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**FOREST AND LANDSCAPE RESTORATION OPPORTUNITIES ASSESSMENT  
FOR MT. KULAL BIOSPHERE RESERVE, MARSABIT COUNTY  
KENYA**



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**TECHNICAL REPORT**

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**Cover page pictures:** A photo of Wola, one of the many gorges in Mt. Kulal and ROAM stakeholders meeting in Gatab, Mount Kulal

(Photo credit: Winjoy Kageni, NMK and Jonah Kiprop, KEFRI)

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## **ABBREVIATIONS AND ACRONYMS**

|       |  |
|-------|--|
| ASALs | Arid and Semi-Arid Lands                                     |
| BCR   | Benefit Cost Ratio   |
| CBA   | Cost Benefit Analysis  |
| EAA   | Equivalent Annual Annuity                                    |
| EMCA  | Environmental Management and Co-ordination                   |
| FAO   | Food and Agriculture Organisation                            |
| FLR   | Forest Landscape Restoration                                 |
| GoK   | Government of Kenya  |
| IPCC  | Intergovernmental Panel on Climate Change                    |
| IRR   | Internal Rate of Return                                      |
| ISRIC | International Soil Reference and Information Centre          |
| IUCN  | International Union for Conservation of Nature               |
| KALRO | Kenya Agricultural and Livestock Research Institute          |
| KEFRI | Kenya Forestry Research Institute                            |
| KES   | Kenya Shillings  |
| KFS   | Kenya Forest Service   |
| NPV   | Net Present Value  |
| REDD+ | Reducing Emissions from Deforestation and Forest Degradation |
| ROAM  | Restoration Opportunities Assessment Methodology             |
| SDG   | Sustainable Development Goals                                |
| SLM   | Sustainable Land Management                                  |
| UNCCD | United Nations Convention to Combat Desertification          |
| WRI   | World Resources Institute                                    |
| WWF   | World Wildlife Fund  |



## EXECUTIVE SUMMARY

This report presents the findings of the first Sub-National Forest Landscape Restoration Assessment (SNFLRA) undertaken for Mt. Kulal Forest and landscape. The SNFLRA process was launched in December 2020 by the Kenya Forestry Research Institute, Food and Agriculture Organization of the United Nations and other concerned stakeholders. The Mt. Kulal Forest and landscape assessment was designed to identify needs and opportunities for the restoration of the productivity and ecological function of degraded landscapes in Mt. Kulal Forest that contributes in ensuring Kenya achieves sustainable development goals related to food, water, and livelihood security and climate resilience.

This SNFLRA report, provides data, analyses and vision to achieve sub-national landscape restoration in Mt. Kulal Forest and landscape. Successful restoration is achieved by strategically addressing the drivers of land degradation that limit the overall ecosystem functioning. In addition, this report provides the framework for restoration of landscapes thus contributing towards achieving Kenya's commitment of 5.1-million-hectare national restoration commitment to the African Forest Landscape restoration Initiative (AFR100) under the Bonn Challenge. The SNFLRA process involved a series of activities that were geared towards assessing the restoration opportunities for the Mt. Kulal forest landscape.

**The SNFLRA Process:** The SNFLRA process took into cognizance of the importance of stakeholder engagement throughout the process. The process began with the training of key technical personnel drawn from Kenya Forestry Research Institute, Kenya Forest Service, National Museums of Kenya, Kenya Wildlife Service, Wazee wa Mazingira and county government of Marsabit representatives. The core implementation team was trained by experts from IUCN and WRI. The team was taken through the ROAM process and were equipped with the necessary skills for undertaking the sub-national forest landscape restoration opportunities assessment.

A data mining Worksop was then held in February 2021. The workshop was organized by KEFRI in collaboration with FAO-Kenya. The Worksop involved stakeholders working in Mt. Kulal landscape. The stakeholders included: Kenya Forest Service (KFS), National Museums of Kenya (NMK), Kenya Wildlife Service (KWS), County Government of Marsabit, and Ministry of Environment and Forestry. The objective of the Worksop was to take stock of existing data for Mt. Kulal landscape which was used in the ROAM assessment. Specific objectives included to: Define the land degradation problem; Undertake data information

mining on biophysical issues of the two landscapes; Undertake data mining on socio-economics aspects of the two landscapes; Undertake stakeholder identification and mapping for Mt. Kulal landscape; Undertake stratification of the landscape and Develop a ROAM workplan.

The ROAM assessment was then undertaken through series of stakeholder workshops held in Gatab and Arapal within the landscape. Stakeholders were also drawn from wazee wa mazingira group and other community from Mt. Kulal landscape. The stocktaking and mapping technical team completed two complementary spatial assessments, one which focused on the identification of appropriate areas for prioritized restoration interventions, and a multi-criteria analysis that used spatial data to help prioritize investment in FLR interventions. The policy and institutional technical team researched and delineated the laws, policies, and practices that both supported and hindered restoration activities in Kenya. Their analysis is based on interactions with key policy makers and a thorough review of Kenya's enabling framework as well as international laws and conventions.

The economics and finance technical team used the results of the intervention mapping to perform a cost benefit analysis on the transitions to "restored" land uses based on the financial capital and opportunities costs of each restoration transition and its estimated area in Mt. Kulal landscape. The financial analysis determined the total investment needed in FLR for Mt. Kulal landscape to achieve its restoration objectives and recommends ways these costs can be borne by both public and private financing sources.

SNFLRA activities were designed using the tools and methods documented in the publication 'Assessing forest landscape restoration opportunities at the national level: A guide to the Restoration Opportunities Assessment Methodology (ROAM)' (IUCN & WRI, 2014), which provides a flexible framework to rapidly assess the opportunities for forest landscape restoration (FLR) at the national and sub-national levels.

**Key Findings:** Stakeholder consultations identified a number of biophysical (Soil erosion; Invasive species; Deforestation; Climate change; Reduced crop yields; Loss of biodiversity; Loss of vegetation cover; Reduced rangeland health; and Pollution from charcoal production) and socioeconomic (Limited income sources leading to unsustainable sand and charcoal production; Overgrazing; Land tenure issues; Limited entrepreneurial culture; Overdependence on forests; Fire incidences; Human-wildlife conflicts; Encroachment for agriculture activities; and Poor infrastructure development) challenges related to land use that are most critical for

restoration to address in Mt. Kulal landscape. To address these land use challenges, five priority FLR interventions (Rehabilitation of degraded natural forests; Agroforestry on Cropland; Tree-based Buffer Zones along roads; Tree-based Buffer Zones along Water Bodies and Wetlands; and Rangeland's restoration) were identified through stakeholder consultations as having potential for implementation in the Mt. Kulal forest landscape. The areas available for each of these interventions were then calculated in a GIS using a series of biophysical criteria to determine the hectares available for each intervention within Mt. Kulal forest landscape. In total, nearly 130,978 hectares have potential for restoration. Restoration opportunities potential per option in Mt. Kulal landscape is as follows: Rehabilitation of degraded natural forests (46,687 ha); Agroforestry on Cropland (612.5 ha); Tree-based Buffer Zones along roads (1,257.06 ha); Tree-based Buffer Zones along Water Bodies and Wetlands (798.4 ha); and Rangeland's restoration (81,623 ha).

In terms of economic analysis of the restoration options, the findings revealed that the transition for each option is economically viable since they have the ability to pay for themselves within a 30 -year time period. The economic benefits achieved through these interventions are sale of firewood, carbon sequestration, water flow regulation, air quality improvement, provision of shade, aesthetic, maize, timber, fruits, soil fertility improvement, provision of grass and hay, sale of bamboo culms and soil erosion prevention. A total of KES 27,504,661,602 is required for undertaking restoration in Mt. Kulal within a 30-year period. The cost of restoration per option in Mt. Kulal landscape is as follows: Rehabilitation of degraded natural forests (KES 7,343,398,230); Agroforestry on Cropland (KES 313,421,150); Tree-based Buffer Zones along roads (KES 36,029,854); Tree-based Buffer Zones along Water Bodies and Wetlands (KES 481,527,016); and Rangeland's restoration ( KES 19,330,285,352). To ensure successful implementation of forest and landscape restoration programmes and plans, different financing mechanisms ranging from global commitments and pledges, regional and sub-regional partnerships with financial institutions such as African Development Bank (AfDB), World Bank; national budget to public private partnership financing models are proposed.

This analysis provides the information necessary to design FLR interventions that can be implemented with specific attention paid to the severity and type of degradation in these areas, and the contributions landscape restoration can make to food security, resilience against climate change, and biodiversity conservation. This necessary information can now be integrated into county planning for social and economic resilience and can unlock different streams of financing for restoration.

# INTRODUCTION

## 1.1. Background Information

Forest and landscape degradation are a serious global problem. It is estimated that between one to six billion hectares of land globally is degraded (Gibbs & Salmon, 2015), that cost an estimated 230 billion USD annually (Nkonya *et al.*, 2016). The degradation poses a major threat to global food security and achievement of the Sustainable Development Goals (SDG's) thus compromising the well-being of at least 3.2 billion people around the world. The main cause of degradation is through conversions of forests to alternative land uses which has impacted negatively on productivity and diminished the flow of products and services for human well-being.

The idea of Forest and Landscape Restoration (FLR) was mooted more than 20 years ago to focus more on restoration beyond the industrial plantations and more involvement of people (IUCN & WRI, 2014). This was informed by the fact that continued land degradation has long-term effects on the overall human wellbeing, hence the need to address the issue to avoid negative impacts. However, it was until 2015 when, Forest landscape restoration received global endorsement through the Bonn Challenge. The global community pledged to restore 150 million hectares of the world's deforested and degraded land by 2020, and 350 million hectares by 2030 ([www.bonnchallenge.org/content/challenge](http://www.bonnchallenge.org/content/challenge)). Underlying the Bonn Challenge is the Forest and Landscape Restoration (FLR) approach, which aims to restore ecological integrity and improve human well-being through multifunctional landscapes.

In Kenya's Arid and semi-arid lands (ASALs) which constitute about 80 % of land cover, deforestation and land degradation is largely driven by unsustainable forest use by communities, including logging for construction materials and fuelwood, overgrazing, land use change, and wildfires, and is aggravated by population growth and the lack of alternatives livelihoods. Deforestation and land degradation threaten vital ecosystem services, and lead to loss of biodiversity and conflict, especially in a context of increased droughts due to climate change and poor water management. While several forest and land management policies and laws have been adopted, policy and capacity gaps remain (KFS, 2014).

The Government of Kenya has taken various steps in terms of policy measures to increase its tree cover and restoring the ecosystem services in support of the country's pledge of its economic, environmental and developmental goals. Kenya's pledge to the Bonn Challenge is to restore 5.1 million hectares by 2030. This includes national strategy for achieving and

maintaining over 10% tree cover by 2022 (GOK, 2019) and Land degradation neutrality target setting for Kenya (GOK, 2018). Furthermore, National Climate Change Action Plan call for growing 7.6 billion trees on 4.1 million ha of land during the next 20 years (GOK, 2018) This will require a substantial number of resources, both financial and technical from the government of Kenya, development partners and other agencies. The project – ‘Restoration of Arid and Semi-arid Lands of Kenya through Bio-enterprise Development and Other Incentives’ Under

The Restoration Initiative (TRI) is one of the project supporting the government to realize the restoratio targets. The project is being executed by FAO with KEFRI as the lead National implementing institution. The other key partners include Kenya Forest Service (KFS), Kenya Wildlife Service (KWS), National Museums of Kenya, Northern Rangeland Trust, Gums and Resins Association of Kenya (GARA), the County governments of Marsabit, Isiolo and Laikipia, Community Forest Associations, Non-state actors, private sector actors and CBOs. The Project is being implemented in: Mount Kulal Biosphere Reserve (Marsabit County) and Mt. Kulal Forest and landscape (Laikipia and Isiolo counties). The overall objective of the project is to: restore deforested and degraded lands through the Forest Landscape Restoration (FLR) approach and enhance the socio-economic development of local communities through development of bio-enterprises of Non-Timber Forest Products and Services (NFTPS) in ASALs. The project strategy is built around four components. Component 1: Policy development and integration aims to build the gap from the FLR policy to a strategy, and to support the decentralization of FLR policy and the development of a NFTPS policy. Component 2 focuses on the implementation of FLR actions in two specific landscapes and the development of NTFPS bio-enterprises and includes an assessment of ecosystem services on project sites. Component 3 strengthens capacity of counties and communities to implement and coordinate FLR. Finally, Component 4 supports knowledge management and monitoring on FLR in Kenya, as well as knowledge sharing with other TRI projects.

As part of its commitments to the Bonn challenge and Forest Landscape restoration to restore degraded land, Kenya has committed to restore of 5.1 million hectares by 2030 out of which only 1 million ha is planned to be from restoration of forestlands while the rest will be from other landscapes especially in the ASALs. This will contribute to the Africa Forest Landscape Initiative (AFR100), 50% reduction of greenhouse gases from the forest sector by 2030 as part of its Nationally Determined Contribution (NDC) to climate change, and to achieve land degradation neutrality by 2030 as a commitment to United Nations Convention to Combat

Desertification (UNCCD) So far, a national assessment of the feasible restoration options has been undertaken through mapping restoration opportunities (KFS , 2016). The restoration opportunities were generated using potential natural vegetation maps among other spatial products. The report highlights restoration opportunities within the forest, rangelands, crop land, riparian areas and other lands. There is a need for developing ROAM at landscape level taking into consideration the actual land use and participatory derived interventions.

## **1.2. Objectives of Restoration Assessment Methodology (ROAM) for Mt. Kulal Landscape**

Restoration Opportunities Assessment Methodology (ROAM) framework is a multi-stakeholder driven process that guides in assessing opportunities for restoration at National, Sub national or landscape level. This ROAM assessment was undertaken for Mt. Kulal landscape to deliver six products namely;

- A shortlist of the most relevant and feasible restoration intervention types within Mt. Kulal landscape
- To identified priority areas for restoration within Mt. Kulal landscape;
- To quantified costs and benefits of each intervention types idented;
- To estimate values of additional carbon sequestered by these intervention types;
- To undertake a diagnostic of the presence of key success factors and identification of strategies to address major policy, legal and institutional bottlenecks; and
- An analysis of the finance and resourcing options for restoration within Mt. Kulal landscape

## DESCRIPTION OF MOUNT KULAL LANDSCAPE

### 2.1. Biophysical and Socio-Economic description of Mt. Kulal Landscape

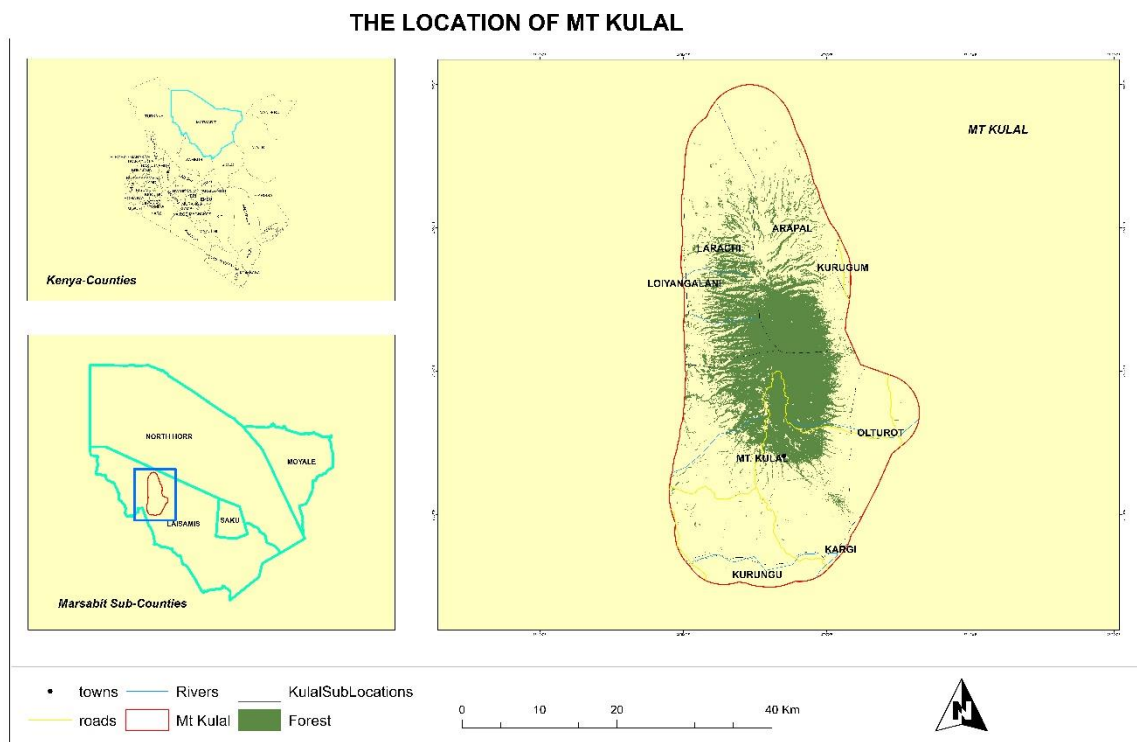
Mount Kulal Biosphere Reserve (MKBR) in Marsabit County covers approximately 7 000 km<sup>2</sup> extending from the eastern side of Lake Turkana to the top of Mount Kulal, where the core zone measuring 11 km<sup>2</sup> is located. It lies between 36° 02' and 37° 02' E latitude and 02° 56' and 02° 58' N longitude and altitude of 350- 2335 m above sea level. Gatab is a village situated on Mt Kulal near its southern end. It is mainly dominated by the Samburu with a few Rendille households. It is the most important village affecting the management of the southern block of Mt Kulal forest. Arapal is a village situated in dry lowlands to the northeast of Mt. Kulal (Forests of Mount Kulal, Kenya: Source of Water and Support to Local Livelihoods, 2007).

The soil types within the biosphere vary based on topographical positions. The mountain slopes are covered with humic Nitisols and Acrisols in case of the basement formations and the lower volcanic areas, and deep humic Andosols above about 2,700 m (Mackel, 1986; Mackel & Schultka, 1988; Mackel & Walter, 1983; Schmitt, 1991; Speck, 1983). At the middle upper slopes, the soils are clay loam (Leenaars et al., 2014 & Bussmann, 2002). The soils of the plains consist mainly of Vertisols, Regosols, Lithosols and Cambisols. On the lower slopes are shallow to moderately deep calcareous soils with texture of stony, gravelly, sandy clay loam to sandy clay. According to Jatzold (1977, 1981), Mt. Kulal is part of the hot, arid tropical climate, with two short, subhumid seasons, with mean monthly daytime temperatures of 26-20°C in the plains, and 17-19°C in the mountains (Gatab, 1,657 m). The main rainfall is concentrated in two wet seasons, from March-May and October-December; extreme rainfalls occur, and e.g., 175 mm within 6 h in Gatab on Mt Kulal (Mackel & Walter, 1983). However, there is great inter-annual variation with some years having one or no rainy season.

The Mount Kulal Biosphere Reserve has three main types of habitat; the mountain top habitat, the flanks, gorges and valleys and the surrounding flat lands all being niches to unique biodiversity. The most prominent components of that are the terrestrial flora and fauna and the fish of Lake Turkana. The mountain slopes are characterized by unique flora which include plants of high potential such as *Olea europaea* sub sp *africana*, *Euclea divinorum*, *Podocarpus falcatus*, *Juniperus procera*, *Myrsine africana*, *Rhus natalensis* and *Vepris simplicifolia*. The middle upper plains are characterized by the presence of different species of *Boscia*, *Maerua*, *Commiphora*, *Aloe* and *Acacia* including the *Acacia senegal* with high potential for gums,

*Boswellia neglecta* and *Commiphora holtziana* exploited for resins, *Aloe kulalensis*, *A. lateritia*, *A. scabrifolia*, *A. secundiflora* as well as the endangered *Osyris lanceolata*. The grass species found within the lower plains of the ecosystem include *Cenchrus cenchroides*, *Chloris pycnothrix*, *Eragrostis aspera*, *E. patula* and *Aristida* spp. There are several species of fauna including the endemic Kulal White-eye *Zosterops kulalensis*.

It is estimated that the period between 1990 and 2010 oversaw a decrease in forest cover from 7.9% to 5.9%, equivalent to a loss of 1.18 million hectares. Generally, agricultural/cultivated areas increased by 7.3% while bare lands increased by 2.6%. The most significant loss of vegetation occurred between 1990 and 2000 when 0.8% of forest cover was lost, with a corresponding increase in the bare land by 4%. Major impact was seen around Gatab area with patches of open forest emerging up to 2000m (GoK., 2016).



**Figure 1:** Map showing the location of Mt Kulal

## 2.2. Demographic information of Mt. Kulal landscape

Loiyangalani sub-county where Mt Kulal forest falls is occupied by various community groups mainly the Turkana, Samburu, El Molo, Gabbra and Rendille. They keep animals such as sheep, goats, cattle, donkeys and camels. The Cushitic-speaking El Molo are the original people around Loiyangalani. Kulal is the Samburu (90%) and the Rendille (10%) which is considered



a sub-tribe. The Samburu predominate on the mountain, while the Rendille are more on the eastern lowlands. The indigenous communities have been responsible for the preservation and maintenance of traditional knowledge and practices that are highly relevant for sustainable use of biodiversity of Mount Kulal.

### 2.2.1. Administrative Division and Population

Mt Kulal Biosphere Reserve and Mt Kulal fall within Loiyangalani Sub- County (Laisamis constituency) of Marsabit County. According to the Kenya National Bureau of Statistics, Loiyangalani Sub- County is one of the seven sub-counties of Marsabit County, the others being Marsabit Central, Marsabit North, Marsabit South, Moyale, North Horr and Sololo (KNBS 2019). Mt Kulal Location where Mt. Kulal falls is divided into Arapal, Larachi, Gatab (Mt. Kulal) and Olturot sub-locations. It has an area of 2,780.7 sq. km and a population of 6,221 people consisting of 2,983 male and 3,237 female in 1,358 households. The population density is 2 persons per sq. km (Table 1). Mt. Kulal Location has about 1,358 households (1200 in 2007). About 90% is Samburu, 8% Rendille and the rest of the population is Turkana and Somali. The Rendille predominate in the eastern lowlands. Samburu predominate on the mountain and immediate lowlands. Gatab village (about 1700 m) on the southern end of Mt Kulal is the main centre and a bit cosmopolitan. Gatab has a health centre with good facilities run by AIC Mission. It also has a police station and an airstrip.

**Table 1: The characteristics of Mt Kulal location population Source: KNBS 2019**

| Sub-Location                        | Total        | Male         | Female       | Households  | Sq. Km         | Persons per Sq. Km |
|-------------------------------------|--------------|--------------|--------------|-------------|----------------|--------------------|
| ARAPAL                              | 1,063        | 506          | 557          | 264         | 1,080.5        | 1                  |
| LARACHI*                            | 283          | 157          | 126          | 52          | 13.7           | 21                 |
| MT. KULAL (GATAB)                   | 2,868        | 1,309        | 1,559        | 618         | 558.5          | 5                  |
| OLTUROT                             | 2,007        | 1,011        | 995          | 424         | 1,128.0        | 2                  |
| <b>Total for Mt. Kulal Location</b> | <b>6,221</b> | <b>2,983</b> | <b>3,237</b> | <b>1358</b> | <b>2,780.7</b> | <b>3</b>           |

### 2.2.2. Land tenure and land use

The land is communally owned. It is mainly used for grazing animals. The land in settled areas like Gatab has been subdivided into family portions.

### **2.2.3. Source of livelihoods**

The major sources of livelihoods of people living around and within Mt. Kulal biosphere reserve include pastoralism; honey; charcoal; subsistent farming and sale of non-timber forest products e.g., herbal products, gums and resins. Ecotourism and selling of red soil (ochre) for adornment is practised at a minimal scale. The Mount Kulal area is remote and living standards are low with majority of people living below the poverty line. The inhabitants of the landscape surrounding Mount Kulal rely on the ecosystems for herding and farming livelihoods while in turn having an undeniable impact on Gatab, the main settlement on the top of Mount Kulal is heavily dependent on forest products. The forest products used most often are poles for construction of local houses. However, the people are allowed to collect dead wood for fuel wood; cutting of living trees for fuel wood in the forests is controlled (Watkins & Imbumi, 2007). Livelihoods in Arapal on the other hand are based on pastoralism complemented with some subsistence farming on the top of Mount Kulal.

## **RESTORATION OPPORTUNITIES ASSESSMENT METHODOLOGY (ROAM)**

### **3.1.ROAM Process**

ROAM process is a rigorous systematic process developed by IUCN and WRI for assessing restoration opportunities at the national, subnational and landscape levels. The ROAM process for Mt. Kulal landscape was guided by the national assessment of forest and landscape restoration opportunities undertaken for Kenya in 2016 by Ministry of Environment and Forestry.

#### **3.1.1. Training of Local Resource Persons (LRP's)**

The ROAM process started with training of eighteen practitioners drawn from national government, county government, development partners and other key agents working in the project areas. The training was conducted from 24<sup>th</sup> to 26<sup>th</sup> August 2020 through a web-based video conference by facilitators from BBC Research & Consulting Partners of USA in collaboration with FAO-Kenya and Nature Kenya. The training was aimed to (1) provide participants with comprehensive training on Restoration Opportunities Assessment Methodology (ROAM) in FLR assessments at the National, Sub national or landscape level; (2) to prepare participants to lead own FLR assessments using ROAM and (3) to create a ROAM work plan for participants to apply ROAM to their programs and projects

#### **3.1.2. Stakeholders Data Mining Workshop**

A data mining workshop was undertaken from 14<sup>th</sup> to 18<sup>th</sup> February 2021. The workshop was organized by KEFRI in collaboration with FAO-Kenya. The workshop involved stakeholders working in Mt. Kulal and Mt. Kulal landscapes. The stakeholders included: Kenya Forest Service (KFS), National Museums of Kenya (NMK), County government of Marsabit, Kenya Wildlife Service (KWS), Laikipia wildlife forum, Mt. Kulal CFA, Northern Rangeland Trust (NRT) and Ministry of Environment and Forestry

The workshop's objective was to take stock of existing data for Mt. Kulal and Mt. Kulal landscapes to be used in the ROAM assessment. Specific objectives included to:

1. Define the land degradation problem in the two landscapes (Mt. Kulal and Mt. Kulal)
2. Undertake data information mining on biophysical issues of the two landscapes
3. Carry out data mining on socio-economics aspects of the two landscapes

4. Undertake stakeholder identification, analysis and mapping for each landscape (Mt. Kulal and Mt. Kulal)
5. Undertake stratification of the two landscapes
6. Develop ROAM plan for the two landscapes

### 3.1.3. Stakeholder Engagement

A multi-sector consultation workshop was conducted to introduce the concept and benefits of landscape restoration, and to gain an understanding of the land use challenges affecting Mt. Kulal and Mt. Kulal landscapes. The workshop participants identified the key land use challenges, drivers, effects as well as a list of restoration interventions that could potentially mitigate these challenges. A list of stakeholders working within the landscapes was also developed by the communities within the landscapes to help in the proposed restoration interventions. (Annex- attendance, all relevant materials developed during the engagement)



**Plate 1:** Stakeholders engagement during data mining (a) and Validation (b) workshops

### 3.1.4 Stakeholders Validation Workshop

A stakeholders validation workshop was held in Nanyuki on 24<sup>th</sup> June 2021 to present the findings to stakeholders and validate the results.

## SUMMARY OF KEY FINDINGS

### 4.1. Stakeholder Identification and Mapping for Mt. Kulal Landscape

A stakeholders' identification and mapping was undertaken to identify key actors who will be key in supporting planning, mobilization of resources and undertaking restoration activities with the Mt. Kulal landscape. A total of 26 key stakeholders were identified and profiled in terms of their roles and contribution in implementing and supporting restoration initiatives within Mt. Kulal Landscapes (Appendix 1).

### 4.2. Land Use Challenges, Drivers, Effects and Interventions

Land use challenges are defined as problems arising from the way land is used and/or managed. Based on how socioeconomic factors such as increase in population density, land tenure, shifting cultivation, lack of land use planning and policy as well as environmental factors such as changes in climatic patterns, availability of rainfall, wildlife habitat affect the way land is used and managed. Stakeholder consultations identified a number of biophysical and socioeconomic challenges related to land use that are most critical for restoration to address land-use challenges in Mt. Kulal landscape (Table 2). Detailed analysis of land-challenges, their drivers, effects and possible intervention are provided in Appendix 2.

**Table 2: Biophysical and Socio-economic land-use challenges identified by stakeholders as priorities for restoration for Mt. Kulal landscape**

| Biophysical challenges             | Socio-economic challenges   |
|------------------------------------|---|
| Soil erosion                       | Limited income sources leading to unsustainable charcoal production |
| Persistent drought                 | Insecurity  |
| Unreliable and erratic rainfall    | Overgrazing   |
| Deforestation                      | Land tenure issues  |
| Climate change                     | Water scarcity  |
| Reduced crop yields                | Illegal logging   |
| Loss of biodiversity               | Fire incidences   |
| Loss of vegetation cover           | Human-wildlife conflicts  |
| Reduced rangeland health           | Encroachment for agriculture activities                             |
| Pollution from charcoal production | Poor infrastructure development                                     |
| Low soil fertility                 | Poverty   |

To address these land use challenges, six priority FLR interventions (Afforestation and reforestation of natural forests; Rehabilitation of degraded natural forests; Agroforestry on Cropland; Commercial Tree and Bamboo Plantations; Tree-based Buffer Zones along Water Bodies and Wetlands and Rangelands restoration) were identified through stakeholder consultations as having the potential for restoring Mt. Kulal landscape. The areas available for each of these interventions were then calculated in GIS using a series of biophysical and socio-economic criteria to determine the hectares available for each intervention (Table 3).

**Table 3: Priority Restoration Interventions And The Estimated Opportunity Area Based On Geospatial Analysis**

| <b>No.</b>  | <b>Priority restoration intervention</b>                | <b>Opportunity area (ha)</b> |
|---|---|------------------------------|
| 1.  | Rehabilitation of degraded natural forests              | 46,687                       |
| 2.  | Agroforestry on Cropland                                | 612.5                        |
| 3.  | Tree-based Buffer Zones along roads                     | 1,257.06                     |
| 4.  | Tree-based Buffer Zones along Water Bodies and Wetlands | 798.4                        |
| 5.  | Rangeland's restoration                                 | 81,623                       |
| <b>Total Area in The Landscape with Opportunity for Restoration</b> |   | <b>130,978</b>               |

**Table 4: Landscape restoration options and their potential to partially address identified land use challenges for Mt. Kulal landscape**

| Land use challenges       | Rehabilitation of degraded natural forests | Agroforestry on Cropland | Commercial Tree and Bamboo Plantations | Tree-based Buffer Zones along Water Bodies and Wetlands | Rangelands |
|---------------------------|--|--------------------------|--|---|------------|
| Soil erosion              | X  | X                        | X                                      | X   | X          |
| Declining soil fertility  |  | X                        |  |   | X          |
| Illegal logging           |  | X                        |  |   |            |
| Climate change            | X  | X                        | X                                      | X   | X          |
| Persistent drought        | X  | X                        | X                                      |   |            |
| Loss of biodiversity      | X  | (X)                      | (X)                                    | X   | (X)        |
| Overgrazing               | (X)  | X                        |  | (X)   | X          |
| Overdependence on forests | (X)  | X                        | X                                      | (X)   |            |
| Water scarcity            | X  |                          |  | X   |            |

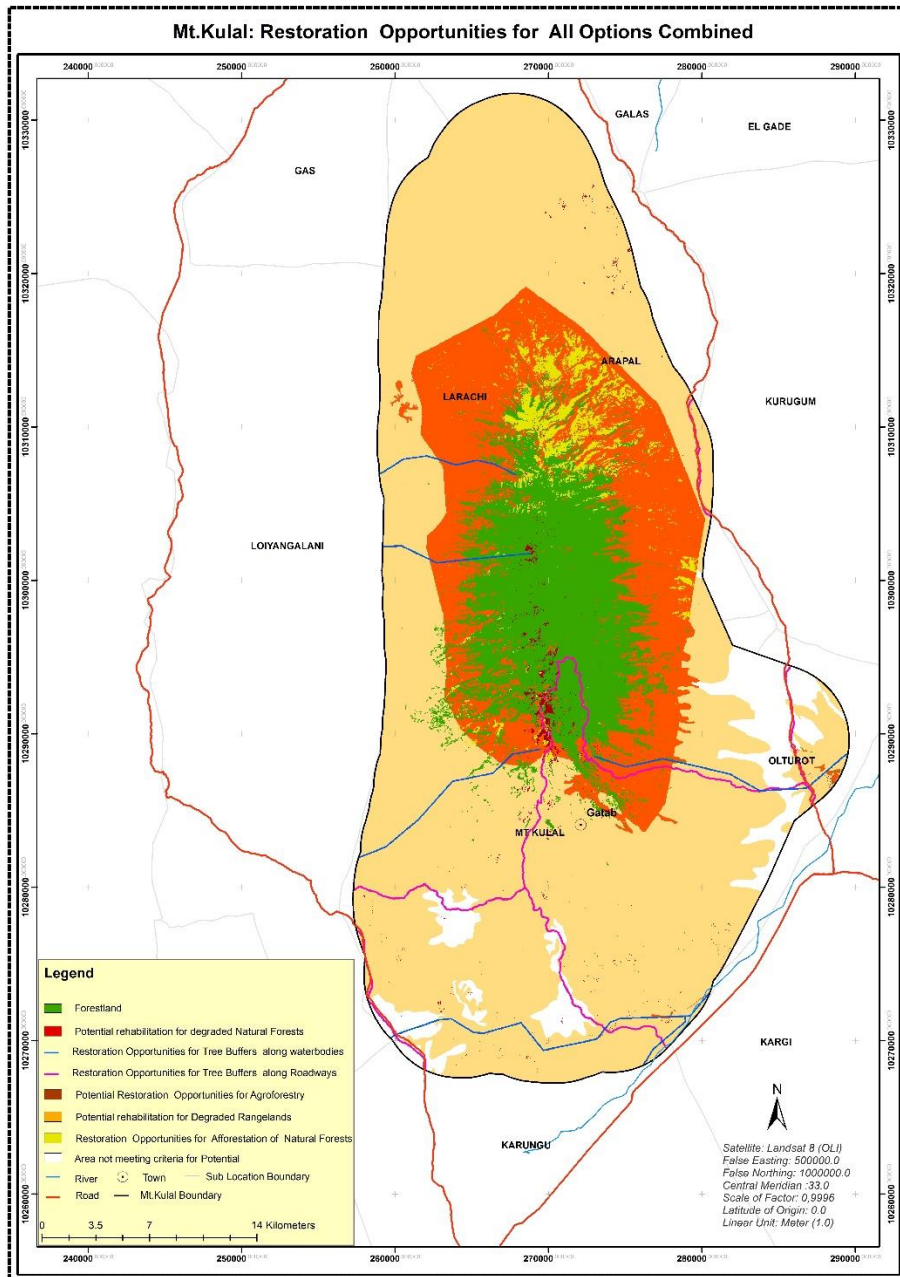
**Legend:**

X: this restoration option is important to address this land use challenge

(X): this restoration option is secondarily important to address this land use challenge

### 4.3. Restoration Interventions for Mt. Kulal Landscape

Interventions that could directly or indirectly help address the land use challenges listed above (Table 4) were identified and prioritized based on their potential to help in restoration and the main ecosystem services desired. The following 6 national landscape restoration opportunities were identified with a total opportunity area for restoration of **130,978 ha** for Mt. Kulal Biosphere Reserve (Figure 2).

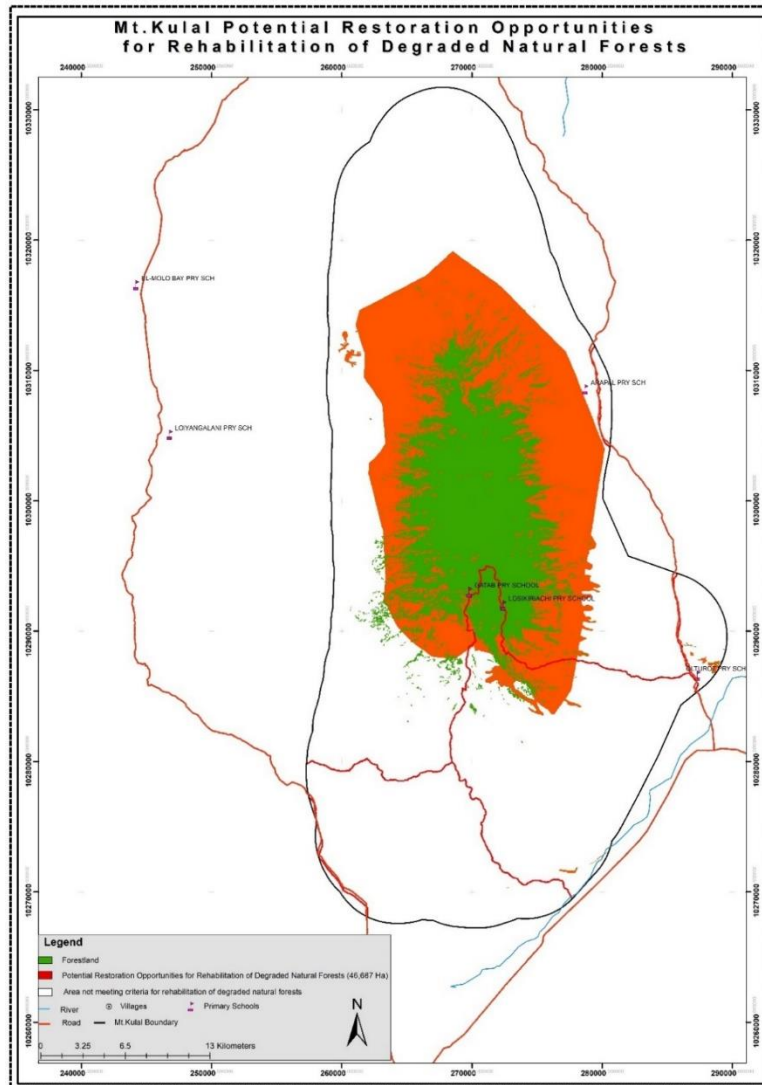


**Figure 2:** Restoration opportunities for rehabilitating Mt. Kulal Biosphere Reserve



#### 4.3.1. Restoration Opportunities for Rehabilitation of Degraded Natural Forests

This is a potential opportunity area for rehabilitating existing natural forests. A total of **46,687 ha** was identified and mapped for restoration under this approach (Figure 3). Plant species identified for rehabilitation in the mountain slopes included; *Olea europaea* subsp *africana*, *Euclea divinorum*, *Podocarpus falcatus*, *Juniperus procera*, *Myrsine africana*, *Rhus natalensis* and *Vepris simplicifolia* while different species of *Boscia*, *Maerua*, *Commiphora*, *Acacia* and *Boswelvia* were identified for the middle upper plains rehabilitation.

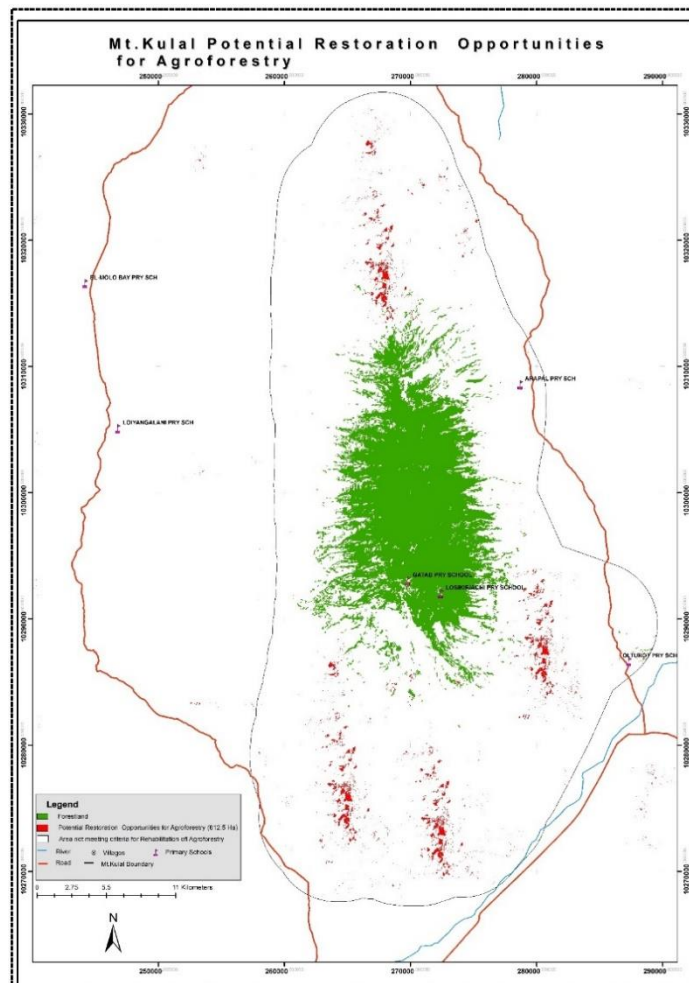


**Figure 3:** Restoration potential for rehabilitation of degraded natural forest in Mt. Kula

#### 4.3.2. Restoration Opportunities for Agroforestry on Cropland

Potential opportunity areas where on-farm trees or the use of agroforestry could be increased. This can be done through a number of different interventions such as field border plantings, woodlots,

agroforests, and inter-planting trees with crops. An area of approximately 612.5 ha (Figure 4) was identified to be suitable for restoration through agroforestry using different suitable plant species such as *Markhamia lutea*, *Osyris lanceolata*, *Podocarpus falcatus*, *Juniperus procera*, *Croton megalocarpus*, *Markhamia lutea*, Neem (*Azadirachta indica*), *Balanites aegyptiaca*, *Acacia senegal*, *Leucaena leucocephala*, *Senna siamea* and *Acacia tortilis*. Fruit plants (avocados, mangoes, oranges, bananas, pawpaws, passion, lemon, watermelon) were also identified as suitable for agroforestry in this area based on the specific elevation and rainfall of the specific area for planting.

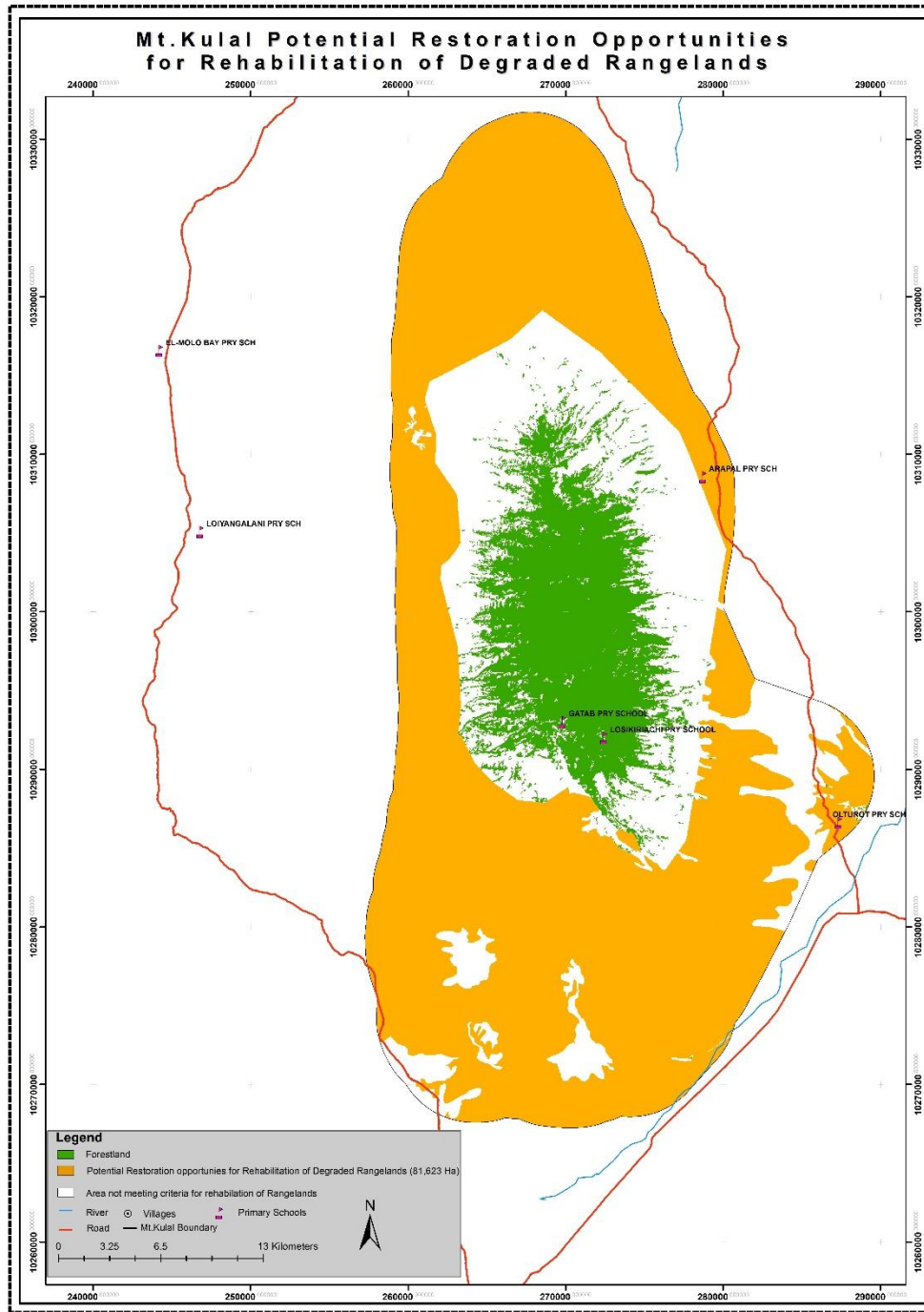


**Figure 4:** Restoration potential for agroforestry in Mt. Kulal Biosphere Reserve

#### 4.3.3. Restoration Opportunities for Rangelands

Potential opportunities for restoration of degraded rangeland and grassland areas. Using this approach, 81,623 ha (Figure 5) were estimated for restoration this in ecosystem. Different grass

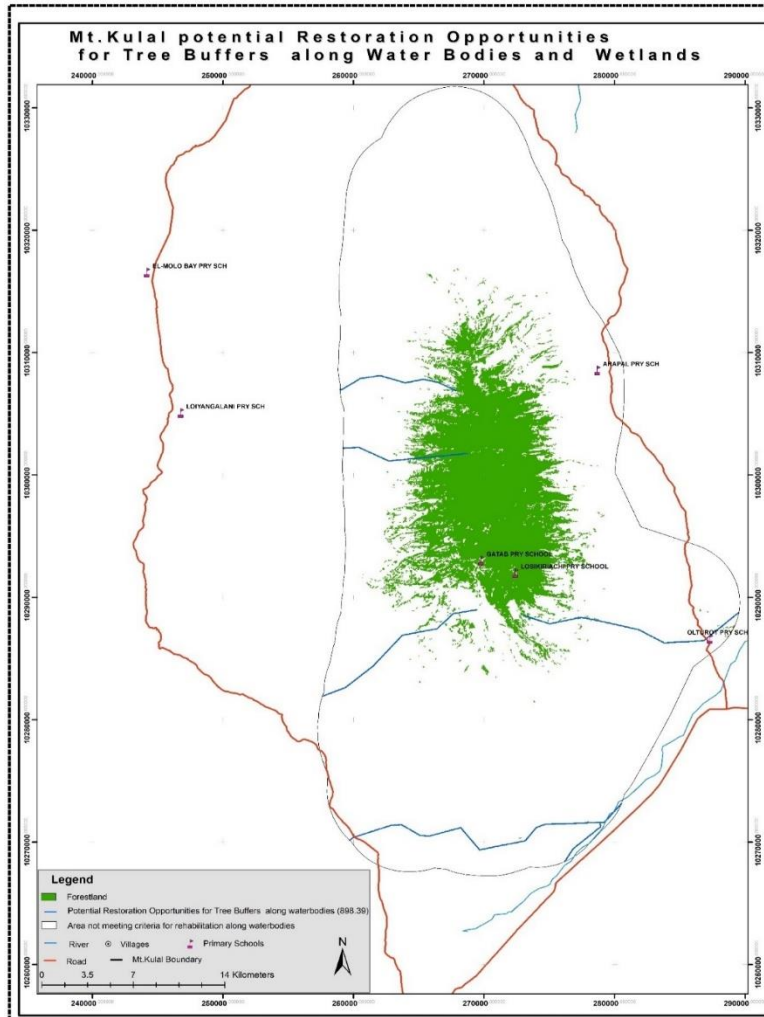
species were identified for use in the restoration. These species include; *Cenchrus cenchroides*, *Chloris pycnothrix*, *Eragrostis aspera*, *E. patula* and *Aristida* spp.



**Figure 5:** Restoration potential for rangelands in Mt. Kulal Biosphere Reserve

#### 4.3.4. Restoration Opportunities for Tree-based Buffer Zones along Water Bodies and Wetlands

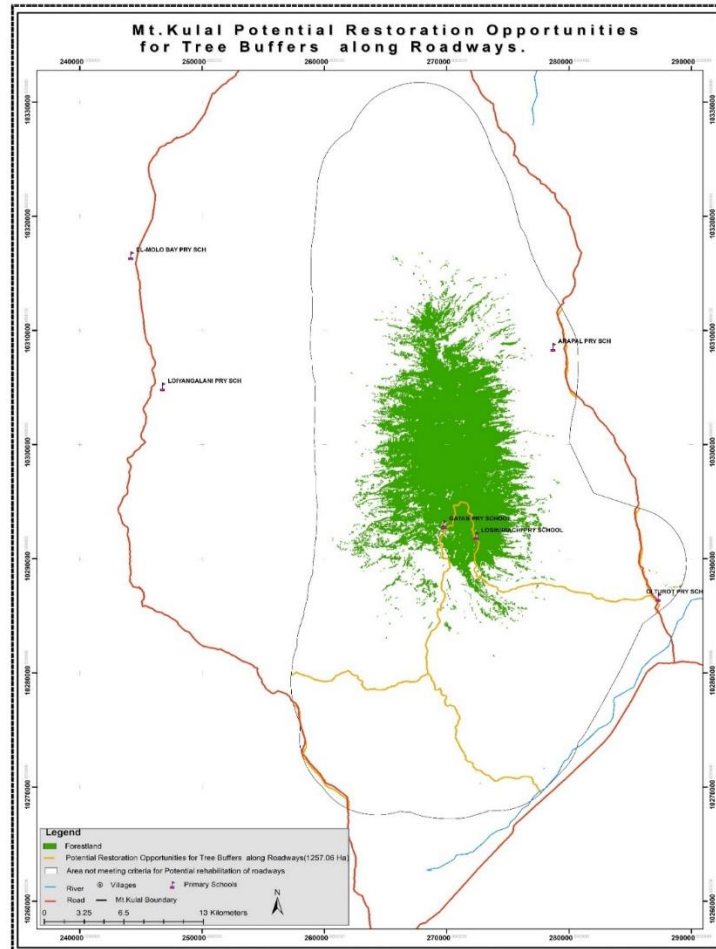
Potential areas along water bodies and wetlands where tree buffers can be established, and where currently there are no trees. These areas are critical due to the importance of trees in helping to reduce erosion and sedimentation into waterways, and because of such, several laws and policies in Kenya require these buffers. It is important to note that while the total area where tree buffers could be established is relatively small, these areas play a key role in managing sediment and water quality and have the potential to provide high levels of ecosystem services and benefits to society and the environment. While there are no permanent rivers around and within Mt. Kulal biosphere, several springs and seasonal rivers were identified where an area of **798.39 ha** (Figure 7) were approximated to be suitable for restoration. Different plant species such as bamboo and vetiver grass were identified for planting in this area.



**Figure 6:** Restoration potential for tree-based buffer zones along water bodies and wetlands in Mt. Kulal Biosphere Reserve

#### 4.3.5. Restoration Opportunities for Tree-based Buffer Zones along Roads

Potential areas along roads where tree buffers can be established. These buffers are important for controlling local air and noise pollution, as well as run off from road surfaces. Approximately **1,257.06 ha** area (Figure 8) was identified. Different plants species will be used based on agroecological zones within the biosphere.



**Figure 7:** Restoration potential for tree-based buffer zones along roads in Mt. Kulal Biosphere Reserve

## ECONOMIC ANALYSIS OF FOREST AND LANDSCAPE RESTORATION OPTIONS

### 5.1. Restoration Transition from Degraded Natural Forests to Improved Natural Forests

One restoration approach was considered in restoring degraded natural forests within the Mt. Kulal Forest landscape, enrichment planting. Economic analysis of the restoration transition from degraded natural forests to improved natural forests through enrichment planting would generate a NPV of KES 318,559 per ha over the 30-year period. The economic benefits achieved through this intervention are sale of firewood, carbon sequestration, water flow regulation and soil erosion prevention. The BCR for the transition is 2.75 meaning for every 1 shilling in invested in the restoration process KES 2.75 will be generated within the 30-year period (Table 5). The discounted cost value for the restoration opportunity is estimated at KES 157,290 per ha. This transition is economically viable since it has the ability to pay for itself within the 30 -year time period.

**Table 5: Economic Analysis of Transition from Degraded Natural Forests to Improved Natural Forests through Enrichment Planting**

| Transition  | Land use   | Economic Evaluation Criteria<br>@ 7% discount rate |      |
|---|------------|--|------|
|   |            | Net Present Value<br>(NPV)                         | BCR  |
| Degraded natural forest to improved enriched natural forest | Baseline   | 649,509  |      |
|   | Improved   | 968,068  |      |
|   | Transition | 318,559  | 2.75 |

#### 5.1.1. Restoration Transition from Degraded Agricultural Landscapes to Improved Agroforestry Systems

Agroforestry involves integration of trees with crops. The trees identified in Mt. Kulal landscape suitable for restoration through agroforestry using different suitable plant species such as *Markhamia lutea*, *Osyris lanceolata*, *Podocarpus falcatus*, *Juniperus procera*, *Croton megalocarpus*, *Markhamia lutea*, Neem (*Azadirachta indica*), *Balanites aegyptiaca*, *Acacia senegal*, *Leucaena leucocephala*, *Senna siamea* and *Acacia tortilis*. Fruit plants (avocados, mangoes, oranges, bananas, pawpaws, passion, lemon, watermelon) were also identified

The economic benefits achieved through this intervention are maize, firewood, timber, fruits, carbon sequestration and soil fertility improvement. The BCR for the transition is 25.64 meaning for every 1 shilling in invested in the restoration process KES 25.64 will be generated within the

30-year period (Table 6). The discounted cost value for the restoration opportunity is estimated at KES 511,708 per ha. This transition is economically viable since it has the ability to pay for itself within the 30-year time period.

**Table 6: Economic Analysis of transition from degraded agricultural landscapes to improved agroforestry systems**

| Transition  | Land use   | Economic Evaluation Criteria<br>@ 7% discount rate |       |
|---|------------|--|-------|
|   |            | Net Present Value<br>(NPV)                         | BCR   |
| Traditional Agriculture to Agroforestry<br><i>Grevillea robusta</i> , Maize and Avocado | Baseline   | 97,183   |       |
|   | Improved   | 1,088,598  |       |
|   | Transition | 991,415  | 25.64 |

### 5.1.2. Restoration of Degraded Rangelands and Woodlands

Grass reseeding restoration approach was considered in restoring degraded grasslands and woodlands within Mt. Kulal landscape; grass reseeding using improved grasses namely *Cenchrus ciliaris*, *Chloris roxburghiana*, *Enteropogon macrostachyus* and *Eragrostis superba*, *Cenchrus cenchroides*, *Chloris pycnothrix*, *Eragrostis aspera*, *E. patula* and *Aristida spp.* Transition from degraded grasslands to reseeded grasslands would generate a NPV of KES 532,566 per ha over the 30-year period (Table 7). The discounted cost value for the restoration opportunity is estimated at KES 236,824 per ha. The economic benefits achieved through this intervention are grass (hay), grass seed and some minimal carbon sequestration.

**Table 7. Economic Analysis of Transition from Degraded Rangelands and Woodlands to reseeded Grasslands**

| Transition  | Land use   | Economic Evaluation Criteria<br>@ 7% discount rate |      |
|---|------------|--|------|
|   |            | Net Present Value<br>(NPV)                         | BCR  |
| Transition from degraded grasslands to reseeded grassland | Baseline   | (207,026)  |      |
|   | Improved   | 325,539  |      |
|   | Transition | 532,566  | 29.2 |



**Plate 3:** Degraded grassland (L) and a grass reseeded land (R)

### 5.1.3. Restoration transition from degraded buffer zones along rivers and wetlands to bamboo and grass strip

Restoration of degraded buffer zones along rivers involves the planting of bamboo and grass strip. This transition would generate a NPV of KES 1,105,203 per ha over the 30-year period. The economic benefits achieved through this intervention are sale of grass, bamboo culms and carbon sequestration. The BCR for the transition is 2.35 meaning for every 1 shilling in invested in the restoration process KES 2.35 will be generated within the 30-year period (Table 8). The discounted cost value for the restoration opportunity is estimated at KES 603,115 per ha. This transition is economically viable since it has the ability to pay for itself within the 30-year time period.

**Table 8. Economic Analysis of restoration transition from degraded buffer zones along rivers and wetlands to bamboo and grass strip**

| Transition  | Land use   | Economic Evaluation Criteria<br>@ 7% discount rate |      |
|---|------------|--|------|
|   |            | Net Present Value<br>(NPV)                         | BCR  |
| Degraded riparian zones to bamboo and grass strip | Baseline   | (92,953)   |      |
|   | Improved   | 1,012,250  |      |
|   | Transition | 1,105,203  | 2.35 |



#### 5.1.4. Indigenous trees buffer along roads

Restoration of bare buffer zones along major road networks involves the planting of indigenous trees as buffers for the roads. This transition would generate an NPV of KES 96,972 per ha over the 30-year period. The economic benefits achieved through this intervention are carbon sequestration, aesthetic value, soil erosion prevention, Shade provision, air quality improvement and storm water protection. The BCR for the transition is 6.1 meaning for every 1 shilling in invested in the restoration process KES 6.1 will be generated within the 30-year period (Table 9). The discounted cost value for the restoration opportunity is estimated at KES 28,662 per ha This transition is economically viable since it has the ability to pay for itself within the 30-year time period.

**Table 9. Economic analysis of transition from bare buffer zones along major road networks**

| Transition                              | Land use   | Economic Evaluation Criteria<br>@ 7% discount rate |     |
|---|------------|--|-----|
|   |            | Net Present Value<br>(NPV)                         | BCR |
| Bare roads to trees buffers along roads | Baseline   | 25,365   |     |
|   | Improved   | 122,337  |     |
|   | Transition | 96,972   | 6.1 |

## **ROAM - RESTORATION FINANCING AND RESOURCE MOBILIZATION**

### **6.0. Financing of Restoration Opportunities**

Effective implementation of restoration initiatives requires massive mobilization of resources that can sustain interventions over the target period, more often in the long run. Overgrazing, human encroachment, overdependence of forests by neighbouring communities, climate change, poor farming practices, unsustainable sand harvesting, demand for settlement land among others contribute immensely to landscape degradation. Consequently, this results to reduced tree and forest cover, soil erosion, human wildlife conflict, loss of livelihoods and farm incomes, strain on natural resources, drought and flooding. Further, it puts pressure on governments to spend more on environment focused programs leaving little for infrastructure development and social protection.

Currently, 21.6 percent of Kenyan landscapes including forests, wetlands, coastal areas, rangelands and agricultural lands are faced with severe degradation. Nationally, it is estimated that over a five-year period (2021-2025) restoration activities can cost about 61 billion Kenya shillings (approx. USD 555 million). This underpins the need for resource mobilization and funds flow for effective multi-sectoral forests and landscapes restoration interventions.

Part of this cost is a measurement within the focus areas of Mt. Kulal Forest and landscape which have their own unique share of challenges. Based on FAO TRI project the target area to be restored under the project is 8,700 hectares with restoration to focus on rangelands grass reseeding, agroforestry, forested areas and natural regeneration in rangelands segregated in hectares.

To achieve projected total basket of these resources, there is need for mobilization from the international community, National and County government's budgetary allocations, development partners, the private sector, NGOs and CBOs.

Some of the global based networks to tap resources from include Global Partnership on Forest Landscape Restoration (GPFLR); International Union for the Conservation of Nature (IUCN); Society Ecological Restoration (SER); Global Environmental Facility (GEF) and International Food and Agricultural Development (IFAD); United Nations Development Programme (UNDP) among others.

## 6.1. Justification for resource mobilization for FLR

It is estimated that more than US\$1500 (App KESs 150,000) per ha is needed for restoration of degraded lands (Pistorius and Freiberg, 2014). This depends on types of landscapes and interventions involved. The amount exceeds by far what global funding has pledged and committed for restoration efforts and it also much higher than the financing abilities of governments. The situation is more serious in developing world where the largest potential for restoration is found.

In Kenya, economic analysis on FLR restoration focuses on 5.1 million hectares of degraded areas is estimated to cost KES 1.9 trillion (Cheboiwo *et al.*, 2018). Based on this ROAM assessment for Mt. Kulal Forest and landscape restoration the required resources for restoration over a 30-year period is estimated at KES 27.5 billion Kenya shillings (Table 10)

**Table 10: Priority Restoration Interventions And The Estimated Opportunity Area Based On Geospatial Analysis**

| No.          | Priority restoration intervention                       | Opportunity area (ha) | Cost Per Ha | Required Resources (KES) |
|--------------|---|-----------------------|-------------|--------------------------|
| 1.           | Rehabilitation of degraded natural forests              | 46,687                | 157,290     | 7,343,398,230            |
| 2.           | Agroforestry on Cropland                                | 612.5                 | 511,708     | 313,421,150              |
| 3.           | Tree-based Buffer Zones along roads                     | 1,257.06              | 28,662      | 36,029,854               |
| 4.           | Tree-based Buffer Zones along Water Bodies and Wetlands | 798.4                 | 603,115     | 481,527,016              |
| 5.           | Rangeland's restoration                                 | 81,623                | 236,824     | 19,330,285,352           |
| <b>Total</b> |   | <b>130,978</b>        |             | <b>27,504,661,602</b>    |

## 6.2. Financing mechanisms and sources for FLR

The implementation of forest and landscape restoration programmes and plans especially in developing world more so in Africa has attracted different financing mechanisms ranging from global commitments and pledges, regional and sub-regional partnerships with financial institutions such as African Development Bank (AfDB), World Bank; national budget to public private

partnership financing models. Each of these financing mechanisms and sources are described in the following sub sections.

### **6.2.1. Global financing mechanisms**

There are a number of global financing mechanisms and sources that are crucial in the implementation of the interventions. Some of these include but not limited to the following:

1. Global Environment Facility (GEF);
2. Green Climate Fund;
3. Adaptation Fund;
4. Bio carbon Fund;
5. Forest Carbon Partnership Facility;
6. Readiness Fund (RF) for Reducing Emissions from Deforestation and Forest Degradation (REDD+);
7. World Wide Fund for Nature (WWF); and
8. Multi-lateral and bilateral funding agencies such as Japan International Cooperation Agency (JICA), Swiss Agency for Development and Cooperation (SDC), Swedish International Development Cooperation Agency (Sida), United States Agency for International Development (USAID), Norwegian Agency for Development Cooperation (NORAD) among others

Applicants must be knowledgeable about proposal conditions and criteria for submission in different landscapes for restoration.

### **6.2.2. Continental/Regional financing opportunities**

At the continental level, Kenya is party to African Union's Agenda 2063. The agenda focuses on building climate resilient economies and communities, anchored under the African Forest Landscape Restoration Initiative (AFR100) that aims to restore 100 million hectares of deforested and degraded land in Africa by 2030. Through this commitment of AFR100, a number of technical and financial partners have set forth an ambition of over one billion dollars of grants and loan financing to all relevant stakeholders engaged in the assessment of restoration opportunities and identification, testing and active up-scaling of promising FLR solutions.

Some of these technical and financial partners include:

1. Global Environment Facility (GEF) that has aligned some of its approaches with AFR100 in response to the Bonn Challenge and the Global Partnership for FLR, supporting restoration initiatives which create multiple benefits and engaging local communities;
2. Federal Ministry for Economic Cooperation and Development of Germany that is providing support for the structure of the initiative and for selected AFR100 countries;
3. World Bank with a commitment of USD 1 billion in institutional investment in 14 African countries by 2030, as part of the Africa Climate Business Plan to support Africa's climate resilient and low carbon development;
4. TerrAfrica process, a partnership between FAO, World Bank and NEPAD. It brings together African countries and partners to share a common vision, exchange knowledge, and scale up Sustainable Land Management (SLM).

### **6.2.3. Sub-Regional Financing Frameworks and Initiatives**

Kenya is a member of the East African Community (EAC), Intergovernmental Authority on Development (IGAD) and Common Market for Eastern and Southern Africa (COMESA). The shared terrestrial and aquatic ecosystems with neighbours' host wildlife, flora and fauna which can generate incomes if properly managed. The ecosystem is not without challenges including but not limited to depletion of natural resources, expansion in human activities.

In view of this, proposals can target:

- East African Community (EAC) Climate Change Policy and Strategy (2018-2023),
- Lake Victoria Basin Commission's Climate Change Adaptation Strategy and Action Plan,
- The Protocol for Sustainable Development of Lake Victoria Basin and the Protocol on Environment and Natural Resources for the EAC.
- The East African Community collaboration with the US Agency for International Development Kenya/East Africa (USAID/KEA) on the Conservation and Management of the Region's Natural Capital Programme that seeks to: improve the collaborative management and conservation of trans-boundary natural resources; reduce wildlife poaching and trafficking; and increase the perceived value of living wildlife. The

community has also targeted to fund rising through the East African Community (EAC) Climate Finance Mobilization and Access Strategy.

#### **6.2.4. National and County governments financing**

Restoration will require also require funding from The National Treasury. Innovative financing instruments and structures like mainstreaming budgetary allocations within Ministries departments and agencies to a Restoration Fund and institutionalising special fee levy and taxes. For this to be achieved, good enabling environment require operationalization in order to create avenue for enhanced resource mobilisation internally.

Counties also need systematic approach in the County Integrated Development Plans (CIDPs) that considers and connects all aspects of the FLR resource provisions and mobilization. However, environmentalists, conservationists should have capacity to lobby for increased funding and also have elaborate Policy Influencing Plans (PIPs) in order to ensure that planned and budgeted restoration funds are actually directed to restoration.

#### **6.2.5. Private Sector financing**

Globally, there is consensus among countries that the private sector must effectively contribute to restoration and conservation activities. A platform for the private sector in voluntarily and not through regulatory policy means in mobilizing resources for forest and landscape restoration in Kenya should lead to establishment of a fund.

The call for development and profits realization with the planet and people in mind, clean environment and conservation should motivate and drive the private investments in nature-based enterprises. Corporate Social Responsibility (CSR) should be up scaled to voluntary commitments to restoration. The demonstration by Equity foundation through its 35 million trees initiative, Brookside Dairy and EABL among others is a direction that can be a benchmark for others. Private sector can market for products bio enterprises products and create forward linkages for Small and Medium Enterprises (SMEs) engaged in alternative products to timber related products.

#### **6.2.6. Public Private Partnerships (PPPs) financing**

Governments globally are faced with budget deficits amidst increased demand for provision of critical services some of which are not directly revenue generating but are either vital enablers or are important for sustaining life to man and other organisms. Public Private Partnership

arrangements are financing models that are gaining popularity to bridge this gap. The model is driven by the need to deliver public goods and services that are critical for socio and economic development. Different actors combine strengths vertically or horizontally to achieve expected results. However, in order to generate resources for landscape restoration and conservation in selected ecosystems in Kenya, elaborate governance frameworks serving the interests of both private and public actors. Such frameworks include land adjudication, lease policies and guidelines, legislation for community land, payment for ecosystem services, gender mainstreaming, franchising, and benefit sharing.

But implementing PPPs in Kenya has had the following challenges:

- a) Projects investments lenders can only be repaid from revenue generated.
- b) Recourse for financing for the PPP in the country is limited.
- c) Only Direct Foreign Investment (DFI) funding is available for such big projects due to high risks involved
- d) Conservation of environment priority is not top on initial investment period
- e) Technical skills to develop and implement Private Public Partnership model is lacking.

In upscale PPPs, focus on elimination of bottlenecks in policy frameworks, strengthening governance and institutional coordination should be top on the agenda. But with increasing popularity, PPP financing models are expected to address some restoration of degraded forests and landscapes through: Technology transfer and innovation for restoration of degraded lands and forests; Integrating quality of life in ecosystems that are sources of good and services; Creating peer check mechanisms where corporate organizations regulate themselves on restoration commitments; Providing for livelihoods options for vulnerable communities and ecosystems on a maximum social benefit perspective; and financing environmental education and awareness campaigns in all landscapes .

## **7.0. Conclusion and Recommendations**

Five types of mutually-supportive forest landscape restoration interventions were identified through stakeholders' consultation as having the greatest potential for scaling-up across Mt. Kulal landscape to address existing degradation and land-use challenges. These were: (1) Rehabilitation of degraded natural forests (2) Agroforestry on Croplands (3) Tree-based Buffer Zones along roads

(4) Tree-based Buffer Zones along Water Bodies and Wetlands; and (5) Rangeland's restoration. Based on the results of the Sub-National Forest Landscape Restoration Opportunities Assessment and Restoration Opportunities Assessment Methodology mapping assessment, the key recommendations are to:

- Adopt a phased approach for meeting restoration objectives for Mt. Kulal landscape. A proportion of the restoration opportunity areas could be targeted for a 2030 timeline, and the remaining areas would be restored in the future.
- Integrate these restoration interventions into County-level development and resource allocation decisions, using the estimates of intervention opportunities area from the SNFLRA as a guide for setting priorities and orienting interventions.
- Provide opportunities for the full participation and empowerment of women and take steps to enhance gender equity in all communications and outreach, training, technical assistance and other support for restoration interventions.
- Focus more resources on implementing rangeland restoration technologies, given that it is the most widespread Sub-National Forest Landscape Restoration Opportunities Assessment and Restoration Opportunities Assessment Methodology across Mt. Kulal landscape and is key to improving livestock productivity in Mt. Kulal which is predominately occupied by pastoralist communities
- Reinforce local environmental governance by supporting the adoption and enforcement of strong community by-laws to reduce the uncontrolled settlements, cutting of trees on and off farms and damage from fire and livestock
- Rehabilitate degraded natural forests and protect existing natural forest stands to capitalize on the soil erosion mitigation benefits and biodiversity value, and prioritize interventions protecting water bodies and wetlands which are the primary sources of water in Mt. Kulal
- Focus more resources on agroforestry within the landscape and encouraging private woodlots to remove pressure from forest reserves and other protected areas and help to alleviate poverty through provision of alternative livelihoods
- Enhance training and assistance for adopting sustainable honey harvesting technologies to reduce incidences of forest/wild fires which lead to loss of biodiversity



- Provide seedlings and other material resources and associated training to encourage enrichment tree planting along rivers, streams and water bodies to secure water resources and mitigate erosion risks.
- Reflect FLR as a national priority consistently across both county and national Governments. Apply an integrated, multi-sectoral approach undertaking restoration initiatives
- Harmonize laws and strengthen policies directly related to FLR including policies on physical planning, water management, forestry and agriculture. Where different policies and laws contradict each other, these contradictions should be addressed.
- Prioritize the implementation of restoration interventions with relatively lower costs and higher benefits including rangeland reseeding, farmer managed natural regeneration, and other forms of agroforestry

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## APPENDICES

### Appendix 1: Stakeholder Identification and Mapping for Mt. Kulal Landscape

| No. | Name of stakeholder   | Roles/ Mandate   | Contribution  | Location/ Address   |
|-----|---|--|---|---|
| 1.  | County Government of Marsabit   | <ul style="list-style-type: none"> <li>All functions under clauses of devolution</li> <li>Policy formulation and legislation</li> </ul>  | <ul style="list-style-type: none"> <li>Capacity building on restoration and formulation of bylaws</li> <li>Leadership</li> <li>Provision of information</li> <li>Represent community interests.</li> <li>Funding of restoration activities</li> </ul>         | <p>Marsabit County</p> <p>Marsabit +254748608423<br/> <a href="mailto:info@marsabit.go.ke">info@marsabit.go.ke</a>.<br/>           0723582684 P.O Box 29-60500 Marsabit</p> |
| 2.  | The United Nations Educational, Scientific and Cultural Organization UNESCO | <ul style="list-style-type: none"> <li>Cultural and environmental conservation</li> <li>To reserve the natural resources and maintain biodiversity in the biosphere reserve</li> </ul> | <ul style="list-style-type: none"> <li>Provision of information</li> <li>Capacity building</li> <li>Conservation and development</li> <li>Education in forest management and resource conservation that links livelihood with ecosystem services.</li> </ul>  | <p>Mt. Kulal</p> <p>UNESCO</p> <p>P.O. Box 30040-00100</p> <p>Nairobi</p> <p>0202229053</p>   |
| 3.  | FAO   | <ul style="list-style-type: none"> <li>Work with the Government of Kenya (GoK) to help build a food-secure country, free of hunger and malnutrition, where food</li> </ul>             | <ul style="list-style-type: none"> <li>Sustainable natural resource and environmental management; food security and nutrition initiatives</li> <li>Restoring degraded landscape and enhancing the socio-economic development of local communities.</li> </ul> | <p>Mt Kulal</p> <p>Block P, Level 3</p> <p>United Nations Complex</p> <p>UN Avenue, Gigiri, Nairobi</p> <p>P.O Box: 30470,00100,GPO</p>                                     |

| No. | Name of stakeholder | Roles/ Mandate   | Contribution   | Location/ Address  |
|-----|---------------------|--|--|--|
|     |                     | <p>and agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner.</p> | <ul style="list-style-type: none"> <li>• “<u>Restoration of Arid and Semi-arid Lands (ASAL) of Kenya through Bio-enterprise Development and Other Incentives</u>” under <u>The Restoration Initiative</u></li> </ul>   | <p>Nairobi<br/>Tel: +254 207625920<br/>Email: <a href="mailto:FAO-KE@fao.org">FAO-KE@fao.org</a></p>   |
| 4.  | CARITAS             | <ul style="list-style-type: none"> <li>• Livelihood support</li> <li>• Drought management</li> </ul>   | <ul style="list-style-type: none"> <li>• Provision of information.</li> <li>• Training, capacity building, extension services,</li> <li>• provision of infrastructure for value addition</li> </ul>  | <p>Mt. Kulal<br/>Catholic Diocese of Marsabit<br/>P.O. Box 62-60500<br/>Marsabit<br/>+25477447205<br/><a href="mailto:info@caritas-dom.org">info@caritas-dom.org</a></p>   |
| 5.  | VSF Germany         | <ul style="list-style-type: none"> <li>• Mitigation of drought and environmental degradation</li> <li>• Livelihood support</li> </ul>                                    | <ul style="list-style-type: none"> <li>• Promotion of livelihood diversification to improve food and nutrition security to enhance resilience to drought</li> <li>• Aims to raise awareness on the positive role of livestock, sustainable agriculture and small-scale integrated farming systems as a key factor for sustainable livelihood development.</li> </ul> | <p>Vétérinaires sans Frontières<br/>Germany<br/>P.O. Box 25653 - 00603<br/>Ngong Road, Piedmont Plaza Nairobi<br/>phone: +254 203 873 676<br/>e-mail: <a href="mailto:info(at)vsfg.org">info(at)vsfg.org</a></p> |

| No. | Name of stakeholder                | Roles/ Mandate  | Contribution   | Location/ Address   |
|-----|------------------------------------|---|--|---|
|     |                                    |   |  | Saku, Laisamis,<br>Loiyangalani Wards   |
| 6.  | Kenya Red Cross Society            | <ul style="list-style-type: none"> <li>Disaster Risk Reduction/Climate Change Adaptation</li> </ul> | <ul style="list-style-type: none"> <li>Water pans to supply water for domestic and irrigation to improve resilience and adaptive capacity to climate change of the rural poor</li> <li>Climate SMART modern farming methods</li> </ul> | Sololo Sub-County,<br>Marsabit<br><a href="mailto:info@kenyaredcross.org">info@kenyaredcross.org</a><br><a href="tel:+25420603593">+254 20 603593</a><br><br>South C, Red Cross Road,<br>Off Popo Road, P.O. Box<br>4071235059-00200 Nairobi<br>Kenya |
| 7.  | World Vision International (Kenya) | Humanitarian aid, development, and advocacy.  | <ul style="list-style-type: none"> <li>Farmer Managed Natural Regeneration.</li> <li>Capacity building on FLR and bio enterprises development.</li> </ul>  | Mt Marsabit, Huri Hills<br>World Vision Kenya, Karen<br>Road, off Ngong Road, P.O.<br>Box 50816-00200,Nairobi,<br>Kenya. Office: +254 732<br>126 000, +254 711 086 000.<br>E-<br>mail: <a href="mailto:wv_kenya@wvi.org">wv_kenya@wvi.org</a>         |
| 8.  | Concern Worldwide                  | <ul style="list-style-type: none"> <li>Ending extreme poverty</li> </ul>                            | <ul style="list-style-type: none"> <li>Livelihoods improvement</li> </ul>  | Marsabit County<br>P.O. Box: 13850-00800,   |

| No. | Name of stakeholder  | Roles/ Mandate  | Contribution   | Location/ Address   |
|-----|--|---|--|---|
|     |  |   | <ul style="list-style-type: none"> <li>• Climate and environment (Climate Smart Agriculture to reduce emissions and destructive impacts on land)</li> </ul>  | Nairobi<br><b>Tel:</b> +254 20 3755051-5<br><b>Fax:</b> +254 20 3755056<br><b>Email:</b><br>Nairobi.admin@concern.net |
| 9.  | National government through Ministry of Environment and Forestry, KEFRI, KFS | <ul style="list-style-type: none"> <li>• Formulation of environmental policies</li> <li>• Research in agriculture</li> <li>• Forestry research</li> <li>• Wildlife conservation</li> <li>• Forest management and protection</li> <li>• Supervise and coordinate all environmental matters</li> <li>• Culture and research</li> <li>• Coordinate and oversee protection, rehabilitation, conservation and</li> </ul> | <ul style="list-style-type: none"> <li>• Policy</li> <li>• Provision of information</li> <li>• Leadership</li> <li>• Provision of information</li> <li>• Represent community interests</li> <li>• Capacity building</li> <li>• Conservation and development</li> <li>• Training, capacity building, extension services,</li> <li>• provision of infrastructure for value addition</li> </ul> | Mt. Kulal   |

| No. | Name of stakeholder                           | Roles/ Mandate   | Contribution   | Location/ Address  |
|-----|---|--|--|--|
|     |   | <p>sustainable management of critical water towers</p> <ul style="list-style-type: none"> <li>• Research and development on industrial and allied technologies</li> <li>• Coordination of all matters on drought risk management</li> </ul>  |  |  |
| 10  | KEFRI<br>Kenya Forestry<br>Research Institute | <ul style="list-style-type: none"> <li>• Undertake research in forestry and allied natural resources</li> <li>• Generate technologies for establishment and management of forest plantations, trees on-farms and enhance production of superior germplasm for priority tree species for different agro-ecological zones</li> </ul> | <ul style="list-style-type: none"> <li>• Tree seeds production</li> <li>• Demonstration of technologies</li> <li>• Tree nurseries development and management</li> <li>• Landscape Restoration</li> <li>• Forest management</li> <li>• The Restoration Initiative tree planting.</li> <li>• Use oriented research and development</li> <li>• Support productive and sustainable forestry and landscape initiatives</li> </ul> | <p>Mt. Kulal<br/>20412-00200 Nairobi,<br/>Kenya.<br/>+254 722 157 414<br/>+254 (0) 724 259781/2<br/><a href="mailto:director@kefri.org">director@kefri.org</a></p> |



| No. | Name of stakeholder                                    | Roles/ Mandate  | Contribution   | Location/ Address   |
|-----|--|---|--|---|
| 11  | KFS<br>Kenya Forest Service                            | <ul style="list-style-type: none"> <li>• Conserve, protect and manage all public forests in accordance with the provisions of the Act;</li> <li>• Manage water catchment areas in relation to soil and water conservation, carbon sequestration and other environmental services in collaboration with relevant stakeholders</li> </ul> | <ul style="list-style-type: none"> <li>• Forest Landscape Restoration</li> <li>• Forest management</li> <li>• The Restoration Initiative tree planting.</li> </ul>   | Mt Kulal<br><br>Kenya Forest Service<br>P.O BOX 30513 - 00100<br>NAIROBI – KENYA<br>020-2014663   |
| 12  | KALRO<br>Kenya Agricultural and Livestock Organization | <ul style="list-style-type: none"> <li>• Crop and Livestock research management and Development</li> <li>• To catalyze sustainable growth and development in agriculture and livestock Product Value Chains</li> </ul>  | <ul style="list-style-type: none"> <li>• Sustainable growth and development in agriculture and livestock Product Value Chains</li> <li>• Strengthening Climate-Smart Agricultural Research and Seed Systems</li> </ul> | Kaptagat Rd, Loresho<br>Nairobi Kenya<br>P.O. Box 57811, City Square, Nairobi, 00200, Kenya<br>Email: <a href="mailto:info@kalro.org">info@kalro.org</a><br>Safaricom: +254 722206986/722206988<br>Airtel: +254 733-333-223/733333224 |

| No. | Name of stakeholder                               | Roles/ Mandate  | Contribution   | Location/ Address   |
|-----|---|---|--|---|
| 13  | KWS<br>Kenya Wildlife Service                     | <ul style="list-style-type: none"> <li>• Custodian of wildlife and coordination wildlife conservation in Kenya</li> <li>• Wildlife conservation and law enforcement</li> </ul>  | <ul style="list-style-type: none"> <li>• Technical support on wildlife conservation as per Wildlife Conservation and Management Act, 2013.</li> <li>• Human Wildlife Conflict mitigation.</li> </ul> | Mt Kulal<br>P.O. Box 40241-00100,<br>Nairobi Kenya<br>Tel: +254(20) 2379407,<br>+254(20) 6002345.<br>Call Center: 0800 597000 or<br>08002215566<br>Email Address:<br>kws@kws.go.ke                  |
| 14  | National Environment Management Authority<br>NEMA | <ul style="list-style-type: none"> <li>• Technical support with implementation of EMCA (1999)</li> <li>• Knowledge and skills support to all stakeholders on environmental conservation with special emphasis on environmental laws, policies and regulations in Kenya</li> </ul> | <ul style="list-style-type: none"> <li>• Compliance with EMCA 1999</li> <li>• Handling EIAs for activities which require assessments.</li> </ul>   | Marsabit County<br>Mt. Kulal forest<br><br>Popo Road, South C, off<br>Mombasa Road<br>P.O Box 67839-00200,<br>Nairobi, Kenya<br>Tel: +254 724 253398, +254<br>735 013046.<br>Email: dgnema@nema.go. |

| No. | Name of stakeholder              | Roles/ Mandate  | Contribution   | Location/ Address  |
|-----|----------------------------------|---|--|--|
| 15  | National museums of Kenya<br>NMK | <ul style="list-style-type: none"> <li>• Collect, preserve, study document Kenya’s cultural and national heritage.</li> <li>• Serve as a national repository for things of scientific, cultural, technological and human interest;</li> <li>• Identify, protect, conserve and transmit the cultural and natural heritage of Kenya.</li> <li>• Promote cultural resources in the context of social and economic development</li> </ul> | <ul style="list-style-type: none"> <li>• Indigenous people historical heritage documentation- Yiaku.</li> <li>• Research, documentation and promotion of IK with a view to preserve culture and biological diversity for sustainable development in Kenya.</li> <li>• Source of information contributing to formulation and other initiatives affecting indigenous communities in Kenya.</li> <li>• Creating institutional linkages that will promote in natural resources management, research, conservation</li> </ul> | Mt Kulal<br>National Museums of Kenya. P.O. Box 40658 – 00100, Nairobi, Kenya.<br>+254 (0)20 233 9158. 0724 255 299   0780 755 231 |
| 16  | Kenya Water Towers Agency KWTA   | <ul style="list-style-type: none"> <li>• Conducting research on the status of water towers, spatial analysis of land use, land cover changes and</li> </ul>   | <ul style="list-style-type: none"> <li>• Support with tree seedlings for reforestation.</li> <li>• coordinate and oversee the protection, rehabilitation and conservation</li> </ul>   | Mount Kulal, Loiyangalani, and Kargi.<br>15th Floor, NHIF Building, Ragati Road.   |

| No. | Name of stakeholder                                | Roles/ Mandate   | Contribution  | Location/ Address   |
|-----|--|--|---|---|
|     |  | <p>hydrological analysis of water towers in Kenya.</p> <ul style="list-style-type: none"> <li>• Design programmes that determine resource allocation for reclamation, restoration, rehabilitation and community livelihood interventions needed.</li> </ul>          |   | <p>PO Box 42903-00100<br/>Nairobi, Kenya<br/>Email: info@watertowers.go.ke<br/>Website: <a href="https://watertowers.go.ke">https://watertowers.go.ke</a><br/>Greenline: 0748 222 222<br/>Phone: +254 (0)20-2711437, Ext.1725</p>                               |
| 17  | The National Drought Management Authority Act NDMA | <ul style="list-style-type: none"> <li>• Mandated to establish mechanisms which ensure that drought does not result in emergencies and that the impacts of climate change are sufficiently mitigated.</li> <li>• Conservation and management of dry lands</li> </ul> | <ul style="list-style-type: none"> <li>• Capacity building</li> <li>• Funding</li> <li>• Forest landscape restoration activities</li> </ul>                                 | <p>Mt Kulal<br/>P.O Box 53547 Nairobi 00200 Kenya<br/>Email: <a href="mailto:info@ndma.go.ke">info@ndma.go.ke</a><br/>Tel: +254(0) 20 2224324, +254(0) 20 2227982.<br/>Fax: +254 722 200656<br/>Website: <a href="http://www.ndma.go.ke">www.ndma.go.ke</a></p> |
| 18  | Faith based organizations - Africa Inland Church   | <ul style="list-style-type: none"> <li>• Developmental support and awareness creation on community activities</li> </ul>   | <ul style="list-style-type: none"> <li>• Capacity building</li> <li>• Participation in forest landscape restoration activities</li> <li>• Community mobilization</li> </ul> | Mt. Kulal   |

| No. | Name of stakeholder             | Roles/ Mandate   | Contribution   | Location/ Address  |
|-----|---------------------------------|--|--|--|
| 19  | Wazee Wa Mazingira groups       | <ul style="list-style-type: none"> <li>• Environmental conservation</li> <li>• Environmental management, protection, security</li> <li>• Administration and Community mobilization</li> <li>• Awareness creation</li> <li>• Formulation of bylaws</li> </ul> | <ul style="list-style-type: none"> <li>• Monitoring and reporting of environmental changes over time</li> <li>• Provision and dissemination of conservation information</li> <li>• Community mobilization</li> <li>• Awareness creation</li> </ul> | Mt. Kulal  |
| 20  | Lake Turkana Wind Power Project | <ul style="list-style-type: none"> <li>• Electricity generation</li> </ul>   | <ul style="list-style-type: none"> <li>• Livelihood support through Winds of Change project</li> <li>• Support nature-based enterprises</li> <li>• Providing water</li> <li>• Road infrastructure development</li> </ul>                           | Loiyangalani, Marsabit County, Mt. Kulal<br>254 (0)20 221 3493<br>Lake Turkana Wind Power Ltd<br>P.O. Box 2114 - 00502, Karen, Nairobi |
| 21  | Local communities               | <ul style="list-style-type: none"> <li>• Conservation and restoration of degraded land</li> </ul>  | <ul style="list-style-type: none"> <li>• Ownership of the project</li> <li>• Participation in restoration activities</li> <li>• Participate in ROAM process</li> </ul>   | Mt. Kulal  |

| No. | Name of stakeholder  | Roles/ Mandate   | Contribution   | Location/ Address  |
|-----|--|--|--|--|
| 22. | GATAB Water Users Association and Gatab Junction Community Water Users | <ul style="list-style-type: none"> <li>• Water infrastructure development</li> </ul>   | <ul style="list-style-type: none"> <li>• Conservation of water catchment areas</li> </ul>  | Gatab<br>Contact Person: Arule Lemosor; 0790007820   |
| 23  | Kulal Community Forest Association (KCFA)                              | <ul style="list-style-type: none"> <li>• Co-management of Mt. Kulal Forest:</li> <li>• Key beneficiary of FLR</li> </ul>   | <ul style="list-style-type: none"> <li>• Primary informant on forest and land restoration.</li> <li>• Bioenterprises development (Bee keeping)</li> <li>• Provide local resource persons for forest conservation.</li> <li>• Implementation of PFMP</li> </ul> | Mt. Kulal<br>Job Learamo: 0723752208   |
| 24  | Strategies for Northern Development SND                                | <ul style="list-style-type: none"> <li>• Support local initiatives for sustainable development</li> <li>• Drought preparedness/Building resilience</li> <li>• Emergency and climate change</li> <li>• Water and sanitation</li> <li>• Conflict resolution</li> </ul> | <ul style="list-style-type: none"> <li>• Funding</li> <li>• Alternative livelihoods for nomadic pastoralists</li> </ul>  | Mt Kulal <ul style="list-style-type: none"> <li>• P.O. Box 296-60700 Moyale/156-60500 Marsabit Kenya</li> <li>• (+254) 741 845 578 / (+251) 911 806 458</li> <li>• info@sndafrica.org</li> </ul> |

| No. | Name of stakeholder                   | Roles/ Mandate  | Contribution  | Location/ Address   |
|-----|---------------------------------------|---|---|---|
| 25  | OI Chore Conservation Community Group | <ul style="list-style-type: none"> <li>• Conservation and restoration of dryland areas</li> </ul>   | <ul style="list-style-type: none"> <li>• Participation in forest landscape restoration activities</li> </ul>  | <p>Gatab, Mt Kulal</p> <p>Chairman: Shadrach Lengoyap<br/>0714800436</p>  |
| 26  | Multilateral funders; GIZ,            | <ul style="list-style-type: none"> <li>• Rehabilitation and restoration of degraded lands</li> <li>• The project supports the counties of Marsabit and Turkana in northern Kenya with developing and implementing the initiated drought-resilience reforms and strategies.</li> </ul> | <ul style="list-style-type: none"> <li>• Funding</li> <li>• Capacity building</li> <li>• Linkages with other organizations</li> <li>• Policy formulation</li> </ul> | <p>Marsabit and Turkana County</p> <p>GIZ Office Nairobi<br/>Riverside Drive, Riverside Mews Building, opp. Prime Bank Headquarters</p> <p>Postal Address<br/>P.O. Box 41607 00100,<br/>Riverside Drive<br/>Nairobi<br/>Kenya</p> |

## Appendix 2: Land Use Challenges, Drivers, Effects and Restoration Interventions to Curb Land Degradation in Mt Kulal Landscape

| Land-use challenges | Drivers  | Effects  | Proposed Interventions   |
|---------------------|--|--|--|
| Persistent drought  | <ul style="list-style-type: none"> <li>• Climate change</li> <li>• Deforestation</li> </ul>  | <ul style="list-style-type: none"> <li>• Loss of pasture</li> <li>• Loss of biodiversity</li> <li>• Soil erosion</li> <li>• Scarcity of resources, livelihood options</li> </ul> | <ul style="list-style-type: none"> <li>• Afforestation/reforestation</li> <li>• Rangelands reseeding</li> <li>• Bio-enterprises development and value chain support</li> <li>• Conservation of existing vegetation</li> </ul>  |
| Overgrazing         | <ul style="list-style-type: none"> <li>• Overstocking of livestock</li> <li>• Loss of traditional knowledge on land carrying capacity</li> <li>• Lack of documented grazing plans</li> <li>• Insecurity</li> </ul> | <ul style="list-style-type: none"> <li>• Soil erosion</li> <li>• Loss of vegetation cover</li> <li>• Reduced natural resource base</li> <li>• Degraded pasture land</li> </ul>   | <ul style="list-style-type: none"> <li>• Tree growing</li> <li>• Alternative livelihoods</li> <li>• Improve livestock management</li> <li>• Rangeland restoration through natural regeneration</li> <li>• Alternative livelihoods</li> <li>• Policy Formulation and implementation of the existing ones</li> <li>• Development and implementation of feedlots system for pastoralists</li> </ul>   |
| Human encroachment  | <ul style="list-style-type: none"> <li>• Population increase</li> <li>• Land degradation</li> <li>• Insecurity</li> <li>• Farming activities</li> </ul>  | <ul style="list-style-type: none"> <li>• Loss of biodiversity</li> <li>• Human wildlife conflicts</li> <li>• Reduced forest/tree cover</li> </ul>                                | <ul style="list-style-type: none"> <li>• Tree growing and restoration</li> <li>• influenced and planned human settlements</li> <li>• Policy Formulation and implementation of the existing ones</li> <li>• Biodiversity conservation</li> <li>• Establishment of conservancies rather than ranches</li> <li>• Capacity building on sustainable land management (SLM)</li> <li>• Ecotourism</li> <li>• Implementation and actualization of the transition implementation plans for forestry (TIPS)</li> <li>• Tree growing and restoration</li> <li>• Enhancing natural regeneration</li> </ul> |



| Land-use challenges | Drivers   | Effects   | Proposed Interventions   |
|---------------------|---|---|--|
| Illegal logging     | <ul style="list-style-type: none"> <li>• Poverty</li> <li>• Lack of alternative livelihood sources/options</li> <li>• Inadequate enforcement of existing laws/policies to guard the forest</li> </ul> | <ul style="list-style-type: none"> <li>• Loss of biodiversity</li> <li>• Reduced forest/tree cover</li> </ul>   | <ul style="list-style-type: none"> <li>• Coordinated human settlements</li> <li>• Policy Formulation and implementation of the existing ones at county level</li> <li>• Enhance forest patrol/ surveillance</li> <li>• Increase community participation in forest management through development of PFMPs and FMAs</li> <li>• Alternative sources of livelihoods</li> </ul>  |
| Climate change      | <ul style="list-style-type: none"> <li>• Deforestation</li> </ul>   | <ul style="list-style-type: none"> <li>• Prolonged and recurrent drought</li> <li>• Floods</li> <li>• Rise in temperatures and heat waves</li> <li>• Outbreak of pests e.g. Locusts</li> <li>• Outbreak on human and livestock diseases</li> <li>• Loss of economic livelihood (due to death of livestock)</li> <li>• Strain on natural resources</li> <li>•</li> </ul> | <ul style="list-style-type: none"> <li>• Aligning programs to international commitments</li> <li>• Implementation of the County Climate Change adaption action plan/ policy</li> <li>• Development of adaptability mechanisms</li> <li>• Tree growing and restoration</li> <li>• Flood control mechanisms e.g.: water checks , gabions, riparian protection etc.</li> <li>• Tree growing and restoration</li> <li>• Promotion of proper species-site matching</li> <li>• Development of adaptability mechanisms-</li> <li>• Alternative livelihoods</li> <li>• Development of value chains, and bio-enterprises</li> <li>• improvement of entrepreneurial culture</li> </ul> |
| Degradation         | <ul style="list-style-type: none"> <li>• Farming activities</li> <li>• Extraction of construction materials</li> <li>• Charcoal burning</li> <li>• Extraction of firewood</li> </ul>                  | <ul style="list-style-type: none"> <li>• Loss of livelihoods</li> <li>• Limited entrepreneurial culture/ mindset</li> <li>• Tragedy of commons, because it's a community land</li> </ul>  | <ul style="list-style-type: none"> <li>• Enrichment tree planting</li> <li>• Capacity building/training on entrepreneurship</li> <li>• Natural regeneration</li> </ul>   |

| <b>Land-use challenges</b> | <b>Drivers</b>   | <b>Effects</b>  | <b>Proposed Interventions</b>   |
|----------------------------|--|---|---|
| Insecurity                 | <ul style="list-style-type: none"> <li>• Scarcity/competition over resources</li> <li>• Poverty</li> <li>• Political interferences</li> <li>• Land tenure</li> <li>• Cultural beliefs</li> </ul>       | <ul style="list-style-type: none"> <li>• Low development</li> <li>• Poverty</li> </ul>  | <ul style="list-style-type: none"> <li>• Law enforcement</li> </ul>   |
| Water scarcity             | <ul style="list-style-type: none"> <li>• Climate change</li> <li>• Lack of water pans/water harvesting structures</li> <li>• Few springs</li> </ul>  | <ul style="list-style-type: none"> <li>• Conflict over the limited resources</li> <li>• Loss of livelihood sources</li> </ul>   | <ul style="list-style-type: none"> <li>• Afforestation/reforestation</li> <li>• Rehabilitation of degraded natural forests</li> <li>• Planting trees along riverbanks and other water sources</li> </ul>  |
| Human-wildlife conflicts   | <ul style="list-style-type: none"> <li>• Uncoordinated settlements</li> <li>• Scarcity of resources</li> </ul>   | <ul style="list-style-type: none"> <li>• Loss of livelihood sources</li> </ul>  | <ul style="list-style-type: none"> <li>• Proper settlement plans</li> <li>• Fencing areas of interest</li> </ul>  |
| Forest/wild fires          | <ul style="list-style-type: none"> <li>• Inappropriate honey harvesting methods</li> <li>• Charcoal burning</li> <li>• Temporary/satellite settlements for pastoralists</li> <li>• Poachers</li> </ul> | <ul style="list-style-type: none"> <li>• Loss of natural habitats</li> <li>• Loss of biodiversity</li> <li>• Reduction of pasture</li> <li>• Wildlife displacement</li> </ul> | <ul style="list-style-type: none"> <li>• Sensitization of the community on the effects of wild fires</li> <li>• Increased level of fire response preparedness in terms of capacity and equipment</li> <li>• Development of a fire early warning system</li> </ul> |

**Appendix 3:** Discounted benefit flow analysis for enrichment planting in degraded natural forests

| <b>Description of benefits and costs</b> | <b>Aggregate Discounted Values 2021<br/>to 2051 @7%</b> |
|--|---|
| <b>Benefits flow</b>                     |   |
| Carbon sequestration                     | 1,087,391   |
| Soil prevention                          | 23,328  |
| Firewood                                 | 10,726  |
| Water flow regulation                    | 3,912   |
| Discounted benefit value                 | 1,125,357   |
| <b>Costs</b>                             |   |
| Purchase of indigenous tree seedlings    | 63,084  |
| Transportation of seedlings              | 4,673   |
| Preparation of stakes                    | 654   |
| Staking out                              | 2,290   |
| Pitting                                  | 16,355  |
| Planting                                 | 4,907   |
| Site maintenance and security            | 22,336  |
| Fencing                                  | 42,991  |
| <b>Discounted cost value</b>             | <b>157,290</b>  |
| <b>NPV</b>                               | <b>968,068</b>  |
| <b>Benefit cost ratio (BCR)</b>          | <b>6.15</b>   |
| <b>Internal rate of return (IRR)</b>     | <b>23.37%</b>   |
| <b>Equivalent annual annuity (EAA)</b>   | <b>83,060</b>   |

**Appendix 4:** Discounted benefit flow analysis for intensive agroforestry *Grevillea robusta*, maize and fruit trees (avocado)

| <b>Description of benefits and costs</b>                       | <b>Aggregate Discounted Values<br/>2021 to 2051 @7%</b> |
|--|---|
| <b>Benefits flow</b>   |   |
| Revenue from sale of maize                                     | 747,593   |
| Sale of fruits (Avocado)                                       | 645,770   |
| Firewood (1st and 2nd Thinning)                                | 91,706  |
| Timber (Sawn timber)   | 77,020  |
| Maize Stover   | 18,606  |
| Carbon sequestration   | 18,383  |
| Value of soil fertility improvement                            | 1,228   |
| Discounted benefit value                                       | 1,600,306   |
| <b>Costs</b>   |   |
| Maize seed   | 55,841  |
| Fertilizer   | 99,273  |
| Ploughing and planting maize                                   | 108,579   |
| Weeding  | 62,045  |
| Grain Harvesting and threshing costs                           | 59,564  |
| Packaging costs  | 11,168  |
| Maintenance  | 59,564  |
| Cost of <i>Grevillea robusta</i> seedlings +<br>Transportation | 12,243  |
| Manure   | 584   |
| Planting of <i>Grevillea robusta</i> and avocado<br>seedlings  | 1,869   |
| Beating up   | 218   |
| Harvesting timber and fruits (Avocado)                         | 31,483  |
| Cost of soil erosion   | 9,277   |
| <b>Discounted cost value</b>                                   | <b>511,708</b>  |
| <b>NPV</b>   | <b>1,088,598</b>  |
| <b>BCR</b>   | <b>2.13</b>   |
| <b>IRR</b>   | <b>20.50%</b>   |
| <b>EAA</b>   | <b>84,964</b>   |

**Appendix 5.** Discounted benefit flow analysis for grass reseeded using enclosures

| <b>Description of benefits and costs</b> | <b>Aggregate Discounted Values 2021 to 2051 @7%</b> |
|--|---|
| <b>Benefits flow</b>                     |   |
| Revenue from grass                       | 384,074   |
| Revenue from grass seed                  | 158,211   |
| Carbon sequestration                     | 17,079  |
| Discounted benefit value                 | 559,363   |
| <b>Costs</b>                             |   |
| Ploughing                                | 4,673   |
| Purchase of grass seeds                  | 7,034   |
| Planting of grass                        | 18,820  |
| Enclosures/Fencing                       | 129,906   |
| Maintenance and security                 | 22,336  |
| Harvesting of grass                      | 24,818  |
| Harvesting of grass seed                 | 24,818  |
| Cost of soil erosion                     | 4,418   |
| <b>Discounted cost value</b>             | <b>236,824</b>                                      |
| <b>NPV</b>                               | <b>325,539</b>                                      |
| <b>BCR</b>                               | <b>2.25</b>   |
| <b>IRR</b>                               | <b>9.06</b>   |
| <b>EAA</b>                               | <b>27,931</b>                                       |

**Appendix 6:** Discounted benefit flow analysis for riparian planting using bamboo and grass

| <b>Description of benefits and costs</b> | <b>Aggregate Discounted Values 2021 to 2051 @7%</b> |
|--|---|
| <b>Benefits flow</b>                     |   |
| Revenue from sale of grass (Napier)      | 974,089   |
| Revenue from sale of bamboo culms        | 538,146   |
| Carbon sequestration                     | 103,130   |
| Discounted benefit value                 | 1,615,365   |
| <b>Costs</b>                             |   |
| Ploughing                                | 4,673   |
| Purchase of bamboo seedlings             | 25,701  |
| Transportation of seedlings              | 4,673   |
| Planting of Bamboo seedlings             | 5,336   |
| Beating up of Bamboo (labour)            | 2,620   |
| Napier Grass cuttings                    | 51,920  |
| Weeding                                  | 111,682   |
| Manure                                   | 124,091   |
| Fertilizer (CAN)                         | 163,800   |
| Maintenance and security                 | 59,564  |
| Harvesting of bamboo                     | 48,924  |
| Cost of soil loss                        | 133   |
| <b>Discounted cost value</b>             | <b>603,115</b>                                      |
| <b>NPV</b>                               | <b>1,012,250</b>                                    |
| <b>BCR</b>                               | <b>1.68</b>   |
| <b>IRR</b>                               | <b>11.80%</b>                                       |
| <b>EAA</b>                               | <b>86,851</b>                                       |

**Table 11:** Discounted benefit flow analysis for roadside planting

| <b>Description of benefits and costs</b> | <b>Aggregate Discounted Values 2021 to 2051 @7%</b> |
|--|---|
| Benefits flow                            |   |
| Carbon sequestration                     | 70,688  |
| Aesthetic value                          | 48,433  |
| Shade provision                          | 21,857  |
| Air quality improvement                  | 4,736   |
| Avoided cost of soil loss                | 4,208   |
| Storm protection                         | 1,077   |
| Discounted benefit value                 | 150,999   |
| <b>Costs</b>                             |   |
| Cost of tree seedlings                   | 5,140   |
| Transportation of seedlings              | 2,336   |
| Planting of trees                        | 2,336   |
| Beating up                               | 873   |
| Fencing                                  | 3,084   |
| Maintenance and security                 | 14,891  |
| <b>Discounted cost value</b>             | <b>28,662</b>                                       |
| <b>NPV</b>                               | <b>122,337</b>                                      |
| <b>BCR</b>                               | <b>4.2</b>  |
| <b>IRR</b>                               | <b>21.3%</b>  |
| <b>EAA</b>                               | <b>10,496</b>                                       |

## Appendix 4: Assumptions Used in the Economic Analysis

Table 1: Assumptions used to calculate costs and benefits for each land use and restoration intervention

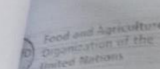


| Restoration transition   | Assumptions   |
|--|---|
| Traditional Agriculture (Maize Farming) to Intensive Agroforestry Grevillea robusta, Maize and Avocado | <ol style="list-style-type: none"> <li>1. Normal Maize agronomic</li> <li>2. Timber to firewood ratio is 20%</li> <li>3. Harvesting cost of maize under traditional agriculture include: stacking, De-husking, transport and threshing@ KES 2500,3500,2100 and 1750</li> <li>4. Harvesting cost under improved agroforestry of maize include: stacking, De-husking, transport and threshing@ KES 2500,4500,2850 and 4750</li> <li>5. Cost of manure per tonne is KES 1000</li> <li>6. Benefits from soil fertility/improvement are realised after the first Year</li> <li>7. No allelopathic relationship between the trees and crops</li> <li>8. Maize stovers for fodder and Grevillea robusta leaves used as fodder</li> <li>9. The Price of maize stover is KES 50 per 30 kg bag</li> <li>10. Fruit trees start producing at the end of 3 years</li> <li>11. Grevillea robusta pruning's are used as firewood after 4 years and harvested for timber at 25- years.</li> <li>12. Price of Grevilea firewood is KES 2000 per m<sup>3</sup></li> <li>13. On average households use 1 M<sup>3</sup> of firewood per year</li> </ol> |
| Degraded riparian zones to bamboo and grass strip  | <ol style="list-style-type: none"> <li>1. The dimension of the buffered 1 ha is (30 m width by 334 m length)</li> <li>2. Value of subsistence grazing is KES 3000/ha (Langat et al., 2018)</li> <li>3. Napier Grass spacing=0.6*0.6 m</li> <li>4. Yield of Napier per ha is 15.7 Metric Tonnes (MT)</li> <li>5. Manure is applied at rate of 10 Metric Tonnes (MT) per ha @ KES 1000 per tonne</li> <li>6. Conversion factor from green to dry matter for Napier is 0.3</li> <li>7. Price of one bamboo culm is 50/-</li> <li>8. Bamboo spacing is 6*6</li> <li>9. Extraction rate of bamboo is sustainable (there is regeneration no net loss)</li> </ol>  |
| Degraded grasslands to grass reseeding   | <ol style="list-style-type: none"> <li>1. Soil Loss (Tons/ha)-72 tons/ha in degraded scenario</li> <li>2. Grass seed yield per ha 30kg/ha in un-improved and 287.7kg in improved scenario</li> <li>3. 4.5 bales in un-improved and 178.25 bales in improved scenario</li> <li>4. Maintenance and security (3,000 per person per month for 20 ha</li> <li>5. Average selling price of grass seeds in Kenya is KES 425/= (Manyeki et al,2015) and price per bale is KES 175</li> </ol>  |



|   |  |
|---|--|
| <p>Degraded forest to Improved protected natural forest (Enrichment planting)</p> | <ol style="list-style-type: none"> <li>1. Grazing and firewood collection will continue in the baseline</li> <li>2. The average value of forest grazing in degraded forest is KES 3,000 per ha per year- we assume 50% benefits from degraded natural forest (Langat et al., 2018)</li> <li>3. No extractive use of the enrichment planted area (grazing, timber) in rehabilitated forest for the first 10 years thereafter licensed extraction is permitted</li> <li>4. Cost of unsustainable extraction is 5% of total benefits</li> <li>5. Degraded natural forest holds about 10% -plant population (2*2 spacing) (10%)</li> <li>6. Price of carbon sequestered is \$6 per tonne</li> <li>7. Cost of sediment removal is KES 178 per tonne (Langat, 2016)</li> <li>8. Maintenance and security (3,000 per person per month for 20 ha)</li> <li>9. Average annual increment in aboveground biomass in natural regeneration by broad category (Metric Tonnes (MT) dry matter/ha/year) = 5 Metric Tonnes (MT) DM</li> <li>10. Benefit from water flow regulation is 142,000 per ha-1yr after 6 years when there is full canopy closure</li> </ol> |
|---|--|






## Appendix 5: Participants' list

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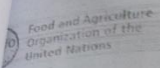






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




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|                   |                    |            |                          |                    |
|                   |                    |            |                          |                    |
|                   |                    |            |                          |                    |



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|                |                    |            |                      |      |
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|                |                    |            |                      |      |



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**GEF-6: The Restoration Initiative Project**

Restoration assessment workshops in Mukogondo and Mt. Kulal Landscapes

Date... 28/5/2021 ..... Attendance Sheet

| Name                  | Organization/Group | Mobile No. | Email                      | Sign   |
|-----------------------|--------------------|------------|----------------------------|--------|
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Food and Agriculture Organization of the United Nations

Republic of Kenya

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| WINIJOY KAGEMI     | NMK                | 0112364345  | winijoykagemi@gmail.com   |      |
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| Name                    | Organization/Group                    | Mobile No.            | Email | Sign               |
|-------------------------|---------------------------------------|-----------------------|-------|--------------------|
| JAMES LEREKO LEPASANTI  | WAZEE WA MAZINGIRA<br>Member (Uganda) | 0725001683            |       | <i>[Signature]</i> |
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| MESJAMBA PETER LOSIKIMU | MEMBER                                | 0728909637            |       | <i>[Signature]</i> |
| STEPHEN S. LEDAANY      | MEMBER                                | 0714915983            |       | <i>[Signature]</i> |
| SAMMY LEPALAT           | MEMBER                                | 0727094130            |       | <i>[Signature]</i> |
| SIMON L. LEMAROKISHU    | MEMBER                                | <del>0700097226</del> |       | <i>[Signature]</i> |
| LEPALAT SIMON           | MEMBER (Mt Kulal<br>Wazee Mazingira)  | 0746078682            |       | <i>[Signature]</i> |
| JOSEPH LENOYAIAP        | CHAIRMAN (Wazee<br>Mazingira)         | 0703155520            |       | <i>[Signature]</i> |
| Raphaella Leagon        | Member                                | 0725062064            |       | <i>[Signature]</i> |
| Esther LENOYAIAP        | Member                                | 0713750633            |       | <i>[Signature]</i> |

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|---------------------|------------------------------------|------------|---------------------------|--------------------|
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| JELLE OMAR          | Member GATOB                       | 0718755404 |                           | <i>[Signature]</i> |
| ALEX LEMADADA       | Member chore conservation<br>Forum | 0725917218 | alexomadada@gmail.com     | <i>[Signature]</i> |
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| BNDUMAI LENOYAIAP   | MEMBER MTKULAL                     | 0792901317 |                           | <i>[Signature]</i> |
| LENDOSOR LMETARAN   | MEMBER MTKULAL                     | 0728912707 |                           | <i>[Signature]</i> |