessful Area (ha)		110,767

Table 12. Total project removals to soil carbon during 2013 and 2014.

Conservancy	Soil Strata	2013		2014		
		Participating Area (ha)	Soil Carbon Removals (tCO ₂ e/yr)	Participating Area (ha)	Unsuccessful Area (ha)	Soil Carbon Removals (tCO ₂ e/yr)
Biliqo Bulesa	Black Cotton		-	17,250	-	23,569
Biliqo Bulesa	Sandy Loam		-	321,121	567	124,369
IlNgwesi	Black Cotton	4689	2,666	4,689	3,557	2,666
IlNgwesi	Sandy Loam	1729	1,712	1,729	833	1,712
Kalama	Black Cotton	14174	12,640	14,174	1,217	12,640
Kalama	Sandy Loam	22599	19,688	22,599	10,785	19,688
Lekurruki	Black Cotton	5143	6,124	5,143	667	6,124
Lekurruki	Sandy Loam	3078	2,648	3,078	621	2,648
Leparua	Black Cotton		-	-	3,231	-
Leparua	Sandy Loam		-	-	788	-
Meibae	Black Cotton		-	11,923	2,326	15,577
Meibae	Sandy Loam		-	77,852	18,611	87,560
Melako	Black Cotton		-	154,699	6,161	251,912
Melako	Sandy Loam		-	291,277	-	476,760
Mpus Kutuk	Black Cotton		-	10,251	1,244	11,023
Mpus Kutuk	Sandy Loam		-	36,889	-	38,746
Naibunga	Black Cotton		-			-
Naibunga	Sandy Loam		-			-
Nakuprat-Gotu	Black Cotton		-			-
Nakuprat-Gotu	Sandy Loam		-			-
Namunyak	Black Cotton		-	5,768	334	8,482
Namunyak	Sandy Loam		-	197,429	31,958	209,323
Nasuulu	Black Cotton		-		1,100	-
Nasuulu	Sandy Loam		-		1,132	-
Sera	Black Cotton		-	49,736	-	86,285
Sera	Sandy Loam		-	261,777	30,073	327,608
Westgate	Black Cotton	5969	(6,817)	5,969	995	(6,817)
Westgate	Sandy Loam	28232	30,453	28,232	817	30,453
Totals		85,613	69,112	1,521,585	117,018	1,730,327

5.4.4 Uncertainty in Project Emissions and Removals

Total uncertainty was calculated by weighting uncertainties according to the magnitude of emission or removal. In this case, uncertainty in net reductions and removals UNR_t is driven by uncertainty in baseline emissions, project emissions and project net changes in carbon stocks.

$$UNR_t = \frac{((UPEM_t \times PEM_t)^2 + (UNCCS_t \times NCCS_t)^2 + (UBE \times BEM)^2)^{1/2}}{PEM_t + NCCS_t + BEM} \quad (19)$$

Where

- UNR_t = uncertainty in net emission reductions and removals, not including leakage, at time t (%)
- $UPEM_t$ = uncertainty in project emissions at time t (%)
- $UNCCS_t$ = uncertainty in net change in carbon stocks at time t (%)
- UBE = uncertainty in baseline emissions (%)
- BEM = baseline animal methane emissions (tCO₂e)
- PEM_t = project animal methane emissions at time t (tCO₂e)
- $NCCS_t$ = net project changes in carbon stocks (tCO₂e)

For the calculation of baseline emissions and reductions, BER, uncertainty arises in the calculation of methane emissions only, because all other net emissions are conservatively assumed to be zero, since fire frequency is not purposely increased in the project.

In this case,

$$UBE = UBEM \quad (20)$$

Where,

- UBE = Uncertainty in baseline emissions (%)
- $UBEM$ = Uncertainty in baseline methane emissions from grazing animals

$$UBEM = \frac{(\sum_{c=1}^k (BEM_c \times UBEM_c)^2)^{1/2}}{\sum_{c=1}^k BEM_c} \quad (21)$$

Where:

- $UBEM$ = Uncertainty in baseline methane emissions from grazing animals (%)

$UBEM_c$ = Uncertainty in baseline methane emissions from animals in category c (%)
 BEM_c = Baseline emissions from animals in category c (tCO₂e)

These uncertainties for each category and in total are presented in Table 8 (section 5.3).

Uncertainty in project methane emissions is calculated as

$$UPEM = \frac{(\sum_{c=1}^k (PEM_c \times UPEM_c)^2)^{1/2}}{\sum_{c=1}^k PEM_c} \quad (22)$$

Where:

$UPEM$ = Uncertainty in project methane emissions from grazing animals during the monitoring period (%)
 $UPEM_c$ = Uncertainty in project methane emissions from animals in category c (%)
 PEM_c = project methane emissions from animals in category c (tCO₂e)

$UPEM_c$ is the uncertainty in methane emissions calculated from the uncertainty, for each animal category, in the regression equations for per animal daily methane production (**Error! Reference source not found.**) and the uncertainty in the arithmetic mean of animal censuses for category c , PN_c , during the monitoring period.

$$UPEM_c = (UPN_c^2 + UDME_c^2)^{1/2} \quad (23)$$

Where:

UPN_c = Uncertainty in the project mean of animals of category c

$$UPN_c = 3.84 \times 100 \times \frac{SD(PN_c, Y)}{PN_c \times (Y-1)^{1/2}} \quad (24)$$

$SD(PN_c, Y)$ = standard deviation of animal counts in category c across Y years of the monitoring period

PN_c = arithmetic mean of animal numbers in category c (head)

Y = years in the monitoring period

3.84 converts the standard deviation into a 95% confidence interval

100 converts the equation into percent

$UPME_c$ = Uncertainty in the regression, taken from the literature (Table 4) for predicting daily methane emissions for animals of category c (%).

These uncertainties are presented in Table 9 (section 5.4.2).

Uncertainty in changes in soil carbon stocks under a **Modeled** approach, $UNCCS_{m,t}$ is obtained from the calculated 95% confidence interval, as required by the VCS^[49,50] from a Monte Carlo simulation of $NCCS_{m,t}$ based on parameter values in stratum m . This interval is determined by iterated calculations

that sample from hypothetical normal distributions of values of each parameter in the calculation, defined by the mean and standard errors of each parameter for that stratum. Repeated calculations, with random draws from the distributions from each parameter, give a distribution of calculation outcomes with an overall mean and standard error for the calculation. Such Monte Carlo simulations will be done by the SNAP model software. The standard error for the SNAP SOC prediction, $SE(PRS_m)$ for each stratum generated by the Monte Carlo simulations will then be used to calculate 95% Confidence Intervals (95% CI) for SOC removals.

Under a modeled approach, $UNCCS_t$ is obtained from the calculated 95 percent confidence interval, as required by the VCS^[49,50] from a Monte Carlo simulation of modeled changes in soil carbon (see Sections Error! Reference source not found. and Error! Reference source not found.) averaged across n models in stratum m and across all s strata. For each stratum:

$$UPRS_{m,t} = 3.84 \times 100 \times \frac{SD(MOD\Delta SOC)}{MOD\Delta SOC \times (n-1)^{1/2}} \quad (25)$$

Where

$UPRS_{m,t}$ = uncertainty in project removals through increased soil carbon in stratum m at time t (%)

$SDMOD\Delta SOC_m$ = standard deviation of more than 100 modeled SOC estimates for stratum m from Monte Carlo simulation.

$MOD\Delta SOC_m$ = Mean modeled project equilibrium SOC for stratum m from more than 100 simulations of project equilibrium SOC, (tC/ha)

n = number of times simulation is run (must be greater than 100)

3.84 = multiplier to convert standard error into a 95% confidence interval

100 = multiplier to convert to percent

These uncertainties are given in Table 10 (section 5.4.3).

$$UPRS_t = \frac{\left(\sum_{m=1}^M (PRS_{m,t} \times UPRS_{m,t})^2 \right)^{1/2}}{\sum_{m=1}^M PRS_{m,t}} \quad (26)$$

In the absence of changes in aboveground woody plant carbon, which are *de minimis* in this ecosystem without fire

$$UNCCS_t = UPRS_t \quad (27)$$

5.5 Leakage

Leakage can result from displacement of livestock off the project area (displacement leakage) and from replacement of livestock, reduced intentionally from project activities to reduce methane emissions, by producers outside the project area to meet market demand (market leakage).

5.5.1 Displacement leakage

Movement of livestock could result in losses of carbon from higher levels of overgrazing off the project area. In this case, displacement leakage (LD_t) must be calculated as a proportion of net removals from increased soil carbon in year t (PRS_t), based on the proportion of total project livestock-days in project year t , $365 \times PN_{c,t}$, that occurred outside the project area.

$$LD_t = \frac{\sum_{x=1}^d \sum_{c=1}^k DN_{c,x}}{365 \times \sum_{c=1}^k PN_{c,t}} \times PRS_t \quad (28)$$

Where,

LD_t = Leakage emissions from displaced livestock (tCO₂e)

$DN_{c,x}$ = Number of livestock of each category c that were off the project area on day x (head)

d = Total number of days livestock of class c were off the project area

k = Total number of livestock categories

$PN_{c,t}$ = Number of animals of each category c in year t (head)

PRS_t = Project removals due to changes in SOC stocks in year t (tCO₂e)

Leakage was judged to be negligible, following VCS Standard 3.3 guidelines^[50], if

$$BEM + PEM_t + PRS_t > 0.95 \cdot (LD_t + BEM + PEM_t + PRS_t) \quad (29)$$

Uncertainty in displacement leakage, ULD_t , if leakage is not negligible, is conservatively assumed to be the same as uncertainty in project net removals (equation (24))

$$ULD_t = UPRS_t \quad (30)$$

5.5.2 Market Leakage

Market leakage was judged to be negligible since livestock reductions were not a project activity and livestock numbers are driven by range capacity (Fig. 7, 15) and rainfall^[51-54] rather than markets.

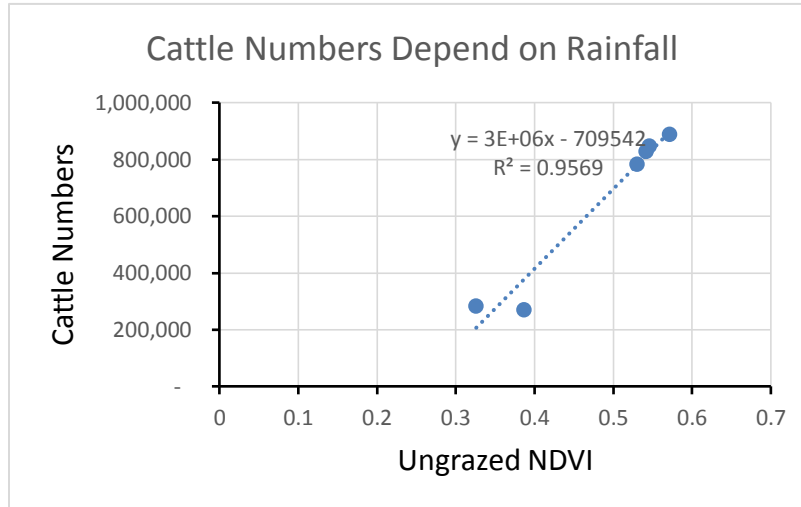


Figure 20. Relationship between cattle numbers in the project area and mean ungrazed NDVI, an indicator of forage biomass and rainfall, for 2004, 2005, 2007, 2008, 2009, and 2011. The years 2009 and 2011 experienced well below-normal rainfall, and 2009 resulted in 67% cattle mortality. Livestock numbers in the project area are controlled by forage production and not market forces.

5.5.3 Total Leakage

Consequently, with market leakage = 0, then total leakage,

$$LE_t = LD_t \quad (31)$$

And total leakage uncertainty

$$ULE_t = UPRS_t \quad (32)$$

5.6 Summary of GHG Emission Reductions and Removals

The estimation of net project emission reductions, PER_t , and net change in carbon stocks, $NCCS_t$, each year of the monitoring period is calculated using the following equation:

$$PER_t = PEM_t - BEM \quad (33)$$

Where:

PER_t = Net project emission reductions in year t (tCO₂e)

PEM_t = Project methane emissions from livestock in year t (tCO₂e)

BEM = Baseline methane emissions from livestock (tCO₂e)

Note that emissions from burning of biomass are excluded because there is virtually no fire in the northern Kenya ecosystem. Note that if project methane emissions decrease relative to the baseline from an intentional decline in livestock in the project area (note, not from forage improvement), ie $PEM_t - BEM < 0$, this GHG removal must be conservatively excluded to avoid market leakage, and proponents must set $PEM_t - BEM = 0$.

Changes in carbon stocks, in absence of changes in aboveground woody plant carbon, which is *de minimis* in this ecosystem without fire, are given by

$$NCCS_t = PRS_t \quad (34)$$

Where:

$NCCS_t$ = Net change in carbon stocks in year t (tCO₂e)

PRS_t = Project removals due to sequestration of soil carbon in year t (tCO₂e)

Note that there is no term for changes in carbon stocks due to changes in woody plant biomass because there are no project activities that should result in declines in aboveground woody carbon, and any increases in aboveground woody carbon are conservatively excluded. The net GHG benefit is calculated using the following equation:

$$R_t = PER_t + NCCS_t - LE_t \quad (35)$$

R_t = Net GHG emission reductions and removals in year t (tCO₂e)

PER_t = Net project emission reductions in year t (tCO₂e)

$NCCS_t$ = Net change in carbon stocks in year t (tCO₂e)

LE_t = Total leakage changes in soil carbon in year t (tCO₂e) (equation

Total project uncertainty is given by

$$UT_t = \frac{((NR_t \times UNR_t)^2 + (LE_t \times ULE_t)^2)^{1/2}}{NR_t + LE_t} \quad (36)$$

Where:

UT_t = Total project uncertainty (%)

UNR_t = Uncertainty in net emissions and removals, not including leakage (%) (equation (19))

ULE_t = Uncertainty in leakage emissions and losses from soil carbon stocks at time t (%)

NR_t = Net emissions reductions and removals at time t , not including leakage (tCO₂e)

LE_t = Leakage emissions and losses from soil carbon stocks at time t (tCO₂e) (equation (31)).

Table 13. Summary of baseline and project emissions and project removals, and total net emissions and removals with all uncertainty calculations.

Year	Baseline Emissions (t CO ₂ e)	Uncertainty %	Project Emissions (t CO ₂ e)	Uncertainty %	Net Change in Carbon Stocks (t CO ₂ e)	Uncertainty %	Leakage (tCO ₂ e)	Uncertainty %	Total Net Emissions and Removals	Uncertainty %
2013	509,750	56.07	429,291	45.23	69,112	6.25	-	6.25	69,112	34.28
2014	509,750	56.07	429,291	45.23	1,781,041	7.75	445,260	7.75	1,335,781	11.81
2015	509,750	56.07	429,291	45.23	2,007,130	6.89	501,782	6.89	1,505,347	10.84
2016	509,750	56.07	429,291	45.23	2,007,130	6.89	418,152	6.89	1,588,978	11.10
2017	509,750	56.07	429,291	45.23	2,007,130	6.89	334,522	6.89	1,672,608	11.37
2018	509,750	56.07	429,291	45.23	2,007,130	6.89	250,891	6.89	1,756,239	11.65
2019	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2020	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2021	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2022	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2023	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2024	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2025	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2026	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2027	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2028	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2029	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2030	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2031	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2032	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2033	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2034	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2035	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2036	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2037	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2038	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2039	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2040	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2041	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2042	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
2043	509,750	56.07	429,291	45.23	2,007,130	6.89	167,261	6.89	1,839,869	11.96
Total	15,802,250		13,308,021		60,056,915		6,132,128		53,924,788	

5.7 Exceptional Climate Change Adaptation Benefit

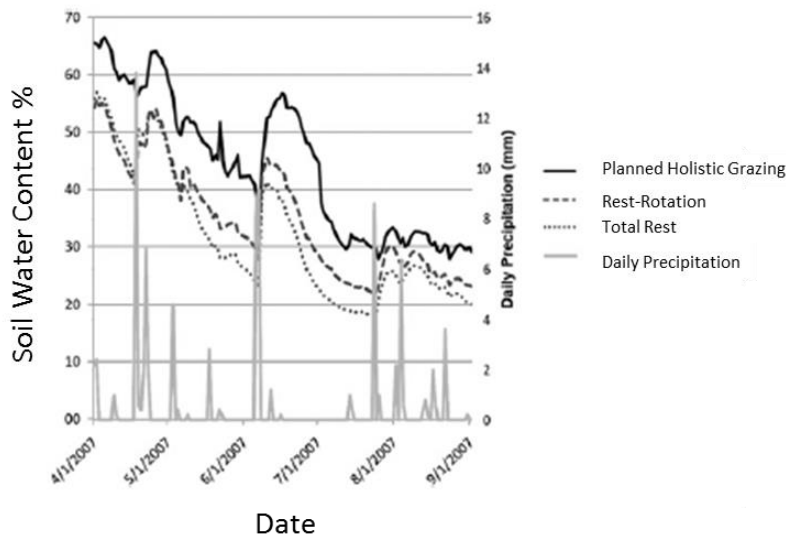
The rebuilding of soil organic carbon from the project activities of widespread PR grazing practices will likely induce dramatic improvements in the ability of people in the project area to adapt to climate change. Recent climate trends in the region^[55] suggest a reduction in mean precipitation, with longer periods of consecutive years with either above- or below-average precipitation. The principal defense for pastoralist communities against such projected changes is to build heterogeneity in grazing use of the landscape so as to create opportunities for “chasing” spatially and temporally variable precipitation within a season and the establishment of grass banks as a hedge against drought. The PR grazing practices are fully expected to restore perennial grass cover and increase soil organic carbon. The occurrence of greater soil carbon across the project area would result in the following aids in climate adaptation

1. Increased infiltration and retention of limited precipitation in shallow soil layers ^[56,57].
2. Green, higher quality forage available for more months during dry seasons/years.
3. Reproduction by livestock will extend further into the dry season or occur during dryer years, which will supply milk to families year-round^[3,58].

4. Increased production for the same livestock densities means that more areas can receive full rest from grazing and be used as grass banks. Perennial plant forms leave palatable, above ground biomass for livestock to consume further into the dry season or in dry years. This increases the number of grazing options and thus the opportunity to further mitigate risk.

Grazing and Dry Season Soil Water Content,
Idaho USA (Weber & Gokhale 2011)

in



to

Figure 21. Soil water content to a depth of 1 m areas receiving different livestock grazing management during the growing season in a temperate shrub steppe[59]. Note the persistently higher water content in planned “holistic” rotational grazing treatments as compared total rest or limited rest-rotation management.

5. Greater retention of water in shallow layers due to higher soil carbon^[56,57,59,60] (Fig. 21) supports the advent of standing water in a greater number of places across the landscape to support cattle, which have a greater dependence on water than smaller livestock, particularly goats.
6. Greater standing biomass and water in the dry season allows greater allocation of livestock to cattle and away from sheep and goats.

Overall, the project activities should greatly enhance communities’ ability to cope with climate change relative to their baseline condition.

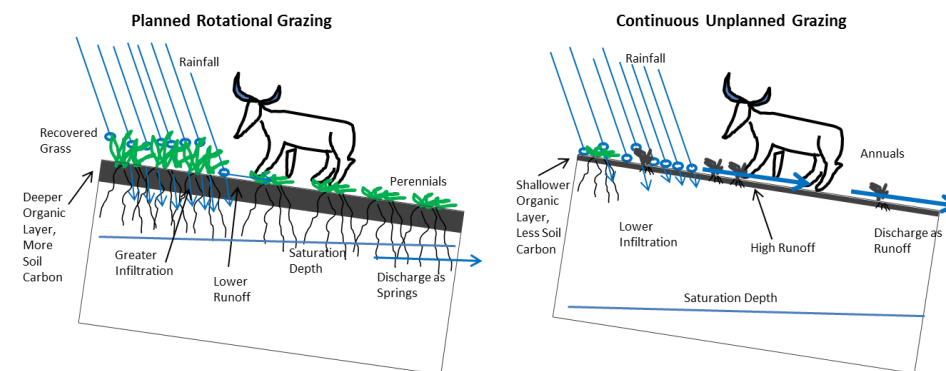


Figure 22. Diagrams to contrast the surface hydrology of rainfall in landscapes with planned rotational grazing (project activity) and continuous unplanned grazing (baseline activity).

6 COMMUNITY

6.1 Community Evaluation

The potential impacts of the population were evaluated in a number of ways. First, our focus has been on educating people about the project activity, which is planned rotational grazing. The education process began with workshops conducted by Grevy's Zebra Trust and Craig Leggett, then of Holistic Management International, first in Westgate and then in Kalama, Lekurruki and Il Ngwesi Conservancies in 2009-2011. Workshops and advertised public meetings to discuss the need for rotational grazing and restoration of grazing lands were conducted at numerous venues throughout the project area in 2012, including Wamba (in Namunyak), and Isiolo. The average number of attendees at meetings ranged from 15 in 2009 to over 100 by 2012. In 2013 and 2014, as new Conservancies (Melako, Leparua, Nasuulu, Nakuprat-Gotu) were added to the NRT group, administrative training by NRT staff included training on planned rotational grazing. Finally, the advent of the livestock to market program in 2010 and its expansion in 2014 (see <http://www.naturevesttnc.org/our-projects/lands/livestock-to-markets/>) led to links between implementing planned rotational grazing and Conservancy cattle being chosen for sale in the program.

The carbon project, whereby yet another benefit of planned rotational grazing is presented, has been communicated much more recently due to high uncertainty in the carbon market and a reluctance to raise hopes about potential revenues. However, the Conservancies began on 15 May 2015 a solicitation of participation and public comment period, with announcement and information about the project distributed by NRT grazing coordinators and other staff in the form of pamphlets available at Conservancy headquarters, and a soon-to-be posted announcement on the NRT website (<http://nrt-kenya.org>). In addition, Conservancy Grazing Coordinators have held meetings within at least every Conservancy

Finally, as part of baseline social data gathering, community elders, women and young herders (morani) were asked a series of questions in focus groups in three Conservancies, and over 1000 households were interviewed in a household survey of four Conservancies in October 2014. These social data highlighted community concerns about

- (1) encroachment by herders from outside the project area,
- (2) security in effectively implementing planned grazing, as the threat of cattle thieving and physical violence inhibits some herders from moving off heavily grazed areas,
- (3) The cost devoted to paying grazing assistants, who will patrol in designated grazing blocks to inform herders from outside the project area about expectations and rules for grazing within the Conservancy and to otherwise diffuse any conflicts.

6.2 Net Positive Community Impacts

The project has introduced multiple positive community benefits^[61]. These benefits will likely extend in many different positive ways to the poorest 25% (5 or fewer livestock, no cattle), women heads of household, young herders (morani) or other young men and women from poor households that may lack capital for livestock but whose education (funded by bursaries) may make them employable. The benefits will extend to communities in Conservancies throughout the project area and thus help people from multiple indigenous ethnic groups. However, insufficient time has passed since the project start for most of these benefits to be realized, but here several positive indicators for key population segments indicating **exceptional community benefits** are shown.

First, Livestock ownership provided a clear metric of the poorest 25% of people (Fig. 23), and our household survey identified opinions of women, including households with female heads.

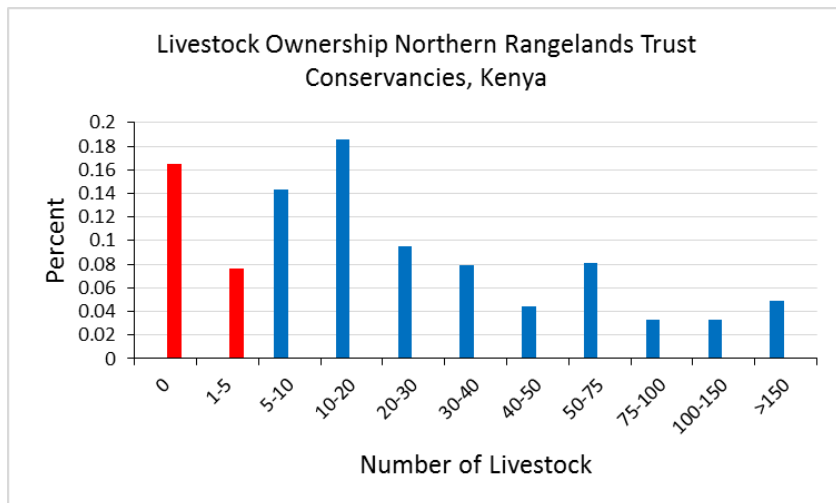


Figure 23. Livestock ownership distribution within four Conservancies in the project area. Red bars indicate the cumulative 25% of households with fewer than 5 livestock and no cattle that comprise the 25% poorest people in the project communities.

Conservancies with a longer history of a grazing plan (Il Ngwesi, Kalama) compared to those with less than one year of history (Melako, Nakuprat-Gotu) showed higher employment rates for the poorest 25% of people (Fig. 24). There was essentially no difference in employment of women due to Conservancy experience. Conservancies with a longer history with a grazing plan had fewer people experiencing lower income than the previous year but showed no difference in the number of households experiencing more income. Households in communities with a longer history of a grazing plan drank milk at a higher frequency and were less likely to be sick.

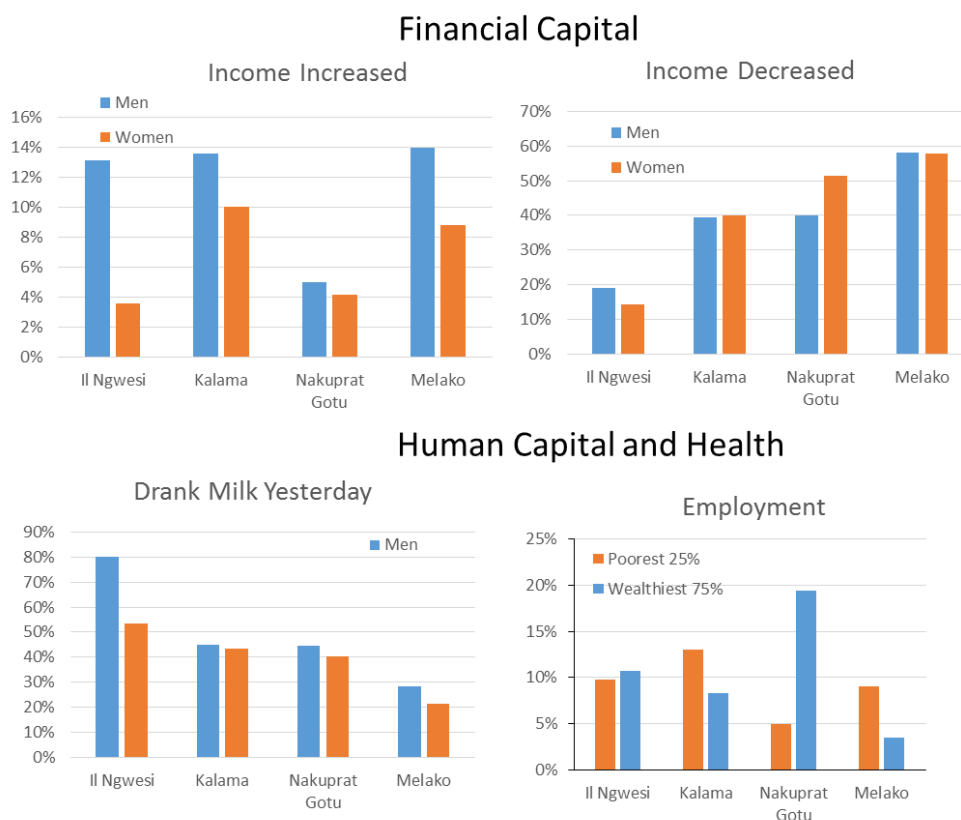


Figure 24. Economic and health indicators for Conservancies with a longer history of planned grazing (Kalama, Il Ngwesi) versus < 1 year with a grazing plan (Nakuprat-Gotu, Melako) in the Northern Kenya Grasslands project area.

Finally, response of communities to planned grazing is overwhelmingly positive, as the vast majority (> 65%) of households find their Conservancy's grazing plan "very helpful" as compared to "not helpful," "somewhat helpful," or "don't know" (Fig. 25). This positivity was expressed across households with men or women as heads, among the poorest 25% (largely not livestock owners) and owners of more than 5 livestock, and among people from Conservancies with a longer history of planned grazing versus not.

All these data indicate some positive trends that have accompanied the onset of project activities. Future data collected across additional Conservancies will allow a better assignment of cause and effect than is possible now, but the results suggest that the project activities are providing some social benefits, even as the resource benefits in livestock and grass await better weather conditions with higher rainfall.

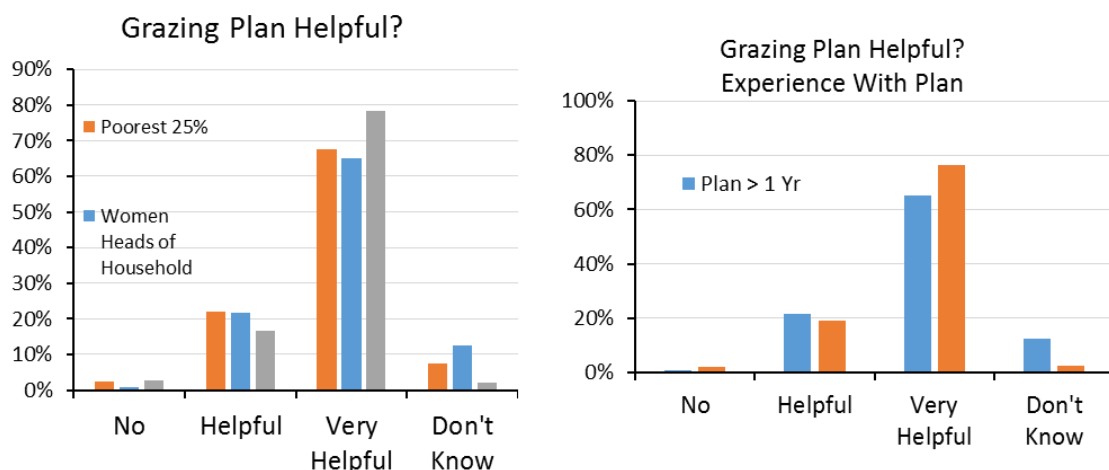


Figure 25. Responses to the question “Is the grazing plan helpful?” across different key groups of households in the project area. Data indicate overwhelming positive support for the project activities.

6.3 Negative Offsite Stakeholder Impacts

The principal offsite stakeholders are herders from other group ranches or trust lands, and these stakeholders may be negatively impacted by the enforcement of project boundaries and the perception that traditional use of other communities’ grazing lands during droughts or dry seasons is no longer permitted. A key mission in designing planned rotational grazing will be to continue to have negotiated agreements among grazing committees of different Conservancies or communities both on and off the project area. These agreements will allow continuance of cultural traditions while maintaining the integrity of the project. They also may enhance social cohesion because acceptance of off-project livestock will be easier once sufficient grass banks are established.

To this end, NRT has established a **regional grazing plan** to manage movements and numbers of livestock across Conservancies during droughts or extended dry seasons. This plan uses near real-time information on rainfall in the previous 1-3 months from USDA-USAID Famine Early Warning System (FEWS) <http://earlywarning.usgs.gov/fews/> and from the University of Reading’s (UK)

Tropical Applications of Meteorology using SATellite data, or TAMSAT

<http://www.met.reading.ac.uk/~tamsat/data/>, to identify areas experiencing drier and/or wetter than normal conditions, then design a large-scale cross-Conservancy rotation of livestock that eases grazing pressure in drier areas while sustainably using forage available within the project area. This regional grazing plan can also accommodate movements of herders from outside the project area as a way to limit encroachment and better manage leakage.

6.4 Exceptional Community Benefits

PR grazing practices should eventually largely remove livestock from continuous grazing in areas near settlements, thereby reducing grazing pressure on forage in these areas. Two key social groups, **women** and the **poorest 25%**, should benefit from this drastic reduction in grazing pressure. Women, together with their male children aged 8-12, typically are responsible for husbanding small livestock, mainly sheep and goats, to provide milk and meat for families. Women should benefit from longer-lasting green forage

because it would drive more sustainable milk production, less time required for herding animals long distances from the family boma to find suitable forage, more time for their children to attend school, and more time and resources (from selling milk) to engage in alternative livelihoods, such as making crafts to sell through wildlife-based tourism, sewing, etc. ^[1,2,32]. These families are also the most likely to benefit from project revenue distributions through bursaries and community-wide infrastructure such as rainwater collection and storage, increasing access of the children of this group to schools and health care. In particular, carbon revenues will also increase outlays from bursaries, which support school fees and other needs for the poorest 25% in NRT communities. Because all Conservancies are participating in the region-wide cooperative project, benefits of employment, cash revenues, and peace and security extend to all ethnic and socioeconomic groups.

Advantages conferred by the Conservancy administration (in terms of revenue distribution and opportunities) and by grazing plans are evident in the early household survey data from 2014 (Figs. 24, 25 in section 6.2)

7 BIODIVERSITY

7.1 Net Positive Biodiversity Impact

The High Conservation Values associated with the forest reserves and other protected areas adjacent to the project area should, if anything, be benefitted by the project. The anticipated increase in grazing options within the project area should reduce pressure to use protected areas for forage during dry seasons or droughts. Previous studies in the NRT or northern Kenya area ^[1,6,7,10,11] strongly suggest that planned rotational grazing and rangeland recovery will enhance numbers of large ungulate and associated carnivore species and increase plant diversity ^[12-15]. However, the impacts of rangeland restoration and soil carbon storage on other potential conservation values are poorly documented outside major, well-studied protected areas. Nevertheless the project is expected to increase species diversity of multiple taxa, including plants ^[11,22,23], birds ^[13,24] and arthropods ^[12,13,15,25], and our baseline data for

areas with different conservation history (Fig. 3, section 2.4.1) suggest that project activities will enhance diversity of multiple previously under-sampled groups.

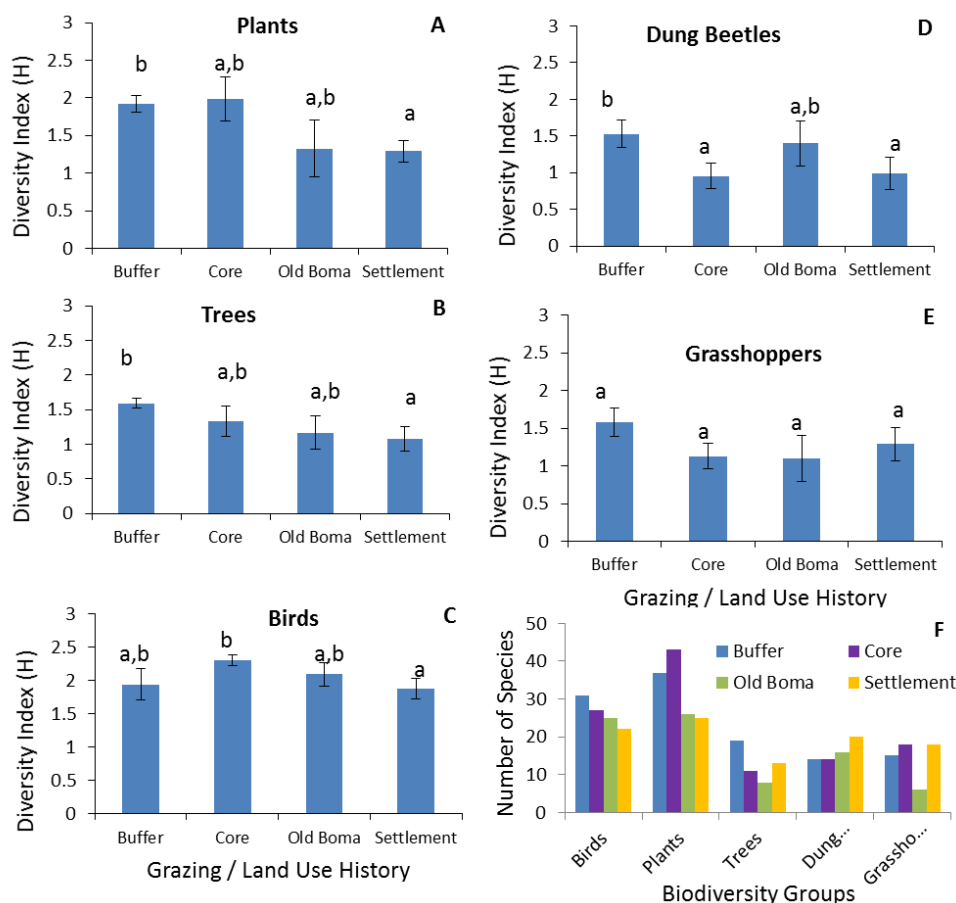


Figure 26. Mean ($\pm$ SE) Shannon-Wiener diversity indices for five different biodiversity indicator groups (A-E) sampled from each of four different land uses/management areas in three Conservancies (Kalama, Westgate, and Sera) in northern Kenya: Buffer areas with only dry season grazing, Core areas with rare dry season grazing only, Old bomas (livestock corrals) abandoned 10-20 years previously, and Settlement areas subject to continuous grazing. F) Cumulative number of species of the different indicator groups across all three Conservancies for each of the different land management/uses.

Baseline measurements of the species diversity of key indicator groups plants (trees and herbaceous), birds, grasshoppers and dung beetles were made at six sites at each of three different Conservancies: Kalama, Sera, and Westgate. This study demonstrates a proof of concept that relaxed grazing pressure from PR grazing practices will increase diversity. The species diversity index of all herbaceous plants and trees was significantly higher in Core versus Settlement areas and for dung beetles in protected areas versus Settlement areas. The data clearly show that PR grazing practices are likely to improve a broad spectrum of biodiversity across the project area. The baseline diversity study sampled a total of 746 trees, 1481 birds, 1161 dung beetles and 351 grasshoppers. Number of herbaceous plants was not available because cover was measured, rather than individuals. 67 herbaceous plant, 24 tree, 83 bird, 31 grasshopper, and 32 dung beetle species were observed or collected across the 18 sites.

Species richness and Shannon-Wiener diversity indices were calculated for the cumulative observed or captured species for each taxonomic group. The standard Shannon-Wiener Index^[63] was H , where

$$H = \sum_{i=1}^n p_i (-\ln(p_i)) \quad (37)$$

Where p_i is the relative (proportional) abundance (or in the case of herbaceous plants, canopy cover) of the i th species in the sample.

Mean species richness per site was not significantly associated with land use or past grazing management for any of the taxonomic groups (Fig. 2A-6A). Cumulative numbers of species across all three conservancies for each grazing history/land use showed different patterns (Table 1): birds, herbaceous plants and trees exhibited a greater cumulative number of species across conservancies in Buffer and Core areas than in Settlements, while dung beetles and grasshoppers both exhibited fewer cumulative numbers of species in Buffer and Core areas compared to Settlement areas.

Buffer areas (seasonal grazing only) had higher species richness or diversity indices than Settlement areas in 10 out of 10 tests ($P = 0.001$, one-tailed test) and Buffer and core areas combined had higher species richness and diversity indices than Settlement areas in 16 of 20 tests ($P = 0.011$, one-tailed tests).

10 species endemic to northern Kenya or the Horn of Africa (Ethiopia, Djibouti, Eritrea, Somalia, and northern Kenya) were found among birds, dung beetles, and grasshoppers combined. Of these endemic species, 5 occurred in Core areas, 4 in Buffer areas, and 1 in Settlement areas, and thus significantly more frequently ($P = 0.10$) in Core or Buffer areas than in Settlement.

The project will not introduce any non-native or GMO species into the project area, as re-seeding or plantings are not a project activity. Project activities merely adjust the way in which livestock are herded and moved across the landscape.

7.2 Negative Offsite Biodiversity Impacts

In the initial phases of the project, there is a strong need to create long periods of rest from grazing across large areas in order to allow some vegetation recovery. Given the widespread occurrence of degraded soil and vegetation conditions across the project area, herders, particularly from Namunyak Conservancy, may be tempted to move livestock into the Mathews Forest Reserve to cut limbs and small trees as forage for livestock. Chronic use of the forest for this purpose in the past has led to a reduction in forest cover and degradation, such as dominance of the forest by fast-growing early successional species¹⁰.

This potential negative impact should disappear as the project proceeds because successful BHPR grazing should produce substantial grass banks that can be used to provide short-term rest and drought forage bases. These grazing options should greatly lessen the motivation for herders to enter forests and thus reduce potential impacts. Consequently, any potential negative effects should be highly temporary

¹⁰

<https://www.conservationgateway.org/ConservationByGeography/Africa/Documents/Mathews%20Forest%20Ecological%20Assessment.pdf>

and produce little lasting effects on biodiversity. The impact of grazing management and movements of herders and avoidance of protected areas when possible is evident in the net impacts of grazing on the Mathews Forest, a major contributor to the High Conservation Value of the project area (see section 7.3)

Despite ready access to firearms, improved socioeconomic conditions associated with the project do not lead to increased wildlife poaching among the principal pastoralist groups, as their cultural traditions largely taboo the consumption of wild meat.

7.3 Exceptional Biodiversity Benefits

The project zone has numerous features that provide High Conservation Values, particularly for ungulate and large mammalian carnivores. Existing data from the literature or past wildlife and vegetation surveys demonstrates:

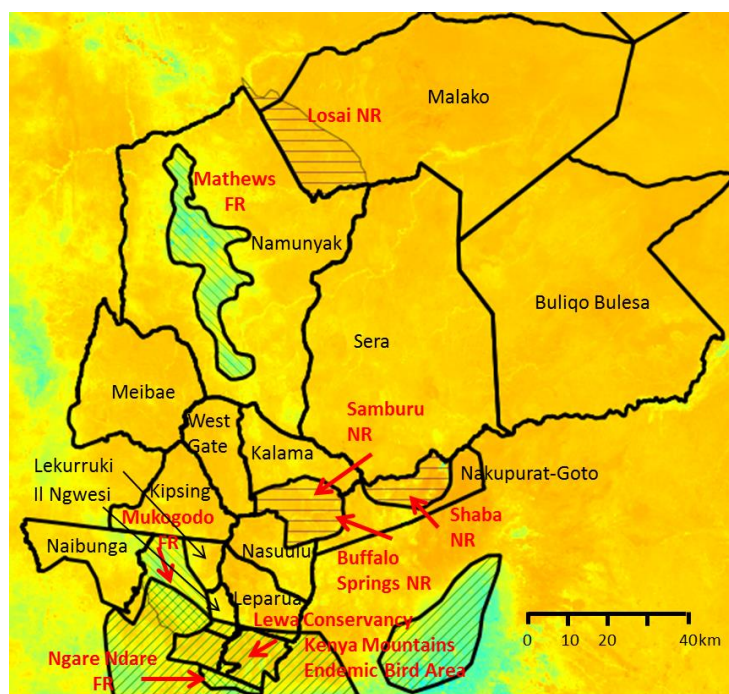


Figure 27. Map of protected areas (red text) in the context of the 15 participating or proposed Conservancies (black text) in the Northern Kenya Carbon Project, including forest reserves (left-slanted hatching), national game reserves (horizontal hatching), and the Kenya Mountains Endemic Bird Area (right-slanted hatching), all overlaid on a map of vegetation (NDVI), with orange showing rangeland with mostly bare ground, yellow showing savanna with grass cover, and blue showing forest.

- Several protected areas (Mathews, Mukogodo, and Ngare Ndare Forest Reserves, Lewa Conservancy (rhino source population), Samburu, Buffalo Springs, Losai, and Shaba National Reserves (see Fig. 18) are adjacent to or included in the participating Conservancies.
- The project zone contains several threatened or endangered species: black rhino (*Diceros bicornis*), Grevy's zebra (*Equus grevyi*), beisa oryx (*Oryx beisa*), African elephant (*Loxodonta africana*), gerenuk (*Litocranius walleri*), lion (*Panthera leo*), cheetah (*Acinonyx jubatus*), wild dog (*Lycaon pictus*)
- The project zone contains several endemic species, include several ungulates, e.g., reticulated giraffe (*Giraffa camelopardus reticulata*), Grevy's zebra, beisa oryx, plus genetically distinct impala (*Aepyceros melampus*) and kudu (*Tragelaphus strepsiceros*) are found in

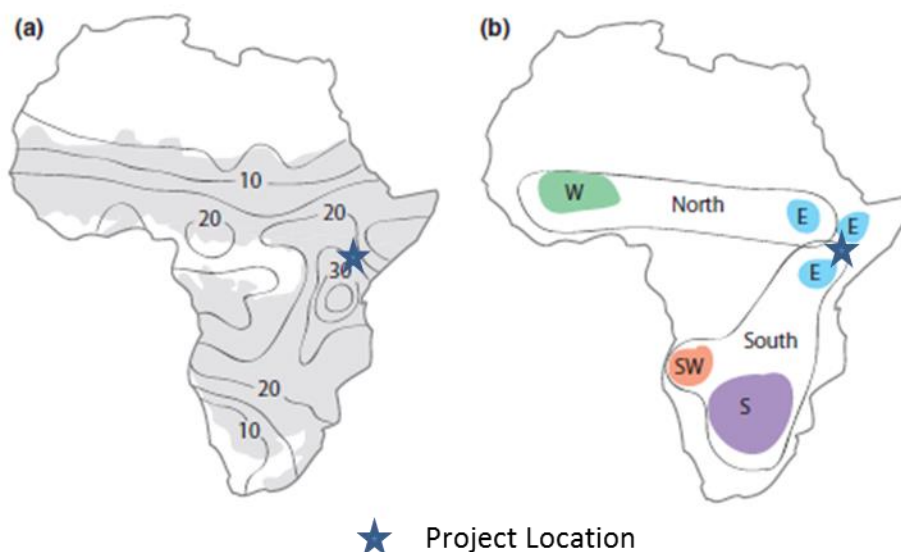


Figure 28. From Ref [9]. Distribution, diversity and regional biogeography of ungulates across sub-Saharan Africa. (a) Isoclines of ungulate diversity across Africa with the distribution of savannah in grey shading. (b) Four biogeographic regions of high ungulate endemism: west (W), east (E), south (S) and southwest (SW) that harbor locally high diversity. East Africa harbors several endemic lineages and the region north of Mt. Kenya represents a suture zone between lineages from Rift Valley and Sahel endemic faunas. The endemic regions are defined by climate and soils and linked by landscapes of low topography of grassland habitat that permit large-scale gene flow over millenia.

d. Northern Kenya hosts multiple bird species in the Mathews range associated with (though not included in, probably due to a lack of data on birds until the recent survey by deJong and Butynski^[16]) the Kenya Mountains Endemic Bird Area. In addition, the region is a “suture zone” between vertebrate faunas to the west (the Sahel) and to the south (Rift Valley).

e. The project zone is a major migration pathway for elephants, and for animals exhibiting seasonal movements up and down the northern slopes of Mt. Kenya in response to wet vs dry periods during the year. Many of these corridors are marked on livestock monitoring maps maintained by grazing corridors, indicating the general awareness of these in grazing management.

The project zone is also an area that could provide critical ecosystem services (e.g., hydrological services, erosion control, fire control) in the form of forage to support wildlife-related tourism and the production of livestock. This increased average and decreased variance in forage production helps meet the basic needs of local communities (e.g., for essential food, fuel, and fodder) and help preserve their pastoralist lifeway and traditional cultural identity.

Population and range expansions of key wildlife species have occurred, particularly in areas where rotational grazing practices have occurred the longest (since 2012) or where livestock incursions into forests have been reduced (Fig. 33, 35). For example, elephant total numbers have not changed dramatically, but they have expanded their habitat use in Westgate and Namunyak Conservancies, particularly in the Mathews Forest where incursions from livestock have declined (Fig. 34).

Livestock monitoring data indicate a clear positive step in reducing encroachment into the Mathews Forest (Fig. 33). Even in a drought year, when encroachment is usually at its worst, livestock produced negative impacts on only 20% of the Mathews Forest in 2014, and mostly on the edges where degradation has already occurred, compared to over 30% of the forest negatively impacted, and mostly in the high biodiversity rainforests at high elevation, that occurred in 2008, a comparatively wet year. As rotational practices continue and grass banks are established across a wide range of locations in the project area, encroachment should decrease further, thus addressing the number one threat to the Mathews Forest.

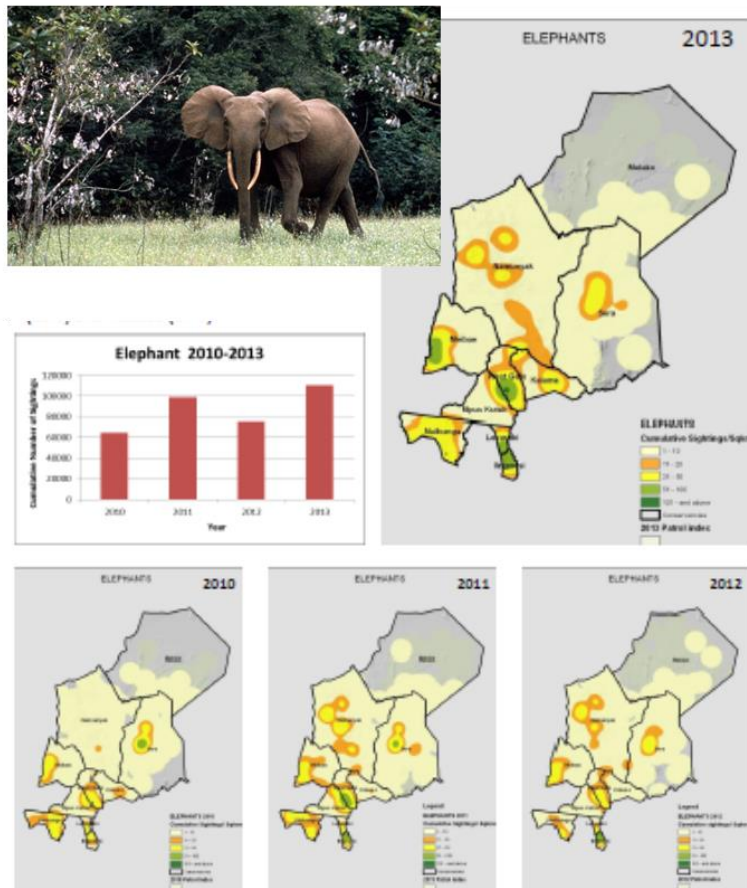


Figure 29. Distribution and abundance of elephants NRT Conservancies, 2010-2013, showing major expansion since 2010, especially into the Mathews Forest, possibly as a consequence of reduced incursions by livestock herders, and into managed grazing, protected areas in Westgate Conservancy (green spot in lower center of map)

Black rhino numbers are very small outside the Lewa Conservancy because most are recently transplanted populations intensively monitored by the Kenya Wildlife Service KWS. One such transplant site is now located in Sera Conservancy. Impacts of the NKCP on rhino reintroduction into any NRT Conservancies will be determined from KWS monitoring data.

2008	2014
Baseline Conditions	Project Scenario

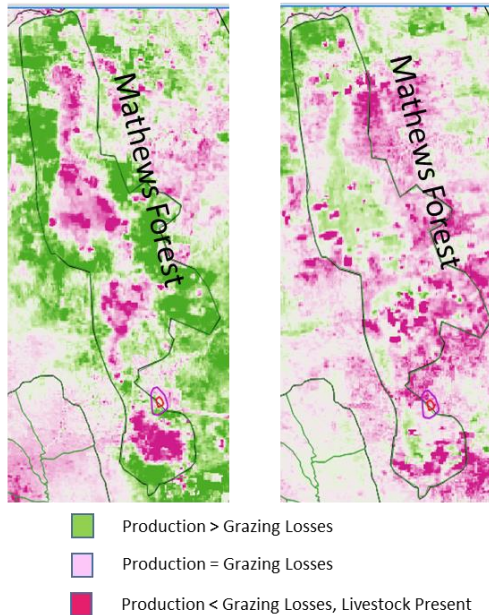


Figure 30. Satellite based monitoring of net annual grazing impacts, using the sum of monthly Δ NDVI (see section 5.4.3) on the Mathews Forest, comparing those in a wet year (2008), conservatively representing baseline conditions, and those in drought year under a preliminary regional grazing plan to mitigate effects of drought in western side of the project area. Note that impacts in 2014 were mostly along the edge of the forest, while impacts in 2008 were concentrated in the interior high elevation rainforest areas of the Mathews.

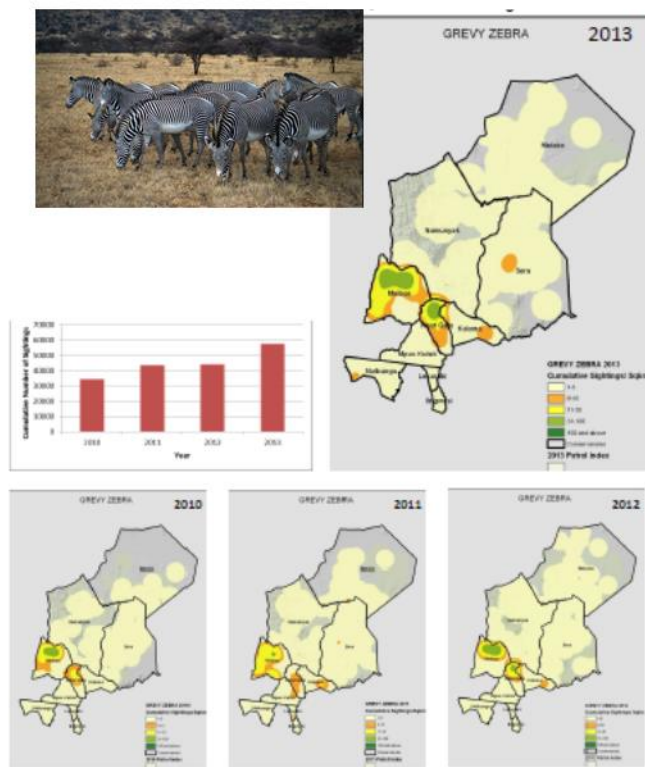


Figure 31. Distribution and abundance of Grevy's zebra, an endangered species, in the NRT Conservancies 2010-2013. Note the increase in population in the northern part of Westgate Conservancy, the principal and earliest areas where rotational grazing practices occurred within NRT.

8 MONITORING

8.1 Description of the Monitoring Plan

The monitoring plan features four main components. First, monitoring of livestock numbers and movements is necessary to establish that Bunched Herd Planned Rotational grazing has been successfully implemented for at least a majority of cattle in the Conservancies. Secondly, vegetation cover and composition need to be monitored to establish a new, reduced grazing intensity and new values for lignin and cellulose, so that the change in soil carbon (CO₂ removals) can be calculated with the SNAP model. Thirdly, project impacts on biodiversity will be monitored. Finally, the impacts of the project on communities and key groups (herders, elders, gender classes, and the poor) will be measured through focus groups and household surveys.

8.1.1 Organizational structure, responsibilities and competencies

The monitoring of project activities, consequences of these for vegetation and soils, project impacts on biodiversity, and changes in key social variables will be administered and coordinated by a joint carbon project task force, spearheaded by Soils for the Future and NRT personnel.

The Conservancies are groups of communities that occupy either designated Group Ranch lands or Trust lands to which they have acquired or are acquiring formal status as Conservancies with rights to benefit from conservation activities, such as wildlife conservation that supports tourism. These communities are almost exclusively pastoral in culture, but are committed to education and to conservation-oriented grazing practices and land zoning. The Conservancies also serve as the source of most project employees involved as grazing assistants, biodiversity field technicians, data entry specialists, etc.

The Northern Rangelands Trust (NRT) (<http://nrt-kenya.com>) is a non-profit non-government organization devoted to helping the northern Kenya Conservancies develop governance, infrastructure and livelihoods that will bring peace, and prosperity to the region. NRT has in place professional personnel, such as grazing coordinators, and administrative competencies to help Conservancies develop and implement their own grazing plans, security teams, and monitoring capabilities. NRT has in place mechanisms to gather data from all Conservancies to build narratives that benefit all Conservancies through external funding, and in this case the data necessary to support claims of greenhouse gas removals. NRT also has established revenue sharing protocols to communities that allow substantial self-determined community-level benefits and projects. These protocols are a key mechanism of delivering carbon benefits to women and the poorest 25% of households.

Soils for the Future, LLC (<http://soilsforthefuture.com>) (SftF) is a for-profit carbon development company, with established expertise in carbon accounting, field data collection, especially of soils and vegetation, and analysis of satellite images. Dr. Mark Ritchie, as President and author of more than 80 scientific publications, provides expertise in a variety of types of ecosystem and biodiversity modelling and satellite image interpretation. He also developed the methodology used in this project: VCS VM0032 methodology. Other SftF personnel have expertise with GIS, soil, ecosystem, and biodiversity

measurements based on experience in Serengeti National Park and other field sites in Tanzania. Finally SftF has personnel with pastoralist backgrounds who speak many of the local languages and have experience with education about soil carbon projects at community and village levels.

The Nature Conservancy provides quality assurance in social data collection, with baseline household surveys and focus groups designed and conducted by Dr. Jessica Musengezi, a TNC social scientist with extensive experience working in Africa. TNC also provides a corporate liaison capability for marketing and selling the credits generated by this project through TNC NaturVest

<http://www.naturevesttnc.org/resources.html>. J.C. Danilovich of TNC NaturVest, trained at Yale and Stanford, will be spearheading this aspect of the project, and will draw his experience with agricultural impact investments in the US, Africa, and Southeast Asia.

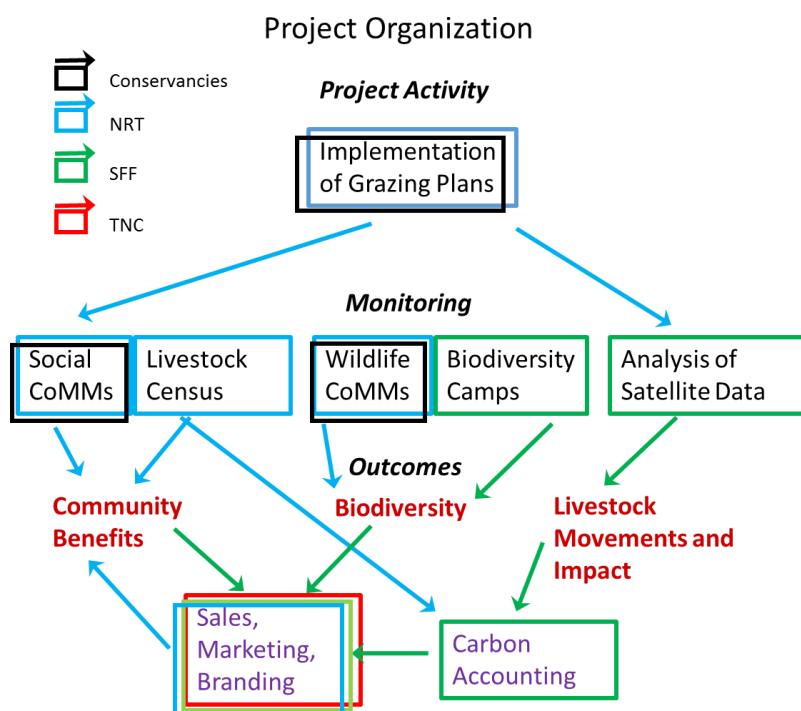


Figure 32. Diagram of project organization, including color-coded responsibilities (boxes) and information flows (arrows). Project actions are divided into project activity, monitoring, and accounting, with red text indicating project outcomes. Black boxes indicate Conservancy responsibilities, blue boxes and arrows indicate NRT responsibilities and sources of information, green boxes and arrows indicate Soils for the Future, LLC responsibilities and sources of information, and red boxes indicate TNC responsibilities. Boxes with multiple colors indicate joint responsibilities.

The overall project organization, task responsibilities and flow of information is given in Fig. 30. The project is truly a joint effort between the three organizations, as indicated by an available MOU between the three parties.

8.1.2 Methods for generating, recording, storing, aggregating, collating and reporting data on monitored parameters

All field data were recorded by hand into field notebooks. Data will be scanned and stored electronically and then entered into Excel or other similar spreadsheets or digitized onto GIS layers analysed in QGIS, a free GIS software program. The project database will be kept jointly by Soils for the Future and NRT. Meta-data will be built so that it will be transparent how all raw data can be explicitly linked into the equations that use it, per methodology VCS VM0032.

Likewise spatial data such as sampling stations, biodiversity sampling camps, observation locations of key species that confer High Conservation Value and satellite remotely sensed images will also be maintained in the project database. Files will be stored as both shape files (readable only in GIS software programs) and as bitmap or TIFF files with meta-data that would allow geo-referencing by future software programs.

Analyses of all social, livestock census, biodiversity, vegetation, and satellite data for Monitoring Reports will be done by primarily by SftF with assistance from NRT monitoring personnel (eg Senior Scientist Jeff Worden).

8.1.3 Describe procedures for handling internal auditing and non-conformities

Data will arrive from multiple field crews and sources (different satellite images), and such data faces some risk of error in reporting and converting into spreadsheet databases. Data checking protocols will be devised at three levels – supervisors of field crews, NRT and SftF scientists. Multiple personnel within the project will check data and calculations to ensure transparency and internal auditing. Evidence for project activities that reduce greenhouse gas removals will be reviewed and cross-checked with supervisors of field crews, grazing coordinators, Conservancy managers per VCS guidelines^[50]

8.1.4 Biodiversity variables and sampling design

8.1.4.1 Biodiversity Objectives

1. Establish a permanent biodiversity monitoring platform that can sample multiple sites that include old bomas, boma edges, and non-boma savanna/grassland habitats across the characteristic rainfall and soils (sandy loam vs. black cotton) featured in the project. Old bomas are small former temporary livestock corrals that occupy less than 0.5% of the project area and thus are not important to overall project carbon accounting, but that harbour higher than normal species diversity and sometimes unique species^[12,23]. Old bomas may thus contribute significantly to biodiversity within a particular Conservancy and soil type even though they do not contribute significantly to greenhouse gas emissions and removals.
2. Establish these platforms so as to compare core, buffer and settlement land uses within Conservancies and to compare these biodiversity values to those within formally protected areas.
3. Measure plant, bird, reptile, grasshopper and dung beetle diversity within the savanna/grassland monitoring platform sites.
4. Design a plan to re-sample trees, mammals, birds, reptiles and amphibians as key bio-indicators in the Mathews Forest (High Conservation Value area adjacent to the project area) after 3 years.

8.1.4.2 Biodiversity Sampling Design

Sampling in savanna/grassland habitats will take place every 3 years in 5 “camps” strategically located to be within 5 km of a suite of sampling sites that include glades (old bomas) and non-boma sites in Core (little or no grazing), Buffer (planned, limited use livestock grazing), and Settlement (unlimited year-round grazing) land use areas within the Conservancies that have implemented these different land uses in the past 5-15 years. Sites associated with each camp should also include black cotton soils, though it is less likely that these soils would contain glades, as herders generally avoid using black soils in the region except during the dry season. Fifteen camps should be sufficient to detect change in biodiversity, given the relative uniformity of soils, annual rainfall amounts, vegetation, and land use across savanna/grasslands in the project zone.

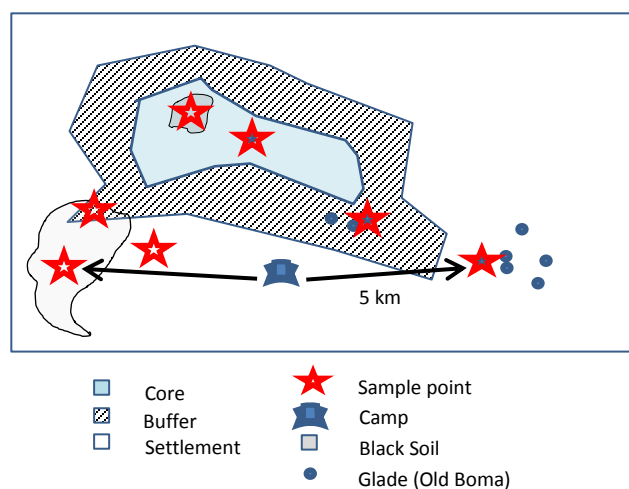


Figure 33. Schematic of a hypothetical biodiversity sampling camp showing sampling sites (red stars) located on different types of sites in Core, Buffer, and Settlement land uses on both sandy loam and black cotton (gray outlined areas) soils, centered on both glades and non-boma sites in a constellation within 5 km of a central camp (blue tent).

Each camp will be associated with a constellation of 7 or more sampling sites (Fig. 33) and allow contrasts in species richness and other diversity estimates among land use (grazing, glade vs non-glade) and soils.

Two types of sampling will occur at each site: **Integrated mini-transects** for measuring plant, grasshopper, and dung beetle diversity (Figure 34) and **belt transects** for measuring bird diversity (Figure 31). Integrated mini-transects follow established sweep-sampling methods for grasshoppers^[18,64], pitfall trap methods for sampling dung beetles^[65], and vegetation methods, with a twist, already used in current community-based VegCoMMs within NRT. Belt transects follow established methods for sampling birds in biodiversity surveys^[13,65-67].

This integrated sampling design allows larger fauna (birds) to be sampled at an appropriate scale while still linking any such data to a measurement of vegetation and plant diversity. Clustering multiple sampling sites around a common camp greatly reduces costs because nighttime sampling of dung beetles in pitfall traps (see below) can be done multiple times, which is important^[68], at the same time as multiple morning sampling of birds and reptiles and afternoon sampling of grasshoppers and plants. Each camp can thus yield biodiversity data across multiple days from all 7 sites in 3-4 days, depending on the proximity of individual sites, and available staff and crews. Assuming reasonably short (2 hour) travel times between camps, grassland/savanna biodiversity assessment for the project can be completed in 45-75 days.

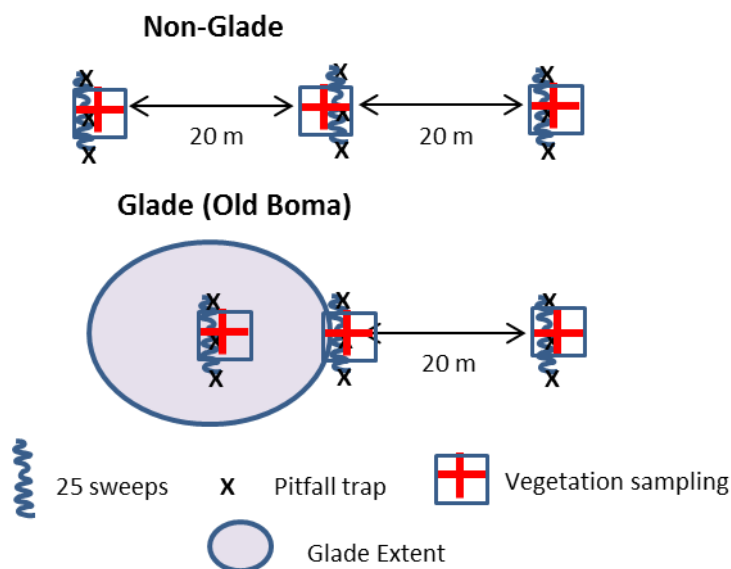


Figure 34. Schematic of integrated mini-transects for sampling vegetation and plant (herbaceous and tree) diversity at sampling sites with glades and without glades. Red crosses indicate the extent (two crossing 10 m transects) of ground sampled with the Mpala stick method^[69] for vegetation cover, along with but with all plant species (including trees) that in the 10 x 10 m plot (blue box) encompassing the stick transects. Wiggled lines indicate grasshopper sampling, or the distance traveled (15 m) while continuously sweeping with a muslin net. X's indicate the location of pitfall traps baited with cattle dung to attract dung beetles. The blue circle indicates the approximate extent of the glade. Mini-transects are positioned along its edge to capture important species that live in the vegetation structure outside the glade but benefit by feeding on more nutritious plants inside the glade. The top diagram shows the positioning of four mini-transects at a sampling site without a glade. Note that even glade sites yield information from non-glade habitat.

With at least four mini-transects sampled at each site, each camp yielded 14 species richness estimates (2 at each of the 7 sites) for birds and a minimum of 21 estimates (3 at each of the 7 sites) of plants and insect species richness. Across the entire survey, the design yields $14 \times 15 = 170$ estimates of bird species richness and diversity and $21 \times 15 = 305$ estimates of plant and insect species richness. The design samples both the extent of the project area (distributed across Conservancies as much as

possible) and differently-scaled heterogeneity in habitats within the project area (on and off glades, on different soil types). This sampling scheme has already proven effective in showing that areas grazed only during the dry season harbour higher plant and tree diversity and show strong trends toward higher bird and grasshopper diversity than continuously grazed areas (Fig. 26 section 7).

8.1.4.3 Biodiversity Methods

Biodiversity surveys consist of coordinated transects to sample plant species, ungulates and/or large primates, birds, reptiles, amphibians, and two groups of insects: dung beetles (Coleoptera, Scarabeinae) and grasshoppers and locusts (Orthoptera) in both rangelands and forests. Biodiversity experts from FFI and the Kenya Museum for the different major taxa were brought in to train local crews in each Conservancy in which the biodiversity monitoring camps are located. Following training, the crews for each Conservancy will work independently from motorcycles while the training team moves on to another Conservancy.

Ungulates and other large mammals

Ungulate species, including Grevy's zebra and elephant numbers were monitored by (1) aerial surveys performed every 3 years within the main districts in which the NRT Conservancies are located (Samburu, Isiolo, Laikipia), (2) recorded sightings by NRT/TNC and Grevy's Zebra Trust staff, and (3) annual recorded sightings by NRT's community-based wildlife monitoring program (Wildlife CoMMs).

Birds

Birds were sampled using the fixed width transect method^[13]. Two transects originated in the center of the mini-transects will be run 200 m at 90° angles to each other. Two observers walked the length of the transect and record every bird sighted within 50 m on either side. The position of individual birds along transects was determined by GPS, and perpendicular distance from the observer to the bird was measured with a rangefinder (e.g., Yardage Pro Scout, Bushnell, Overland Park, Kansas). Surveys were conducted between 06:30 and 10:00, when it was expected birds would be most active. The number of birds in flocks of a given species were also estimated.

Plants

Plant diversity and vegetation cover in the savanna/grassland biodiversity survey will be sampled using a modified version of the Mpala stick method. The stick method uses a demarcated stick and a standardized data form to estimate cover of different vegetation types and other ground cover using line intercept principles. The method was designed for use by local community monitoring programs and does not specifically yield an estimate of plant species richness or other diversity measures. However, the method can easily be modified to estimate species richness of both herbaceous and woody species. When the sticks are laid out, they form a "cross" that defines a square of 10 x 10 m. A list of all woody and herbaceous species found inside this 10 x 10 m area estimates species richness, and this list can easily be written on the back of the data form.

Grasshoppers

Grasshoppers were sampled by walking along a transect and continuously sweeping vegetation with a strong muslin net 25 times, typically along a 10 m transect^[70]. Sweeps were conducted twice during the

visit to each camp. Captured grasshoppers were hand-caught from the net to avoid damage and euthanized in a cyanide bottle and stored in 70% ethanol until identification. Species were identified based on keys and other protocols drawn from Kenya Museum collections.

Dung beetles

Dung beetles were sampled during both day and night by placing cattle dung in small 9 cm diameter pitfall traps^[65,68] placed in a line of four, each 10 m apart at each mini-transect at each sampling site. Traps were baited and opened at least 2 nights during the sampling period at each camp, and are likely to sample more than 58% of the regional dung beetle fauna^[68]. Trapped beetles were extracted from traps, euthanized in cyanide bottles and stored in 70% ethanol until identification.

Experts

Dr. Mark Ritchie of Syracuse University, an expert in grasshoppers^[18] and dung beetles^[71], and Emilian Mayemba, a top plant naturalist from Serengeti National Park in Tanzania direct the diversity monitoring of non-wildlife taxa. A number of experts from the Kenya Museum of Natural History have been consulted in developing identification keys and other protocols for the NKCP biodiversity surveys. Available staff include Ronald Muliwa (birds), Michael Mungai (Orthoptera), and Morris Mutua (Coleoptera).

8.1.5 Community variables and sampling design

The key variables to be determined from the three types of surveys reflect specific aspects of financial, human, natural, physical, and social capital that may be influenced by the carbon project. Some very important variables to consider for NRT and the NKCP are given below. Questions will be asked to both heads of household (mostly men) as well as head women of households so as to monitor project impacts on women as well as different groups of men.

Social data collection involved gathering information from approximately 5 groups of key informants from key Conservancies with representation and at least 10-15 focus groups [2 or 3 each from within the entire project area from women, elders, morans. For household surveys, the goal is a sample size sufficient to demonstrate significant change over some period of time during the implementation of the project. Given typical standard errors in human data of 10-20% and frequent non-normal distributions, more than 1000 households mainly of Maasai, Samburu, Borana, and Rendille ethnic groups were interviewed to ensure a sample large enough to successfully compare different subgroups^[72]. This sample size was selected based on reducing the coefficient of variation to less than 30%, based on standard deviations in responses from Louise Glew's thesis^[1] comparing socio-economic results from communities with and without Conservancies. This sample size should allow 15% improvement in conditions during the project crediting period to be found statistically significant ($P < 0.05$). Sufficient effort will be made to include some of the same individuals upon re-sampling (samples taken after the start of the project) in order to reduce sampling error.

For assessing livestock numbers, the methodology VM0032 requires that at least 30 households or 10% of households, whichever is greater, in the project area need to be surveyed. 1000 is approximately 10% of all households in the project area (Table 6, section 4.5.3). Surveys asked for the number and kind of livestock owned in each household, how these are grouped with others in BHPR grazing, and their locations through the year.

8.2 Data and Parameters Available at Verification

Per the VM0032 methodology, the following data and parameters will be presented at validation:

- (1) Maps of the project area, indicating all land parcels included in the project, as indicated in accompanying shape files with vector coordinates of project and stratum boundaries (Fig.
- (2) Map(s), with accompanying georeferenced shape files, of the locations of the permanent sampling stations overlaid on a map of project strata.
- (3) Results of analysis to determine the number of sampling units and their allocation among strata.
- (4) Results of cluster analysis to determine project strata.
- (5) Table of all project strata, their description, and area, PA_m
- (6) Legal statements of the usage rights of Conservancy members to graze livestock and benefit from carbon sales, and governmental permissions for conducting the project.
- (7) Justification of planned rotational grazing practices.
- (8) Justification of methane as the major emission source and methane and soil carbon as the major sink for carbon dioxide in the project.

8.3 Data and Parameters Monitored

Data and parameters monitored fall into three major categories: (1) data and parameters needed to calculate project greenhouse gas removals and emissions, (2) data gathered to demonstrate impacts of the project on biodiversity, and (3) data gathered to demonstrate project impacts on communities.

8.3.1 Project greenhouse gases and emissions

Per methodology VM0032 a data table will show calculations of project scenario methane emissions based on the equations in Table 5 (**section 4.5.3**) for each animal category for each year that data are available, plus $PN_{c,t}$, for each year during the crediting period, sorted by the k categories in the project area: species, breed (if applicable), sex, and age, plus the respective live body weights (W_c) of each category, with 95% CI and uncertainties. Unlike when determining the baseline, the **arithmetic mean** of the counts during the crediting period will be used. Animal counts will be obtained from herder surveys taken by grazing scouts during monitoring of herd movements.

:

Data Unit / Parameter:	$PN_{c,t}$
Data unit:	number
Description:	Mean number of animals of category c in the project area during year t
Source of data:	Measured in project area

Justification of choice of data or description of measurement methods and procedures applied	Measured as the arithmetic mean of one or more years' animal censuses during the crediting period
Any comment:	

Calculations of methane emissions based on the equations in Table 3 for each animal category in each year of the project since the start or verification. The last table should include calculated total emissions for each year. This will be the project emissions in year t : PEM_t . The table should also contain the uncertainty in both daily per-animal methane emissions and the uncertainty in the arithmetic mean count based on the equations in **section 4.5.4.5**.

Parameters for calculating changes in soil organic carbon after Y crediting years will also be shown, along with their uncertainty (**sections 5.4.3 and 5.4.4**). Updated SNAP model input parameters, $GI_{j,m,Y}$ (mean grazing intensity during crediting years Y), $MAP_{j,m,Y}$ (mean annual rainfall during crediting years Y), and $MAPLC_{j,m,Y}$ (mean aboveground plant lignin and cellulose in crediting year Y) will be tracked at each sampling station. Each parameter will be listed along with its uncertainty based on a 95% confidence interval.

Data Unit / Parameter:	$MAP_{m,t,Y}$
Data unit:	mm/yr
Description:	Mean annual precipitation in stratum m over the crediting period Y years.
Source of data:	Read from RFE 2.0 algorithm estimates of rainfall based on inputs of vegetation indices and cloud top temperatures available from NOAA (Ref[1]) http://www.cpc.ncep.noaa.gov/products/fews/RFE2.0_desc.shtml
Justification of choice of data or description of measurement methods and procedures applied	Parameter in SNAP soil carbon model
Any comment:	

Data Unit / Parameter:	$GI_{j,m,Y}$
Data unit:	Dimensionless proportion
Description:	Mean annual grazing intensity at station j in stratum m over the crediting period Y years
Source of data:	Measured in project area. at each sampling station at least twice each growing season prior to verification by comparing clipped biomass at least at the end of the growing season, or more frequently for some models, inside and outside small (1 m ²) fences. $GI_m = 1 - (\text{biomass outside/biomass inside})$. Biomass is clipped, dried at 25 – 50 °C, and weighed.
Justification of choice of data or description of measurement methods and procedures applied	Parameter in the SNAP soil carbon model.
Any comment:	

Data Unit / Parameter:	$MAPLC_{j,m,Y}$
Data unit:	Dimensionless proportion
Description:	Mean aboveground plant cellulose plus lignin at sampling station j in stratum m in project crediting year Y
Source of data:	Measured in project area by MIR spectral analysis of clipped plants (two 0.0625 m ² quadrats) at ICRAF laboratories in Nairobi

Justification of choice of data or description of measurement methods and procedures applied	SOC is a parameter in the SNAP soil carbon model..
Any comment:	

After crediting periods long enough to detect changes in SOC at sampling stations, e.g. 5-7 years, the soil organic carbon $SOC_{m,j,z}$ will also be re-measured in order to re-validate and recalibrate the SNAP soil carbon model.

Data Unit / Parameter:	$SOC\%_{j,m,z}$
Data unit:	Dimensionless proportion
Description:	Proportion soil organic carbon at station j in stratum m at time (year) = Z, the number of years sufficient for changes in SOC at individual sampling stations
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	Measured SOC necessary to detect changes in SOC in the project that will be used to re-validate and if necessary, recalibrate-the soil carbon model of choice. Tracked at the level of $j = 1$ to z_m individual sampling stations in each stratum because that provides the most rigorous test of a soil carbon model.
Any comment:	

Data Unit / Parameter:	$BULK_{j,m,z}$
Data unit:	g/cm^3

Description:	Bulk density in stratum m, station j, year Z
Source of data:	Measured in project area
Justification of choice of data or description of measurement methods and procedures applied	Necessary to convert proportion of SOC in soil to mass of SOC/volume following changes in SOC, after Z crediting years 5-7 crediting years
Any comment:	

In addition, data to verify activity will be presented. These data include satellite images showing bi-monthly 15 day composite EVI (images will be available) and used to calculate mean NDVI scores for every 15-day period each year within designated grazing blocks within each Conservancy over the monitoring period. These data will then be used to calculate a change in NDVI ($\Delta\text{NDVI} = \text{earlier NDVI} - \text{later NDVI}$, with more positive values indicating stronger impacts, Fig. 23) between images, which serves as a measure of livestock impact on forage during the 15 days between composite images, as compared to the baseline and calibrated to ungrazed inaccessible areas to estimate grazing intensity (see section 5.4.2 for more details).

Data Unit / Parameter:	$\text{NDVI}_{jm,Z}$
Data unit:	Dimensionless fraction
Description:	Vegetation index calculated from MODIS spectral imagery (available at NOAA website)
Source of data:	MODIS 15 day composite calculations of NDVI for tile 21,9
Justification of choice of data or description of measurement methods and procedures applied	Metric associated with standing herbaceous biomass, ranging from negative (water) to 1 (densest green rainforest canopy). Allows estimate of forage availability (Fig. grazing intensity from satellite imagery)

Any comment:

8.3.2 Project impacts on biodiversity

Biodiversity monitoring will focus on the response of plant, bird, grasshopper and dung beetle species richness and Shannon-Wiener diversity index to different land uses on different soil types important to biodiversity. Biodiversity camps will be expanded from three to five to better represent the project area. Baseline data that allow a comparison of areas subject to planned vs. continuous grazing (Fig. 17, section 8.1.4) suggest that project activities will increase biodiversity of key biodiversity groups.

8.3.3 Project impacts on communities

Key social survey questions, both as household surveys and focus groups, were developed to measure the impacts of the project on communities and the development of natural, financial, physical, social, and human capital. The example questionnaires for focus groups and household surveys provides a summary of the key information that will be for comparing baseline to project scenarios and thus determining the project impact on local communities. For the baseline social assessment, **focus groups** were conducted in three Conservancies, Il Ngwesi, Kalama, Nakuprat-Gotu, covering four of the five major ethnic groups in the project area: Maasai, Samburu, Turkana, Borana. **Household surveys** were conducted in 1012 households within four Conservancies: Il Ngwesi, Kalama, Nakuprat-Gotu, Melako, and included significant samples of Maasai, Samburu, Turkana, Rendille, and a small sample of Borana.

Future social data gathering will expand on this baseline to sample Samburu dominated communities in Namunyak, and Borana-dominated communities in Biliqo Bulesa and the total number of households to exceed 1500 households (nearly 15% of the households in the entire project area). Focus groups were performed by TNC and NRT staff, while members of each Conservancy will be employed and trained to conduct household surveys in their home Conservancies as part of NRT's Social CoMMs initiative to develop self-monitoring capacity within each Conservancy.

8.3.3.1 Focus groups

Focus groups were convened by invitation of 6-8 community elders, 6-8 adult women, and 6-8 young men (morani). Groups were asked a series of questions related to perceived benefits of establishing Conservancies, challenges and weaknesses in their effectiveness, their ability to maintain traditions, and what improvements are most needed. Focus groups were a clear means to identify key issues affecting women and how they might differ from those of both older and younger men.

Table 12. Questions addressed and to which subsets of society in northern Kenya pastoralist communities.

Question	Elders	Women	Morani
Number of respondents	6-8	6-8	6-8
Are you aware of conservancy functions?			
What role does the conservancy play in the community in general?			
What role does the conservancy play in your day to day life?			
Are you aware of any activities or projects the conservancy has done in your area			
In your opinion were the conservancy activities in your area effective?			
In your opinion are conservancy resources used fairly?			
What types of conflict have you seen in your			
What role does the conservancy play in your day to day life?			
How does conflict affect you daily life?			
What are the key things that make you feel safe and secure?			
What do you do when it is safe that you wouldn't normally do when it is insecure? How does your daily life change?			
What do you consider your strongest and most important traditions?			
Which traditions do you feel you are losing as a community?			
Which traditions do you most want to maintain and foster?			
Have your traditional practices changed since the conservancy started? How?			
Do you feel that the conservancy helps support your traditions?			
What role does the conservancy play in your day to day life?			
What do you see as biggest advantages of being in a conservancy?			
What you see as the biggest disadvantage of being in a conservancy?			
What is the one thing you would like the conservancy to monitor?			

8.3.3.2 Household Surveys

Interviews and data gathering occurred in more than 1000 households in October, 2014. These included multiple ethnic groups and included sufficient information on economic status and assets to assess and identify the poorest 25% and to separate households headed by women vs ones headed by men. Here the survey is shown to demonstrate the types of data and questions asked and show that responses will assess all six major types of social capital.

SECTION A: RESPONDENT AND HOUSEHOLD CHARACTERISTICS

1. Please help me to make a complete list of the people who normally sleep and eat their meals together in this household, starting with the household head, then the immediate family and extended family.								
	1	2	3	4	5	6	7	8
ID - Code	Name	Relationship of (NAME) to the household head?	Is (NAME) male or female? 0= Male 1= Female	How old is (NAME)? 99= Don't Know	What is (NAME)'s marital status? 1= Married/Living together 2= Divorced/Separated 3= Widowed 4= Never married	Has (NAME) ever attended school? 0= No 1= Yes	What is the highest level of school (NAME) has attended?	What is the main activity of (NAME)?
1		1						
2								
3								
4								
5								
6								
7								
8								
9								
10								

RELATIONSHIP TO HEAD OF
HOUSEHOLD CODES

- 1= Household head
- 2= Wife or Husband
- 3= Son or daughter
- 4= Son-in-law or Daughter-in-law
- 5= Grandchild
- 6= Parent
- 7= Parent-in-law
- 8= Brother or Sister
- 9= Other Relative
- 10= Adopted/foster/stepchild
- 11= Not Related
- 99= Don't Know

EDUCATION LEVEL CODES

- 1= No formal education
- 2= Some primary school
- 3= Completed primary school
- 4= Some secondary school
- 5= Completed secondary school
- 6= More than secondary school

MAIN ACTIVITY

- 1= Livestock keeper
- 2= Farmer
- 3= Employee
- 4= Trader
- 5= Own Business
- 6= Unpaid family helper
- 7= Housewife
- 8= Student
- 9= Not Active
- 10= Other (Specify)

Q No.	Background Data	Codes
2.	How long has the household head lived in this area?	1= Up to 1 year 2= 1-5 years 3= 6-10 years 4= Over 10 years
3.	To which tribe does the household head belong?	1= Maasai 2= Samburu 3= Borana 4= Somali 5= Turkana 6= Pokot 7= Rendile 8= Lhamus 9= Meru 10= Pokomo 11= Gabra 12= Other, specify _____ 99= Don't know/won't say
SECTION B: HOUSEHOLD ASSETS AND INCOME		

4.	Does your household have: <CIRCLE ALL THAT APPLY>	1. Electricity 2. Paraffin lamp 3. Radio 4. Television 5. Mobile phone 6. Iron 7. Refrigerator 8. Generator 9. Clock or wrist watch 10. Bed or mattress 11. Settee or Sofa 12. Kerosene Cooker 13. Solar panel 14. Bicycle 15. Motorbike 16. Truck/Car																											
5.	Please indicate all the different activities that household members engage in to obtain income for the household <NOTE ALL THAT APPLY> RESPONSIBLE PERSONS CODES: 1= Mainly wife/ adult females 2= Mainly husband/ adult males 3= Both adult males and females 4= Mainly girls (<15) 5= Mainly boys (<15) 6= Mainly children, both girls and boys (<15) 7= All household members	<table border="1"> <thead> <tr> <th></th> <th>Responsible persons</th> </tr> </thead> <tbody> <tr><td>1. Crop sales</td><td></td></tr> <tr><td>2. Livestock sales</td><td></td></tr> <tr><td>3. Livestock product sales (i.e. milk, skins etc.)</td><td></td></tr> <tr><td>4. Business/petty trade</td><td></td></tr> <tr><td>5. Firewood/Charcoal sales</td><td></td></tr> <tr><td>6. Natural resources (salt, gum, incense, honey)</td><td></td></tr> <tr><td>7. Other natural resources</td><td></td></tr> <tr><td>8. Casual labor</td><td></td></tr> <tr><td>9. Salary</td><td></td></tr> <tr><td>10. Remittances/ gifts</td><td></td></tr> <tr><td>11. Other (Specify below)</td><td></td></tr> <tr><td></td><td></td></tr> </tbody> </table>		Responsible persons	1. Crop sales		2. Livestock sales		3. Livestock product sales (i.e. milk, skins etc.)		4. Business/petty trade		5. Firewood/Charcoal sales		6. Natural resources (salt, gum, incense, honey)		7. Other natural resources		8. Casual labor		9. Salary		10. Remittances/ gifts		11. Other (Specify below)				
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6.	Please indicate how important these activities are for household income? Please divide the 10 stones I have given you over the different activities, with more important activities receiving more stones.	<table border="1"> <thead> <tr> <th></th> <th>Number of stones</th> </tr> </thead> <tbody> <tr><td>1. Crop sales</td><td></td></tr> <tr><td>2. Livestock sales</td><td></td></tr> <tr><td>3. Livestock product sales (i.e. milk, skins etc.)</td><td></td></tr> <tr><td>4. Business/petty trade</td><td></td></tr> <tr><td>5. Firewood/Charcoal sales</td><td></td></tr> <tr><td>6. Natural resources (salt, gum, incense, honey)</td><td></td></tr> <tr><td>7. Casual labor</td><td></td></tr> <tr><td>8. Salary</td><td></td></tr> <tr><td>9. Remittances/ gifts</td><td></td></tr> <tr><td>10. Other (Specify below)</td><td></td></tr> <tr><td>11.</td><td></td></tr> </tbody> </table>		Number of stones	1. Crop sales		2. Livestock sales		3. Livestock product sales (i.e. milk, skins etc.)		4. Business/petty trade		5. Firewood/Charcoal sales		6. Natural resources (salt, gum, incense, honey)		7. Casual labor		8. Salary		9. Remittances/ gifts		10. Other (Specify below)		11.				
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7.	How would you describe household income over the past 3 months?	1= Reliable, able to meet needs 2= Unreliable, not able to meet needs 3= None at all, not able to meet needs																											
8.	Did you or any member of the household do any casual work in the past two weeks?	0= No 1= Yes																											

9.	How do you compare your household's income during these past 12 months with the previous year?	1= Increased 2= Same as previous year 3= Decreased 99= Don't know																																																								
10.	Does the household own any of the following livestock?	<table border="1"> <thead> <tr> <th></th><th>None</th><th><10</th><th>10-50</th><th>51-100</th><th>101-150</th><th>>150</th></tr> </thead> <tbody> <tr> <td>1. Cattle</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>2. Donkeys</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>3. Sheep</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>4. Goats</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>5. Camels</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>6. Chickens</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>7. Other (specify)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>		None	<10	10-50	51-100	101-150	>150	1. Cattle							2. Donkeys							3. Sheep							4. Goats							5. Camels							6. Chickens							7. Other (specify)						
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7. Other (specify)																																																										
11.	Are any of your livestock sick at present?	0= No 1= Yes 99= Don't Know																																																								
12.	In the past week, did you sell any: <CIRCLE ALL THAT APPLY>	1= Cattle 2= Donkeys 3= Sheep 4= Goats 5= Camels 6= Chickens																																																								
13.	Did you or anyone in your household sell any milk yesterday?	0= No 1= Yes 99= Don't Know																																																								
SECTION C: HEALTH																																																										
14.	In the past 7 days, did you or anyone in the household eat meat?	0= No 1= Yes 99= Don't Know																																																								
15.	Did you or anyone in the household drink milk yesterday?	0= No 1= Yes 99= Don't Know																																																								
16.	Have you or any of the adults been sick in the past two weeks?	0= No 1= Yes 99= Don't Know																																																								
17.	Are any of the children sick?	0= No 1= Yes 99= Don't Know																																																								
SECTION D: CONSERVANCY PERCEPTIONS AND INTERACTIONS																																																										
18.	In the past year has the conservancy done any projects or activities in your village?	0= No 1= Yes, specify _____ 99= Don't Know																																																								
19.	In your opinion are Conservancy benefits distributed fairly?	0= No 1= Yes 99= Don't Know																																																								
20.	Do you feel that your opinion is adequately represented in conservancy decisions?	0= No 1= Yes 99= Don't Know																																																								
21.	Are you satisfied with the work the conservancy is doing?	0= Not at all satisfied 1= Yes, Somewhat satisfied 2= Yes, Very satisfied 99= Don't Know																																																								
22.	Have you or anyone in your household been employed by the conservancy in the past 12 months? Casual or permanent?	0= No 1= Yes 99= Don't Know																																																								

23.	Did you or anyone in your household attend the last conservancy Annual General Meeting?	0= No 1= Yes 98= Don't Know
SECTION E: GRAZING MANAGEMENT		
24.	Does your community have a grazing plan?	0= No <SKIP TO Q30> 1= Yes 98= Don't Know
25.	Do you feel the grazing plan is helpful?	0= No 1= Somewhat helpful 2= Very helpful 98= Don't Know
26.	How would you rate the quality grazing lands in this area?	1= Very good quality 2= Good quality 3= Average quality 4= Poor quality 5= Very poor quality
SECTION F: WILDLIFE BENEFITS AND CONFLICT		
27.	Does your household derive any cash or in kind benefits from wildlife?	0= No <SKIP TO Q29> 1= Yes 98= Don't Know
28.	If yes, what types of benefit do you derive? <NOTE ALL THAT APPLY>	1= Income from tourism 2= Employment 3= Bursaries 4= Income from craft sales 5= Food 6= Cultural 7= Enjoy seeing wildlife 8= Other, specify _____
29.	Have you experienced any problems with wildlife in the past six months?	0= No <SKIP TO Q31> 1= Yes 98= Don't Know
30.	If yes, what types of problems have you experienced? <NOTE ALL THAT APPLY>	1= Harm or disturbance to livestock 2= Grazing competition 3= Competition for water sources 4= Threats to family members 5= Property damage 6= Crop damage 7= Other, specify _____
31.	In your opinion are problems with wildlife in the community:	1= Increasing 2= Declining 3= The same 98= Don't know
SECTION G: CONFLICT AND SECURITY		
32.	Do you consider your community to be:	1= Safe 2= Neither safe nor unsafe 3= Unsafe 98= Don't know
33.	Compared to 12 months ago, how is the security in your community	1= Improved 2= The same 3= Worsened 98= Don't know
34.	Do you feel safe enough?	0= No 1= Yes 98= Don't Know

PROJECT IMPLEMENTATION REPORT:

VCS Version 3; CCB Standards Third Edition

35.	In your opinion, what are the 3 most common types of conflict in your community? Please rank 1, 2, 3.	1= There are no disputes 2= Disputes about livestock raiding 3= Disputes about other property 4= Grazing land disputes 5= Disputes about water sources 6= Land / boundary disputes 7= Disputes about charcoal burning area 8= Farm disputes 9= Other, specify _____ 98 = Don't know	1. 2. 3.
36.	Have you witnessed or heard of any conflict in the past two weeks?	0= No <SKIP TO Q42> 1= Yes 98= Don't Know	
37.	Was it resolved peacefully?	0= No 1= Yes 98= Don't Know	
38.	Have you heard of any livestock theft or road banditry in the past two weeks?	0= No 1= Yes	
SECTION H: CELL PHONE MONITORING			
39.	In the future, we can make this process simpler and quicker if we send information via mobile phone. Would you be willing to participate in a mobile phone survey in future?	0= No 1= Yes	
40.	If yes, could you provide your cellphone number?	Cell number: _____ Name: _____	

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